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RE-MODELING THE INTERIOR: SPATIAL METHODS AND POLICY REVISIONS TO
IMPROVE INVENTORY AND DESIGNATION OF BLM'S AREAS OF CRITICAL
ENVIRONMENTAL CONCERN

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Re-Modeling the Interior: Spatial Methods and Policy Revisions to Improve Inventory and Designation of BLM's Areas of Critical Environmental Concern

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The Bureau of Land Management (BLM) manages a vast amount of public land in the western United States, most of which they currently manage for multiple uses. Specific conservation and management of these lands could mitigate climate change impacts and contribute to the global initiative to conserve 30 percent of lands and waters by 2030. Particularly, the agency can achieve this through more effective administration of Areas of Critical Environmental Concern (ACEC), a designation that is prioritized under the Federal Land Policy and Management Act (FLPMA). To do so requires updated regulations that set clear parameters around inventory and designation, as well as a strategy for how to inventory and assess potential ACEC land—the latter of which can be achieved through a geospatial approach. This study models ACEC suitability across a case study using existing regulatory framework, predicting where high suitability exists and highlighting gaps in agency planning. Results indicate the need for a more robust tribal consultation process and specific revisions in the guiding designation criteria. Ultimately, if the BLM can reconsider ACECs as a priority and utilize existing geospatial data in the inventory process, they will realign their planning process with FLPMA's intentions and be well-equipped to contribute to 30 by 30.

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RE-MODELING THE INTERIOR: SPATIAL METHODS AND POLICY REVISIONS TO IMPROVE INVENTORY AND DESIGNATION OF BLM'S AREAS OF CRITICAL ENVIRONMENTAL CONCERN

1. INTRODUCTION

Public lands in the western United States represent a major opportunity in the face of climate change. As warming temperatures contribute directly to more frequent species extinctions and loss of biodiversity, conserved lands can protect critical habitat for threatened and endangered species, account for anticipated shifts in species ranges, and mitigate carbon emissions (Haight & Hammill, 2020; Law et al., 2021; Spooner, Pearson, & Freeman, 2018). To maximize effectiveness, these lands should be connected to each other, accompanied by strong federal management guidelines, and informed by local and tribal knowledge and value (Belote & Wilson, 2020; Dickson et al., 2016; Flores & Russell, 2020). Though an existing framework exists to grow and manage these public lands, more substantial, urgent measures are needed to address the pressures of the climate crisis.

President Biden's Executive Order *Tackling the Climate Crisis at Home and Abroad* (Exec. Order No. 14008, 2021) and the subsequent "America the Beautiful" report represent this urgency, citing current challenges of safeguarding drinking water, clean air, and wildlife, while expressing the "need to fight climate change with the natural solutions that our forests, agricultural lands, and ocean provide" (U.S. Department of the Interior, 2021). The initiative prioritizes the goal of conserving at least 30 percent of our global lands and waters by 2030—referred to as 30 by 30—and lays out eight key principles to guide conservation decisions including: pursuing collaborative and inclusive practices, supporting local conservation efforts, honoring Tribal Nation sovereignty and priorities, and building on existing tools and strategies. With the new energy of this movement, federal land management agencies have an opportunity to contribute significantly to conservation and climate change resilience.

The Bureau of Land Management (BLM) is particularly equipped to do this, as they have authority and the regulatory tools to take strong conservation action. The agency manages approximately one million square kilometers of land, seventy percent of which are in the 11 contiguous western states (Vincent et al., 2020). The majority of the conservation lands under the agency, including National Monuments, National Conservation Areas, Wilderness Areas, Wilderness Study Areas, and Wild and Scenic Rivers, are managed as part of the National Conservation Lands (NCL).¹ These designations require congressional approval and prescribe a wide range of management practices (16 U.S.C. § 7202). However, the agency's organic act, the Federal Land Policy Management Act (FLPMA), also requires the BLM to prioritize the designation and protection of Areas of Critical Environmental Concern (ACEC) (43 U.S.C. § 1712 (b)). Unlike NCL designations, ACECs are designated administratively through regional resource management plans (RMP) and offer "largely untapped potential for flexible conservation management as part of the [BLM's] multiple-use, sustainable-yield mission to contribute to the Administration's 30 by 30 goal" (Blumm, 2021).

FLPMA defines the ACEC term quite broadly as "areas within the public lands where special management attention is required (when such areas are developed or used or where no development is required) to protect and prevent irreparable damage to important historic, cultural, or scenic values, fish and wildlife resources or other natural systems or processes, or to protect life and safety from natural hazards" (43 U.S.C. § 1702 (a)). Under Section 201, the Secretary is

¹ These lands were formerly known as the National Landscape Conservation System.

directed to “prepare and maintain on a continuing basis an inventory of all public lands and their resources...giving priority to areas of critical concern” (43 U.S.C. § 1711). The same section indicates that “inventory shall be kept current so as to reflect changes in conditions and to identify new and emerging resource and other values.” This is the extent of FLPMA supervision—agency staff must look for further guidance and clarification in the National Environmental Planning Act (NEPA) and the subsequent BLM Manual 1613, the latter of which has not been updated since 1988. These guidelines are laid out for reference in Appendix I.

Resource management planning guidelines in NEPA stipulate that “areas having the potential for...[ACEC] designation and protection management shall be identified and considered through the resource management planning process” and that these potential areas must meet both the relevance and importance criteria, defined as:

1. Relevance. There shall be present a significant historic, cultural, or scenic value; a fish or wildlife resource or other natural system or process; or natural hazard.
2. Importance. The above described value, resource, system, process, or hazard shall have substantial significance and values. This generally requires qualities of more than local significance and special worth, consequence, meaning, distinctiveness, or cause for concern. A natural hazard can be important if it is a significant threat to human life or property (43 CFR § 1610.7-2).

Notably, the “more than local significance” requirement becomes a key measure in determining ACEC suitability, despite NEPA only *generally* requiring these qualities. BLM Manual 1613 on ACECs provides more detailed descriptions of the Relevance and Importance (R&I) criteria required for designation, stating that an area meets the relevance criteria if it contains one or more of the following:

1. A significant historic, cultural, or scenic value (including but not limited to rare or sensitive archeological resources and religious or cultural resources important to Native Americans).
2. A fish and wildlife resource (including but not limited to habitat for endangered, sensitive, or threatened species or habitat essential for maintaining species diversity).
3. A natural process or system (including but not limited to endangered, sensitive, or threatened plant species; rare, endemic, or relic plants or plant communities that are terrestrial, aquatic, or riparian; or rare geological features).
4. Natural hazards (including but not limited to areas of avalanche, dangerous flooding, landslides, unstable soils, seismic activity, or dangerous cliffs). A hazard caused by human action might meet the relevance criteria if it is determined through the resource management planning process to have become part of a natural process.

A potential ACEC must also meet one importance criteria, the first of which also requires more than local significance:

1. Has more than locally significant qualities that give it special worth, consequence, meaning, distinctiveness, or cause for concern, especially compared to any similar resource.
2. Has qualities or circumstances that make it fragile, sensitive, rare, irreplaceable, exemplary, unique, endangered, threatened, or vulnerable to adverse change.
3. Has been recognized as warranting protection to satisfy national priority concerns or to carry out the mandates of the FLPMA.
4. Has qualities that warrant highlighting to satisfy public or management concerns about safety and public welfare.
5. Poses a significant threat to human life and safety or to property (BLM Manual 1613.11).

These guidelines provide some direction to land managers once areas are nominated, either internally by the agency or by external parties, but they are vague and require generous agency interpretation. Furthermore, there is no current requirement to collect and assess data around ACECs in the first place. BLM Manual 1613 and CFR § 1610 simply mention that consultation of the “inventory data” is a requirement (BLM Manual 1613.21 B; CFR § 1610.7-2 (a)).

The ambiguity of this guiding language leaves substantial room for the designation to protect a variety of lands, but the agency is not utilizing it nearly as effectively as they could. While field offices have an opportunity to explore further ACEC designations once every five years during their evaluation cycle, new designations are often only considered if something significant has changed on the ground since the previous planning process (Ward & Carey, 2022). Through an intensive legislative history and FLPMA’s definition, it is clear that Congress intended the BLM to prioritize ACEC designations; however, in actuality the process is variable, disorganized, and ineffective due to the lack of clear, strong regulations coupled with a decentralized agency (Sheldon & Baldwin, 2015). Sheldon and Baldwin (2015) assert that the current administration of the areas is hobbling the potential of a “remarkable tool for landscape-level planning and management, and its ability to respond to increasing pressures on the public lands from recreation demands, habitat fragmentation, and climate change.”²

There are a host of specific issues with this process, which currently allows for nearly unlimited agency discretion: planning regulations are spread across various manuals and documents, authorized activities are varied between district and individual RMPs, and most significantly, there is a gaping hole in the regulations that actually govern how ACECs are managed once they are designated (Sheldon & Baldwin, 2015). However, to meet the immediate need of increasing conservation lands, the first priority should be to develop a more robust system for inventorying land for potential ACEC suitability and subsequently designating them. Here, it is possible to turn to geospatial methods to facilitate the initial stage of an efficient, low-resource inventory process.

Many researchers have attempted to systematically identify how land in the United States can be managed to maintain biodiversity, connectivity, and ecosystem function using spatial techniques (Belote et al., 2016; Dickson et al., 2014; Jenkins et al., 2015). However, little work has been done on applying similar techniques to identify new areas of protection, especially using a policy-driven approach (Dickson et al., 2016). As the BLM begins to rely more and more on geospatial data (Ward & Carey, 2022), a large-scale ACEC suitability analysis could identify initial conservation hot spots across the west, facilitate more effective and substantial use of the ACEC designation, increase contribution towards 30x30, and identify gaps in guiding statutory and regulatory policies.

This paper has two main components that together expose the unstable underpinnings of the existing ACEC inventory and designation process and offer tools to stabilize and leverage the process moving forward. First, it proposes a geospatial approach to modeling ACEC suitability across a field district using the existing framework of the R&I criteria to guide data collection, manipulation, and analysis. Using vector counts in the ArcGIS environment, the analysis identifies cultural, ecological, and historic value across a BLM field district and predicts where high suitability areas exist. The analysis also characterizes gaps in agency planning and decision

² In fact, recent RMPs have decreased ACEC acreage significantly between the draft and final plan. See https://www.pewtrusts.org/-/media/assets/2020/01/blm_ignores_own_finding_in_proposed_management_plans_v4.pdf, March 2, 2021.

making, suggesting the need for a more structured, intentional tribal consultation process and revision of the guiding criteria. Second, it lays out specific policy revision suggestions based on the results of the analysis and the existing regulatory and statutory guidance, and advocates for an immediate reevaluation directive to meet the demands of climate change and the 30x30 Initiative.

2. CEDAR CITY FIELD OFFICE

2.1 Rationale for Case Study Location

While this type of spatial study would be useful across the entire country, data limitations inhibit its feasibility. Instead, the BLM field district level is an ideal scale to develop a case study because it is the scale at which the agency conducts their land use planning process. To increase the usefulness of this particular analysis, field districts were only considered as a case study location if they were currently going through a resource management plan (RMP) development or revision process, thus creating an opportunity to provide feedback—and potentially further ACEC nominations—to the field office based on the results detailed here. Of these locations, the Cedar City Field Office (CCFO) was ultimately chosen because of the responsiveness of the BLM staff, the access to existing cultural data, and the status of the planning process.³ Furthermore, because CCFO is in the middle of this planning process, they have already completed an Analysis of the Management Situation (AMS) report—which is typically the first document to be produced in the planning process—and a draft ACEC report. These documents informed the methodology of this analysis and provided useful information for gauging its accuracy in modeling suitable locations for designation.

2.2 Case Study Description

The CCFO, located in southwest Utah, manages over 2.1 million acres of BLM land, which accounts for 56% of the planning area land (Fig. 1). Currently, the area contains no ACECs. The only specially designated BLM lands are three small Wilderness Study Areas (WSA): Spring Creek, North Wah Wahs, and White Rocks. The region is high desert, characterized by altitudes above 5,000 feet and native sagebrush, pinyon, and juniper trees. More mountainous areas of conifer, ponderosa pine, and aspen are also dispersed throughout the area (Cedar City Field Office, 2013a). There are high concentrations of special status vascular plants in the San Francisco Mountains, Wah Wah Mountains, Horse Hollow, and Antelope Range, including several endemic species: pinyon penstemon is only known in southwest Utah throughout the Antelope Range, and a new species of mustard, Hayden's mustard, was recently discovered in the Wah Wah Mountains (Franklin, 2005; Hilderbrand & Al-Shehbaz, 2017). Old-growth ponderosa pine forests are also present throughout the area and provide substantial habitat for many special status plants, ungulates, and bird species (Cedar City Field Office, 2013a). Thirty-five special status aquatic and terrestrial wildlife species occur in the area, including several raptors listed under the Endangered Species Act, the greater sage-grouse, and the Utah prairie dog, the latter of which is only found in southwestern and central Utah and is also federally listed as threatened (Cedar City Field Office, 2013a).

Numic-speaking people have traditionally occupied the larger Great Basin region since the end of the Pleistocene, during which the historic Lake Bonneville extended down through the

³ Due to the planning efforts required to develop management plans for the reestablished Grand Staircase-Escalante and Bears Ears National Monument boundaries, the Cedar City RMP process was started in 2013 and then put on hold until further notice.

western slope of present-day Utah. The lake was an important water source and tribes still consider the historic boundaries as culturally significant (Stoffle et al., 2011a). There are many other traditional springs, sites, and geologic features present throughout the area, including Parowan Gap, a pass through the Red Hills that contains thousands of petroglyphs and paintings. Two trails listed on the National Register of Historic Places (NRHP), the Old Spanish Trail and the Dominguez-Escalante Trail, cut through the planning area. These are remnant of the late sixteenth century and early seventeenth century expeditions of Mexican pioneers and settlers (Cedar City Field Office, 2013a). Five scenic byways are partially or entirely included in the southeastern portion of the CCFO: Highway 143, Markagunt High Plateau, Beaver Canyon, Dry Lakes/High Mountain, and Kolob Reservoir.

The BLM, as mandated by FLPMA, is responsible for managing these features along with oil and gas leasing, grazing, off-road vehicle use (OHV), and mineral development (43 U.S.C. § 35 1732 (a)). There are currently 254 authorized oil and gas leases scattered throughout the CCFO; however, oil and gas interest in the area is quite low compared to surrounding areas of Utah and

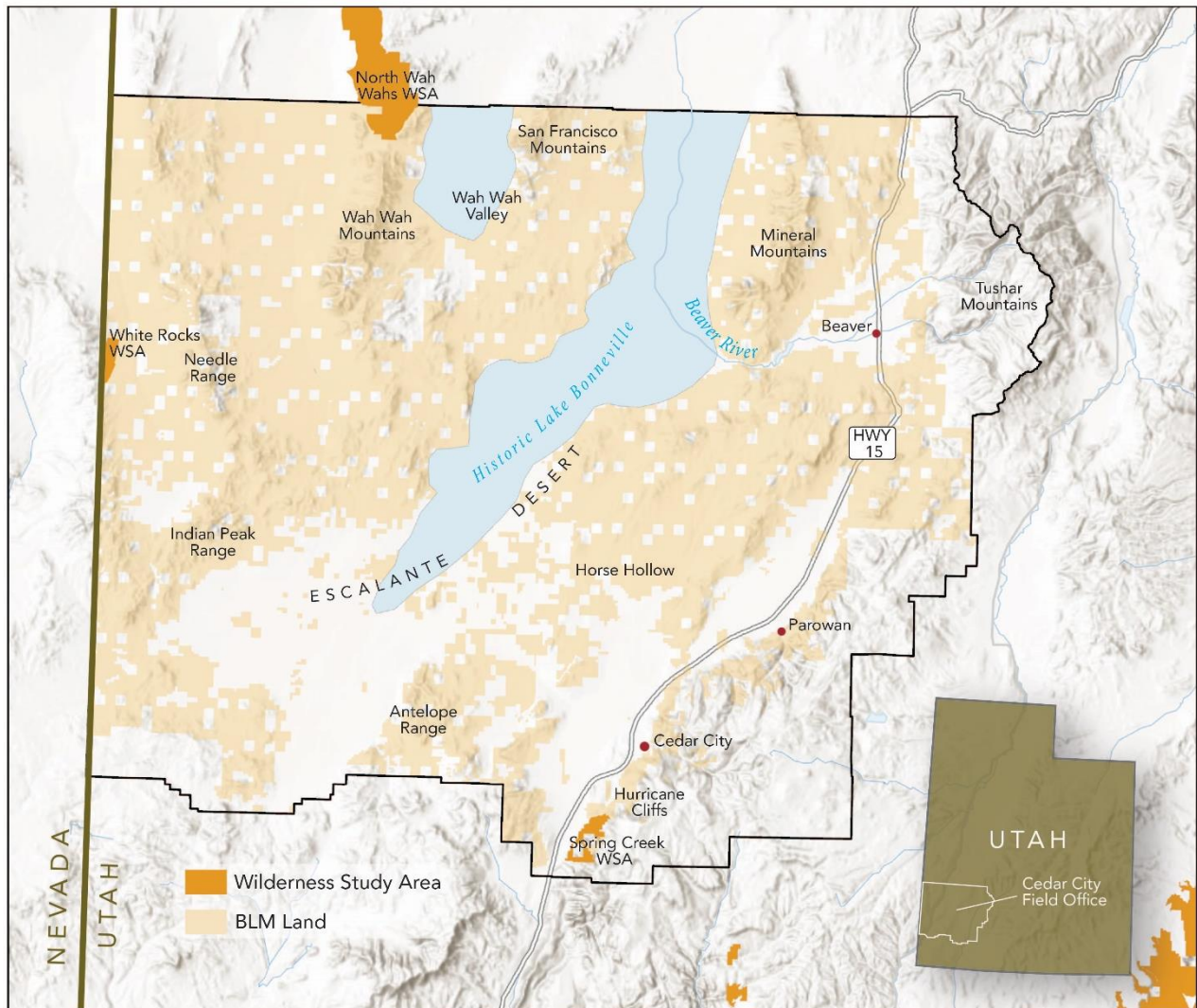


Figure 1. The Cedar City Field Office study area, with the boundary in black. The BLM manages over half of the land (light yellow). Three Wilderness Study Areas are also present within the area (orange).

the West, with only three wells drilled—and subsequently abandoned and reclaimed—in the last 25 years (Cedar City Field Office, 2013a). The agency has identified some areas of high and moderate mineral development, but these are similarly minor compared to surrounding areas. They administer 159 active grazing allotments, which cover the majority of the BLM land in the CCFO, managing them to improve soil quality and riparian health after historic grazing deteriorated habitat across the area and led to arid, dry conditions in the Wah Wah Valley and around the town of Beaver. The BLM also maintains OHV restrictions in these locations, along with large portions of the Escalante Desert, the Indian Peaks, the Needle Range, and much of the land bordering Highway 15 to the east (Cedar City Field Office, 2013a, Appendix A).

3. METHODS

3.1 Data Collection and Creation

The existing R&I criteria laid out in BLM Manual 1613, combined with BLM's interpretations of the criteria during the initial management planning in the field district, laid the framework for the set of layers collected and created for this analysis. An initial survey of RMPs throughout the West indicated that most ACECs are designated using the first three relevance criteria, a finding consistent with Millar (2016). Additionally, many areas that were nominated within the CCFO did not meet any of the importance criteria, but still contained important cultural, ecological, and cultural values.⁴ Therefore, the first three relevance criteria informed the entirety of the data collection process. An interpretation of each is offered in the CCFO draft ACEC report as detailed below:

1. “A significant historic, cultural, or scenic value (including but not limited to rare or sensitive archeological resources and religious or cultural resources important to Native Americans)” was interpreted by the BLM to include rare or sensitive archeological resources, sites of religious or cultural resource important to Americans Indians, and significant historic or cultural resources determined by the staff archeologist. Scenic value was determined relevant if it was inventoried as Class A scenery.
2. “A fish and wildlife resource (including but not limited to habitat for endangered, sensitive, or threatened species or habitat essential for maintaining species diversity)” was interpreted to include habitat for endangered, threatened, or sensitive species and habitat essential for maintaining species diversity.
3. “A natural process or system (including but not limited to endangered, sensitive, or threatened plant species; rare, endemic, or relic plants or plant communities that are terrestrial, aquatic, or riparian; or rare geological features)” was interpreted to include documented occurrences and/or habitat of endangered, sensitive, or threatened plant species in the area; rare, endemic or relict terrestrial, aquatic or riparian plants or plant communities; and rare geological features (BLM Manual 1613.11; Cedar City Field Office, 2013b).

Wilderness Study Areas, Wilderness Areas, existing ACECs and other special designations were excluded from consideration in this analysis due to their insignificance within the CCFO extent. To further refine the data pool, layers that were relevant to the criteria but did not include features within the study area were also excluded. For example, slope angles and regular avalanche zones could be useful to gauge potential hazards in cooler climates. A list of these relevant data sources is included in Appendix II and should be considered in future analyses.

⁴ A further discussion of the interpretation challenges of the importance criteria is presented in Section 6.

Historical, Cultural, and Scenic Value Data

National Historic Places points were downloaded from the NRHP. Within the Cedar City field district, only one point from the dataset—the Frisco Charcoal Kilns—fell on BLM land and was kept as part of the analysis. A polygon was drawn around the entire historical site boundary, which was visible over satellite imagery. The AMS identified three other sites from the NRHP: the Parowan Gap Petroglyphs, the Wildhorse Canyon Obsidian Quarry, and the Sand Cliffs Signatures (Cedar City Field Office, 2013a). The NRHP data did not have exact locations for these sites, so they were estimated based on written descriptions from Peart et al. (2013) and the AMS. Parowan Gap, Wildhorse Canyon, and Fremont Canyon, which contains the Sand Cliff Signatures, were digitized into polygon features using the top of the canyon walls as the guiding parameter. Two National Scenic and Historic trails are present within the field district, the Old Spanish Trail and the Dominguez-Escalante Trail. These lines were downloaded from the BLM's database and buffered by three miles to maintain scenic value, as this is the average distance one can see to the horizon on flat ground (French, 1982). Two Utah Scenic Backways, two Utah Scenic Byways, and one National Scenic Byway in the southeastern portion of the field office were digitized from the BLM map of Scenic Backways and Byways and also buffered by three miles (4828 meters) (Cedar City Field Office, 2013b).

Visual Resource Inventory (VRI) was downloaded from the agency's data portal. VRI is an inventory and management tool that the BLM uses to determine visual value of landscapes. There are four classes of value based on a scenic quality evaluation of seven key factors: landform, vegetation, water, color, adjacent scenery, scarcity, and cultural modifications. Class I and Class II are the most valued, with Class II corresponding to Class A scenery (BLM Manual H-8410-1). There was no Class I scenery present in the Cedar City district, so only the Class II data was exported to use in the analysis.

Including tribal knowledge and value is critical to this inventory process. Here, thanks to a recommendation from the Utah Deputy Preservation Officer and Tribal Liaison, it was possible to lean on existing ethnographic studies developed for an assessment of proposed solar energy zones (SEZ) in southwest Utah. These studies overlapped with initial areas that the BLM had identified as having the highest concentration of archeological sites when they began working on the Cedar City plan in 2009 (Thomas, 2022). The Confederated Tribes of the Goshute Reservation and the Paiute Indian Tribes of Utah worked with a team of anthropologists at the University of Arizona to identify important sites in the area. These sites included specific peaks, rivers, springs, trails, mountain ranges, and the historic Lake Bonneville (see *Tribally Informed Sites of Importance*, Table 1) (Stoffle et al, 2011). This data was digitized from the maps in the three SEZ reports into a polygon layer, a point layer, and a line layer. As little research has been done on buffering this type of data, the point layer was buffered by 500 meters because many of the sites are springs, and this distance has been identified as the most common distance to buffer a groundwater source (Cheng & Thompson, 2016). The line layer, which contained only a single trail feature, was buffered by 4828 meters to maintain consistency with the other trails present in the area. The Beaver River was also identified as an important site and was buffered by 600 feet (183 meters), the minimum riparian buffer distance suggested by Bentrup and Kellerman (2004).

Paleontological data was available through the Utah Geology data portal, but this dataset was excluded to avoid a double count: only one site, the Parowan Canyon trackway site, was within the study area and was already accounted for through the NRHP data.

Wildlife Data

Both guidance from the BLM and data availability informed which aquatic and terrestrial species were considered in this analysis. The agency identified 35 sensitive species within the planning district, defining a “sensitive species” as “wildlife species that are federally listed, or are proposed or candidates for a federal listing, or for which a conservation agreement is in place...[or] are species for which there is credible scientific evidence to substantiate a threat to continued population viability” (Cedar City Field Office, 2013a). In their AMS, the BLM summarized a population and habitat forecast for each of these species, and the final list for this analysis included any species that are predicted to experience habitat change or would benefit from increased management direction.

From this final list of species, data on current habitat and range was pulled from the U.S. Fish and Wildlife Service’s Threatened and Endangered Species Active Critical Habitat Report layer and the Utah Division of Wildlife Resources (UDWR) Species of Greatest Conservation Need layer. For species ranges that were extracted from the UDWR data, only sightings that were reported in 2010 or later were used. This method likely underestimates some species’ ranges; however, it also accounts for timeliness of occupancy and provides a stronger argument for protection.

Three species ranges were determined using other methodologies. Updated Greater Sage-grouse winter, summer, and brood habitat data was downloaded separately from UDWR. These three layers were merged and dissolved to create a final habitat layer. To account for big game migration corridors, winter and summer habitat for mule deer and elk was also downloaded from UDWR, as these were the two ungulate species mentioned most frequently in the AMS. Each layer was filtered to only display crucial habitat, as this is the main concern of the agency (Cedar City Field Office, 2013a). UDWR defined crucial habitat as “habitat on which the local population of a wildlife species depends for survival because there are no alternative ranges or habitats available” and one in which degradation of this habitat “will lead to significant declines in carrying capacity and/or numbers of wildlife species in question” (Utah DWR, 2021). Each species habitat layer was left as an individual layer in the analysis as described in Table 1.

Plant Data

A list of special status plants found in the AMS was used to identify plant species to include in analysis. This list was cross-checked with a more recent BLM list of sensitive plant species (BLM, 2018), and the final list included 18 species that were present in one of the two lists (Table 2). Due to a lack of publicly available data, data was digitized from a progress report of plant information compiled by the Utah Natural Heritage Program to estimate locations of each species (Franklin & State of Utah DNR, 2005). The report contained a series of maps characterizing distributional plant data across the state, and because the occurrences of the species were often quite small, distribution symbols were used to represent centrum points of polygon data. These points were digitized into a Sensitive Plants layer and a two-mile (3219 meters) buffer was applied to match the size of the centroid polygons given in the report maps.

Five of the 18 species were not mentioned in the report: mound cryptanth, Kaye H Thornes buckwheat, flaming gorge evening primrose, yellow evening primrose, and Hayden’s mustard. The two species of primrose, along with mound cryptanth, were excluded due to a lack of sufficient data. The initial location of Hayden’s mustard was digitized from the 2017 paper documenting the discovery (Hildebrand & Al-Shehbaz). The range of Kaye H Thornes buckwheat was available through the National Science Foundation’s SEINet data portal and was also digitized and added to

the Sensitive Plants layer. Additionally, pinyon penstemon was clustered throughout a larger area than most plant species occurrences, so a polygon was created to encompass its approximate range. This data was left as one Sensitive Plants layer because polygons of each range had very little overlap, therefore not limiting or complicating the subsequent count analysis.

Other Ecological Data

Ponderosa pine forests are noted in the initial BLM documents as an important habitat type for a variety of species (Cedar City Field Office, 2013a). Additionally, the species was cited in the draft ACEC nomination evaluation report as a relevance value for multiple nominations (Cedar City Field Office, 2013b). Ponderosa pine extent data was downloaded from the Atlas of the United States Trees dataset on DataBasin and clipped to the Cedar City field district. A sensitive soil layer was also created from Sheehan and Gough’s (2016) climate vulnerability model by filtering out only the high soil sensitivity, which equated to a sensitivity index of greater than .05.

Table 1: Geospatial layers and manipulations

Feature	Specific Data Extracted	Further Manipulations
Cultural/Historical Features		
Visual Resource Inventory	Class II Scenery	Clipped to CCFO boundary
National Register of Historic Places	Frisco Charcoal Kilns cultural resource structure point	Buffered point by 4828 meters
Other NRHP sites	Parowan Gap, Sand Cliff Signatures, Wildhorse Obsidian Quarry	Parowan Gap, Fremont Canyon, and Wildhorse Canyon traced into polygon features using the tops of the canyon walls as parameter
National Scenic and Historic Trails	Old Spanish Trail, Dominguez-Escalante Trail	Clipped to CCFO boundary, buffered trails by 4828 meters
Tribal Informed Sites of Importance (Polygons)	Historic Lake Bonneville boundary, Table Butte, Indian Peak Range, Wah Wah Mountain Range, San Francisco Mountains	Features were digitized from Solar Energy Zone Ethnographic study maps
Tribal Informed Sites of Importance (Points)	Antelope Springs, Doctor Rock, Mountain Spring, Thermal Hot Springs, Lund, Mountain Springs Peak, Wallaces Peak, Indian Peak, Wah Wah Springs	Buffered by 500 meters
Tribal Informed Sites of Importance (Lines)	Trail from Indian Peak to Wallaces Peak	Buffered by 4828 meters

Utah Lakes, Rivers, Streams, and Springs	Beaver River	Clipped to CCFO boundary, buffered by 183 meters
Scenic Backways and Byways	Utah Scenic Backway, Utah Scenic Byway, National Scenic Byway	Three scenic backways/byways were digitized from BLM data and buffered by 4828 meters
Ecological Features		
Animal Species of Concern	From USFWS data: Mexican Spotted Owl, Utah Prairie Dog From UDWR data: Bonneville Cutthroat Trout, Burrowing Owl, Kangaroo Mouse	All species layers were clipped to CCFO boundary
Utah Elk and Mule Deer Habitat	Winter and summer ranges for both elk and mule deer	Clipped to CCFO boundary, dissolved into one layer for each species
Greater Sage-grouse	Winter, summer, and brood habitat	Clipped to CCFO boundary, dissolved into one layer
Plant Species of Concern**		Buffered by 3219 meters
Sensitive Soils	High sensitivity index from climate vulnerability model	Clipped to CCFO boundary, filtered out sensitivity index > 0.5
Ponderosa pine	Atlas of the United States Trees dataset	Clipped to CCFO boundary

**see Table 2

Table 2: Plant Species of Concern

Plant Species	Data Source
Pinyon penstemon (<i>Penstemon pinorum</i>)	Franklin 2005
Avon milkvetch (<i>Astragalus avonensis</i>)	Franklin 2005
Mound cryptanth (<i>Cryptantha compacta</i>)	Excluded from analysis due to lack of data
Belknap Peak draba (<i>Draba ramulosa</i>)	Franklin 2005
Creeping draba (<i>Draba sobolifera</i>)	Franklin 2005
Frisco buckwheat (<i>Eriogonum soledium</i>)	Franklin 2005
Ostler's ivesia (<i>Ivesia shockleyi</i> var <i>ostleri</i>)	Franklin 2005
Ostler's peppergrass/pepperplant (<i>Lepidium ostleri</i>)	Franklin 2005

Pink egg milkvetch (<i>Astragalus oophorus</i> var <i>lonchocalyx</i>)	Franklin 2005
Welsh milkvetch (<i>Astragalus welshii</i>)	Franklin 2005
Jones' globemallow (<i>Sphaeralcea caespitosa</i> var <i>caespitosa</i>)	Franklin 2005
Kaye H Thornes buckwheat/ Spoonleaf wild buckwheat (<i>Eriogonum artificis</i>)	SEINet data portal
Wirestem buckwheat (<i>Eriogonum pharnaceoides</i>)	Franklin 2005
Flaming gorge evening primrose (<i>Oenothera acutissima</i>)	Excluded from analysis due to lack of data
Yellow evening primrose (<i>Oenothera acutissima</i>)	Excluded from analysis due to lack of data
Franklin's penstemon (<i>Penstemon franklinii</i>)	Franklin 2005
Hayden's mustard (<i>Terraria haydenii</i>)	Hildebrand and Shehbaz 2017
Frisco clover (<i>Trifolium friscanum</i>)	Franklin 2005

3.2 Geospatial Analysis

The purpose of this analysis is twofold: first, by overlapping several features that quantitatively show relevance and importance, it is possible to identify initial, suitable areas on the landscape that merit heightened protection through an ACEC designation. Second, due to CCFO's unique position within the planning process, model results can be compared to existing ACEC nominations in order to gauge how accurate the model is in predicting value across the landscape based on the guiding R&I criteria.

All data manipulation and subsequent analysis was done using Esri's ArcGIS Pro using a NAD 1983 UTM Zone 12N projection. All feature distributions were collected or created as vectors; therefore, a novel suitability model workflow was designed to be run within the vector space. All layers from Table 1 were combined into a single feature layer using the Count Overlapping Features tool, which calculated the number of overlapping polygons across the study extent. A standalone table was also generated from the count, related to the resulting layer using a one to many relate, and then exported to ultimately provide individual feature identification within each polygon. The resulting count layer was then clipped by a BLM land polygon layer to display only areas managed by the agency. High suitability areas were identified as areas that had three or more overlapping layers.

Both the nominated and final potential ACEC polygon layers were obtained from the BLM to compare analysis results to the nominated ACECs and the BLM's final potential ACECs. These layers were overlaid with the Count Overlap layer and the Summarize Within tool was used to calculate the mean of the polygon counts within each ACEC polygon. To determine how many unique features were present within each potential ACEC, all eight polygons were extracted as separate layers and used to clip the Count Overlap layer by polygon. The resulting layers were

related back to the original Count Overlap table again and exported to Excel. Once duplicate features were removed, it was possible to identify which features were present in each polygon (Appendix III).

4. RESULTS

4.1 Modeled High Suitability Areas for ACEC Designation

In this analysis, any area on BLM land across the entire CCFO extent containing three or more overlapping polygons was considered an area with high suitability potential. Areas with high suitability appeared in the northeast portion of the district, the central Escalante Desert, just north

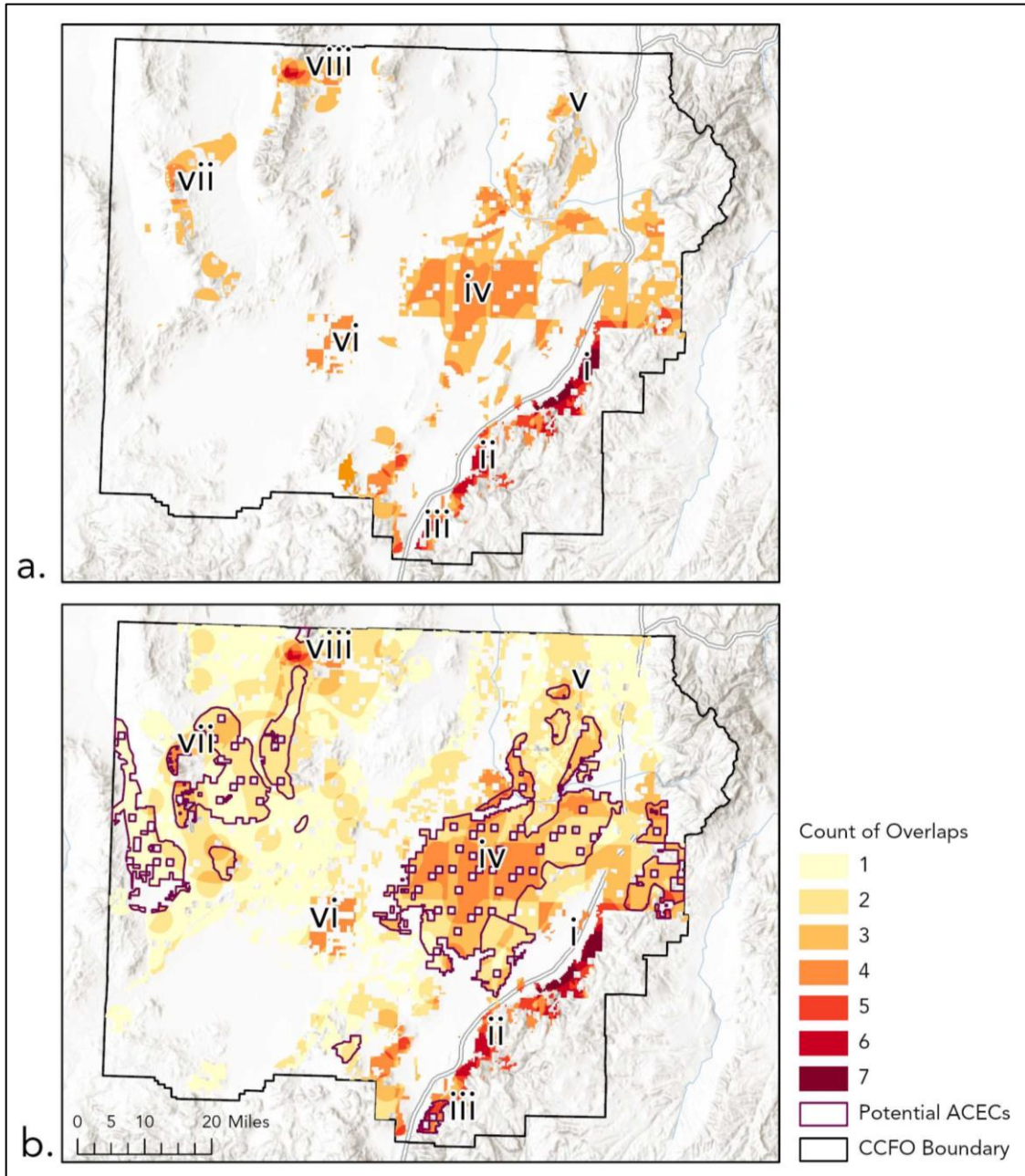


Figure 2. A count of overlapping layers representing the various R&I criteria across BLM land in the CCFO. (a) depicts the areas that have at least three overlapping layers on BLM land, with i-viii identifying the highest suitability areas. (b) offers a comparison of the overlapping features and the Potential ACECs identified by the BLM.

of UT 56 near Eight Mile Hills, and along Highway 15 to the east (Fig. 2). The highest number of overlaps occurred in the southeast along Hurricane Cliffs, specifically around Cedar City (i) and Parowan (ii). The most southern portion of the field district also contains high counts of polygons, particularly around Kanarrville, a small town forty miles north of St. George (iii). Overlapping layers include sensitive plants (specifically Welsh's milkvetch, Nevada willowherb, and Pinyon penstemon), VRM Class II scenery, Ponderosa Pine, Utah prairie dog habitat, crucial mule deer habitat, spotted and burrowing owl habitat, the Old Spanish Trail, the Dominguez-Escalante Trail, and Bonneville cutthroat trout habitat. The National Scenic Byway through Parowan Canyon, the Utah Scenic Byway through Cedar Canyon, and Parowan Gap also contribute to higher values in the southeast.

Horse and Little Horse Valleys and the BLM land just north along the Beaver River (iv) met between three and four criteria, containing crucial mule deer, Utah prairie dog habitat, and sage grouse habitat, as well as the historic Lake Bonneville boundary which was identified as a cultural site of importance (Stoffle et al., 2011a). A small portion of the Mineral Mountains met four criteria, containing the Wildhorse Canyon Obsidian Quarry, sensitive soils, crucial mule deer habitat, and VRM Class II scenery (v). Another clustering of features is present in the middle of the Escalante Desert towards the south end of the historical lake boundary, where Utah DWR reported recent dark kangaroo mouse sightings and burrowing owl and Utah prairie dog habitat (vi).

Two other large areas of high counts occurred in the northern tip of the Needles/Indian Peaks Range (vii) and in and around the Wah Wah Valley and the northern portion of the Wah Wah Mountains (viii). These areas had high counts largely because of their cultural value: both mountain ranges are considered sacred to the Paiute Indian Tribe and the Confederated Tribes of the Goshute Reservation, and Stoffle et al. (2011a,c) specifically recommends that the BLM consult tribes whenever land management actions occur on or near these topographic areas. The Indian Peak to Wallaces Trail also falls within both of these zones, as do multiple locations of Hayden's mustard and Frisco buckwheat. Smaller areas of high counts are scattered throughout the study extent and remain pertinent indicators of widespread suitability.

4.2 Modeled High ACEC Suitability Compared to Nominations and Potential ACECs

In the 2013 draft ACEC report, 23 nominations were made by the BLM, the Wilderness Society, the U.S. Fish and Wildlife Service, the Southern Utah Wilderness Alliance, and the Utah Professional Archeological Council (Cedar City 2013b). When compared to the modeled distribution of R&I features, six nominated areas had a mean overlap count greater than one, meaning that on average throughout the polygon, more than one R&I value was present (Fig. 3). Two areas had a mean overlap count of greater than two: South Central Utah, which became part of the final Eastern Wildlife Potential ACEC, had a mean count of 2.5 features, while Spring Creek Canyon to the south encompassed over five features on average throughout the nominated area. Of these six nominations, five were submitted externally. Spring Creek Canyon, the highest correlated area, was submitted internally by the BLM.⁵ All six were incorporated into the BLM's final list of potential ACECs shown in Figure 4.

⁵ Details on each nomination, including their nominated name and the source of the nomination, can be found in Appendix A of the Draft Evaluation Report for Areas of Critical Environmental Concern.

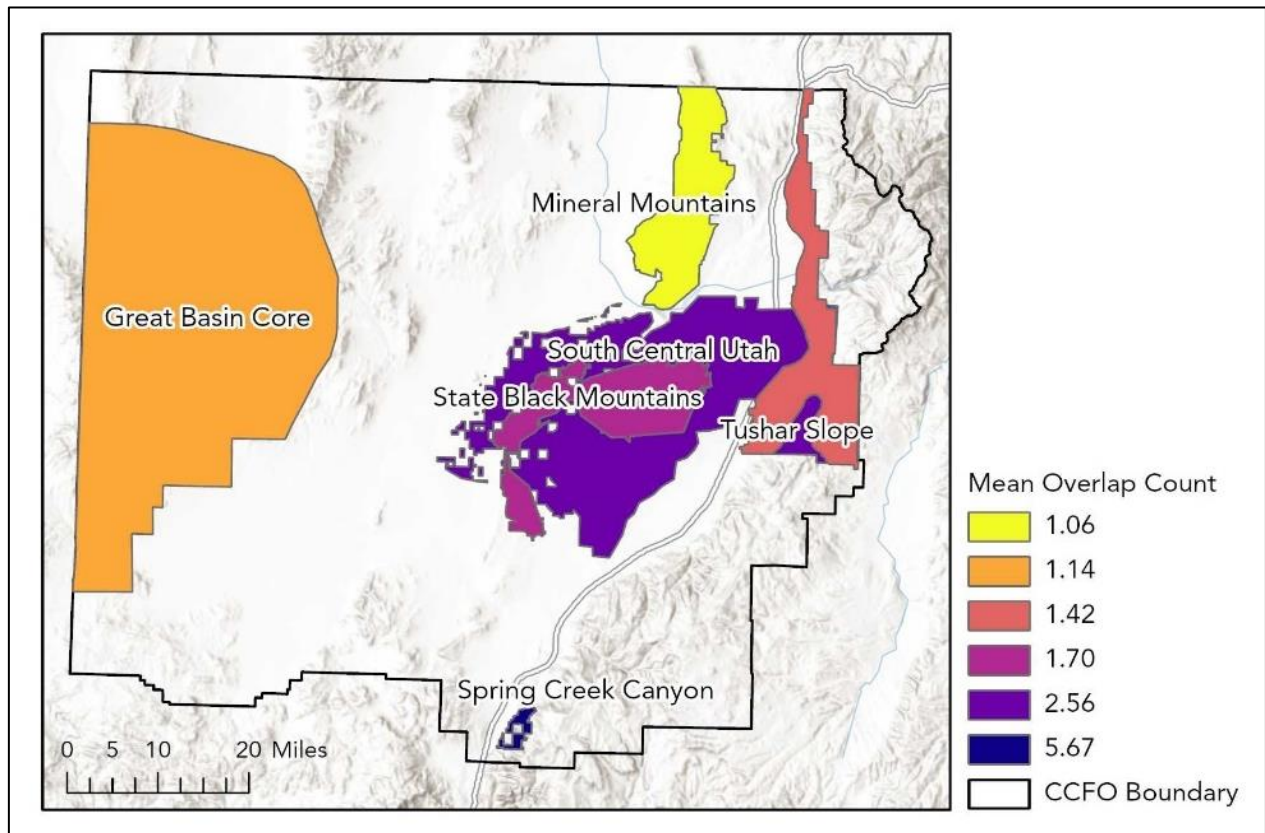


Figure 3. The ACEC nominations submitted to the CCFO that had a mean overlap count over 1. The mean overlap count is an average of the counts of overlapping polygons throughout each nominated area.

Though it is interesting to compare ACEC nominations to the suitability analysis, it is more pertinent to understand how modeled hot spots compare to the results of the BLM’s internal evaluation of these nominations. From the initial 23 nominations, the BLM identified 14 as containing R&I values and combined them into eight potential ACECs (Fig. 4). When the planning process resumes, the agency will present these potential ACECs in Alternative B of the draft RMP (Cedar City Field Office, 2013b). Each of the final eight polygons contain at least three unique features, with the Eastern Wildlife ACEC encompassing 12 features (Fig. 5, Table 3). Of the eight modeled high suitability areas, five were consistent with the BLM’s potential ACECs. Spring Creek Canyon ACEC had the highest correlation with modeled high suitability area iii, with a mean feature count of 4.64 (Fig. 5b). Eastern Wildlife and Mineral Mountains also had a high correlation with two modeled high suitability areas iv and v based on count of overlapping layers. Parowan Gap had the lowest mean count at 0.49 but contains eight unique features (Fig. 5a).

Several areas of high suitability, particularly i and ii, did not overlap with land nominated or considered for an ACEC designation, raising a question of how the BLM approached the nomination process and whether there were other factors that contributed to these areas being excluded such as off-road vehicle use, existing mineral leasing, grazing allotments, or proximity to I-15. Eastern and Western Wildlife ACECs were both identified for their Utah prairie dog and greater sage-grouse habitat, and two smaller areas were identified based on one specific species occurrence each (pinyon penstemon and ponderosa pine). The remaining areas noted specific cultural sites, VRI Class II scenery, and Mexican spotted owl habitat as identification criteria (Table 3). These criteria are fairly diverse, and many of the same layers used for nomination of Potential ACECs are present in modeled areas a and b, including Utah prairie dog, VRM Class II scenery, and ponderosa pine. Area h, just between two sections of the Ponderosa Pine ACEC, was also not accounted for in the Potential ACECs: these overlapping layers were mainly cultural features that may not have been incorporated into the process as no tribes submitted nominations to CCFO.

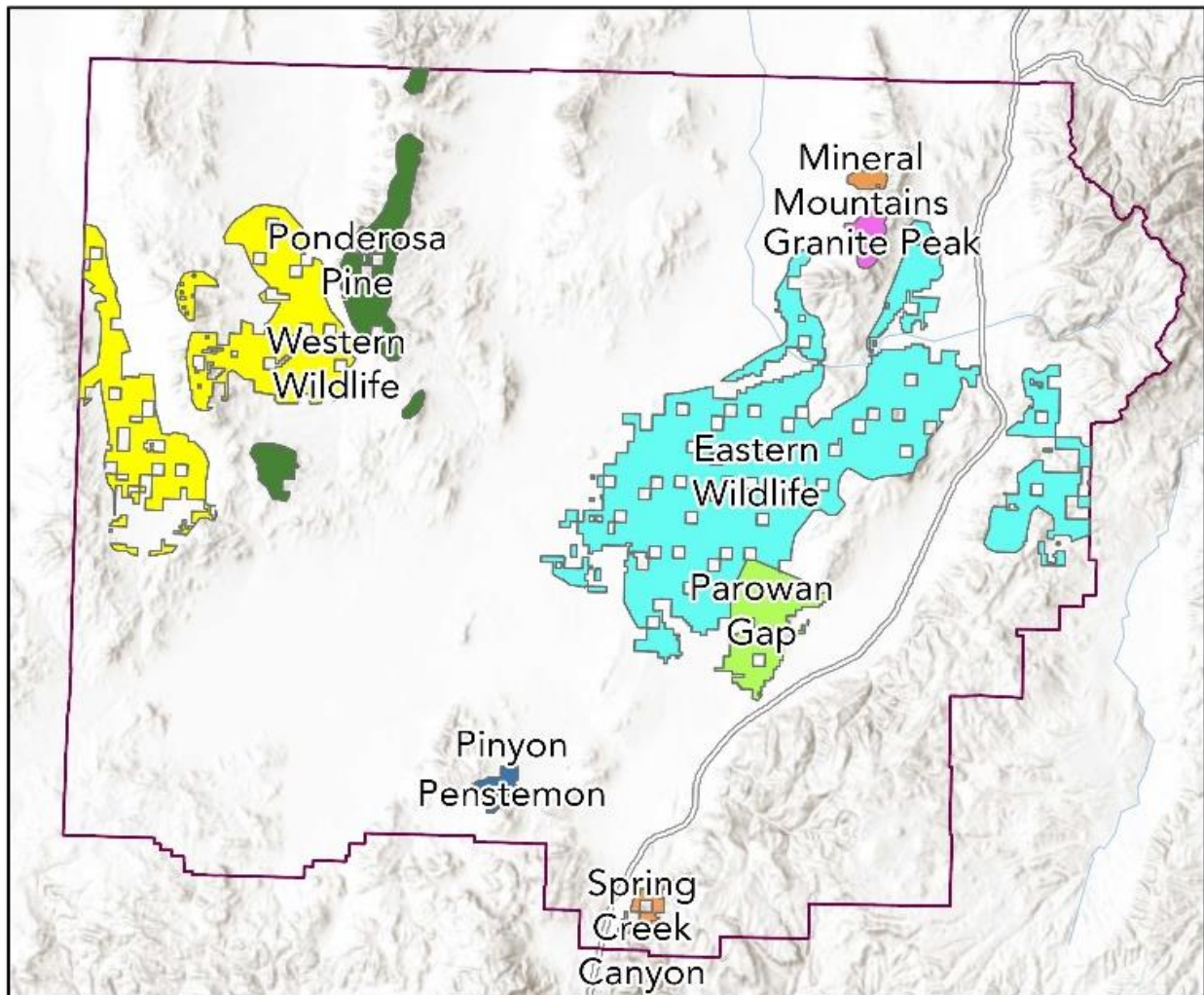


Figure 4. The eight potential ACECs identified by the BLM in 2013. Map adapted from Appendix B of the Draft Evaluation Report for Areas of Critical Environmental Concern.

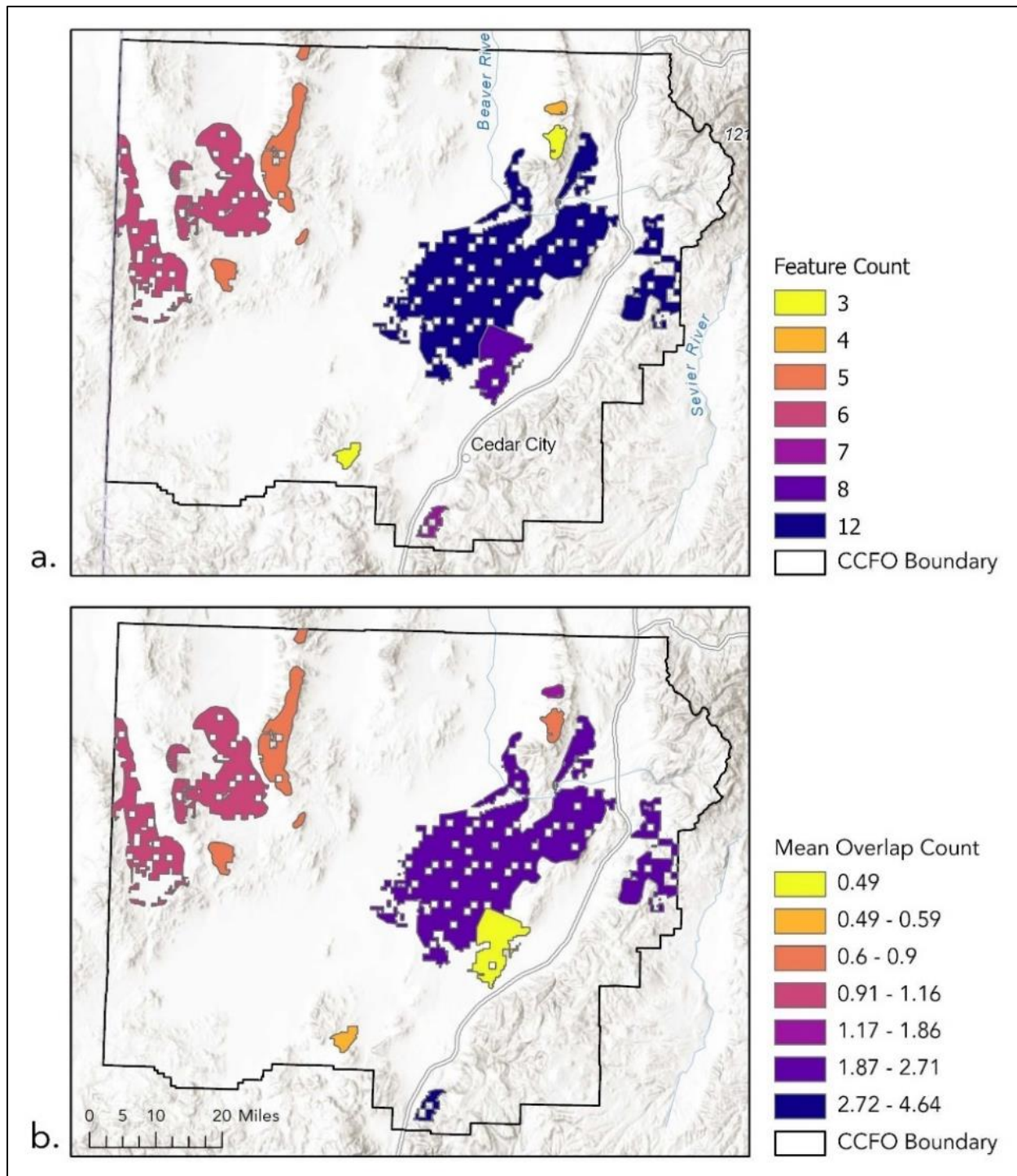


Figure 5. A comparison of the modeled high suitability areas in relationship to the ACECs identified by the BLM in the planning process. The count of features present in each polygon is shown in (a), while (b) represents correlation across each area by displaying the mean of the polygon counts from the count overlap layer.

Table 3: BLM Nomination Criteria Compared to Modeled Mean Values and Criteria for Potential ACECs in CCFO

Potential ACEC	BLM Identification Criteria (met both R&I)	Mean Count Overlap	Feature Count	Layers Counted in ACEC
Eastern Wildlife ACEC	Utah prairie dog habitat, greater-sage grouse habitat	2.71	12	Dominguez-Escalante Trail, crucial mule deer habitat, burrowing owl habitat, Utah prairie dog habitat, sensitive soils, ponderosa pine, Old Spanish Trail, sensitive plants (Welsh's milkvetch, Franklin's penstemon), the Beaver River, greater-sage grouse habitat, cutthroat trout habitat, historic Lake Bonneville
Granite Peak ACEC	VRI Class II scenery, NRHP eligible sites	.82	3	Sensitive soils, crucial mule deer habitat, VRM Class II
Mineral Mountains Obsidian ACEC	Wildhorse Canyon cultural resources, Wildhorse Canyon Obsidian Quarry	1.86	4	Wildhorse Canyon and Wildhorse Canyon Obsidian Quarry, sensitive soils, crucial mule deer habitat, VRM Class II
Parowan Gap ACEC	Parowan Gap petroglyphs, other significant cultural sites in the area, ethnographic landscape boundary around Parowan gap, unique high density of nesting raptors	.49	8	Parowan Gap, crucial mule deer habitat, greater-sage grouse habitat, Utah prairie dog habitat, burrowing owl habitat, Old Spanish Trail, Dominguez-Escalante Trail, Scenic Byways
Pinyon Penstemon ACEC	Pinyon Penstemon	.60	3	Pinyon Penstemon, Utah prairie dog habitat, sensitive soils
Western Wildlife ACEC	Utah prairie dog habitat, greater-sage grouse habitat	1.16	6	Indian Peaks to Wallaces trail, greater-sage grouse habitat, Utah prairie dog habitat, sensitive plants (pink egg milkvetch), Indian Peak range,

				Mexican spotted owl habitat
Wah Wah Ponderosa Pine ACEC	Stands of old-growth ponderosa pine, oldest known genetic ponderosa pine, bristlecone pine	.90	5	Indian Peak range, Utah prairie dog habitat, sensitive plants (Jones' globemallow), Indian Peaks to Wallaces trail, Wah Wah mountains
Spring Creek Canyon ACEC	Mexican spotted owl, scenic red rock canyons, diverse riparian corridors	4.64	7	Mexican spotted owl habitat, Dominguez-Escalante Trail, crucial mule deer habitat, ponderosa pine, Utah prairie dog habitat, VRM Class II, sensitive plants (Nevada's willowherb)

Though the mean overlap count was highest in Spring Creek Canyon, Eastern Wildlife, and Mineral Mountains Obsidian ACECs, the sheer number of overlapping features is only one indication of high suitability. Compared to the criteria used by the BLM to determine suitability, this analysis also identified four suitable areas that correlated with four potential ACECs using the same criteria: Eastern and Western Wildlife, pinyon penstemon, and Mineral Mountains. In fact, it predicted almost identical ranges for pinyon penstemon and Wildhorse Canyon as the draft ACEC report, identified accurate locations of important sites like Parowan Gap and the obsidian quarry, and established correct habitat ranges of greater-sage grouse, Mexican spotted owl, and Utah prairie dog.

On a large scale, the area of highest suitability did not overlap with any ACEC nominations or Potential ACECs; however, the model did identify several other areas as having high suitability potential, some of which correlated directly to potential ACECs. Furthermore, these areas without a correlation to on-the-ground decision making provide a space to explore other considerations of the agency that could be incorporated into the modeling process moving forward.

5. DISCUSSION

5.1 Discrepancies in Modeled Suitability

A successful suitability model that would assist the BLM's initial ACEC inventory process requires an outcome that is in line with the methods the agency uses to assess areas for nomination. Overall, the results of this analysis indicate a fairly strong correlation between the internal and external ACEC nominations, the BLM's interpretation of the R&I criteria, and the spatially informed interpretation offered here. However, gaps in findings and methodology suggest the need for more current, accurate, fine-scale data and better tribal engagement in the inventory process.

Accuracy is best assessed with a comparison of which features were present in a specific area of the model and which features were mentioned in the potential ACEC evaluations (see Table 3). The model was most accurate in predicting areas with high ecological value, identifying hot spots of Utah prairie dog habitat, greater-sage grouse habitat, and pinyon penstemon occurrence. This is unsurprising given that the majority of the proposed ACECs in the CCFO were based on

threatened, endangered, sensitive, endemic, and important species—the BLM has a longstanding tendency to designate ACECs based on these criteria over others (Millar, 2016). Additionally, Wildhorse Canyon and Parowan Gap were well accounted for in both the model and the final list of potential ACECs: each of these cultural features were the sole determinant of the BLM’s final consideration, which is also in line with Millar’s (2016) finding that cultural resources are the most common features to determine designation of ACECs with only a single criterion.⁶ The Wah Wah Ponderosa Pine was the only areas from the final list that noted different ecological criteria than the model in the same area. This inconsistency is likely due to inaccuracy of ponderosa pine data used, which did not show a range in or around the Wah Wah Mountains.

The most significant discrepancy was in the cultural and scenic criteria, many of which accounted for high polygon counts in the model but were not mentioned as values in the potential ACECs. Specifically, three scenic byways in the southeast corner of the field district, as well as the Spanish Trail, the Dominguez-Escalante Trail, and several important tribal sites were significant in determining modeled hot spots yet were absent from the BLM’s draft ACEC report. Variance between field district interpretation accounts for some of this discrepancy: for instance, the Kanab Field Office has considered scenic value to include National Historic Highways and Backcountry Byways in their ACEC evaluation process, but the CCFO has a narrower definition, stating that “scenic value was determined relevant if it was inventoried as Class A scenery by the BLM” (U.S. DOI, 2018; Cedar City Field Office, 2013b). VRM Class II data did overlap significantly with scenic byways and backways around Cedar City, however a large buffer resulted in the scenic roads contributing more to modeled hot spots than that of VRM Class II area. There were no external or internal nominations submitted that mentioned National Historic Trails, despite the BLM forecasting an increase in tourism and illegal collection and damage of cultural resources on and around them (Cedar City Field Office, 2013a). Exclusion of these features in the nomination process likely contributed to discrepancy between the modeled hotspots and the nominated potential areas in the southeast corner of the study site.

Furthermore, there were no tribal nominations submitted and many of the important sites identified in the SEZ ethnographic studies were not mentioned in the draft ACEC report. Partly because two mountain ranges, the Indian Peak to Wallaces Peak trail, and the historic Lake Bonneville area were all identified as important cultural sites, the model identified high suitability throughout the central Escalante Valley, around the Indian Peak Mountains, and along the southern border of the Wah Wah Mountains. Though some of these areas were included in the Potential ACEC list, they were nominated because they contain habitat of species of concern rather than cultural features, suggesting that tribal consultation is compulsory in the development of internal ACEC nominations if cultural features are to play a hand in furthering conservation measures under the BLM.

Beyond the type of features present across the landscape, there are other factors that guide land use planning and may contribute to discrepancies between modeled and potential ACECs. Areas with high potential for locatable mineral leasing and development, OHV access, and grazing permits are examples of additional considerations the agency is balancing under a multiple use mandate. In the CCFO, increased OHV use threatens habitat for some vulnerable species, which actually resulted in areas like Spring Creek Canyon meeting the second Importance criteria (Cedar City Field Office, 2013b). Lands with high and moderate potential for mineral development are

⁶ The final Parowan Gap ACEC also identified unique high density of nesting raptors, though this was evaluated as a separate nomination and both the cultural and the wildlife nominations were found to meet Relevance and Importance values separately (see Cedar City Field Office, 2013b, page 43-50).

concentrated in the Indian Peaks and Wah Wah Mountains to the west, which could have influenced the final boundaries of the Western Wildlife and Ponderosa Pine ACECs; both were significantly smaller than the proposed Great Basin Core area. Most of the Eastern Wildlife, Western Wildlife, Pinyon Penstemon and Spring Creek Canyon areas are currently open for OHV use, and suggested management practices for the designation of these ACECs includes restricting use to designated roads or prohibiting it altogether (Cedar City Field Office, 2013b). The considerations of the multiple use mandate create an additional layer of complexity to modeling suitability that is worth contemplating. Though leasing, OHV use, and grazing data could be incorporated into future analysis, it is more valuable to identify all locations across a landscape that have high cultural, ecological, and historical value, even those that are subject to multiple uses at the current time.

5.2. R&I and Special Management Attention Considerations

The features in the analysis were chosen based on their relevance values, and though a strong argument can be made for the importance values they possess as well, some of them did not meet the importance criteria in the BLM's evaluation for a variety of reasons. The Beaver River corridor was proposed as part of an ACEC by the Utah Professional Archaeological Council and identified in the SEZ ethnographic assessment as a major waterway and agricultural resource for Numic people in the area (Stoffle et al, 2011b). In this same report, the consulting tribes specifically asked to be formally contacted whenever land management planning occurred near the Beaver River. However, the BLM determined that the proposed ACEC did not meet the importance criteria, as it did not have "more than locally significant qualities" or qualities that make it sensitive or vulnerable to adverse change (Cedar City Field Office, 2013b) No further information was given about this decision. Crucial mule deer habitat contributed to the high suitability scores to the southeast of I-15, but the BLM determined that mule deer habitat does not meet the same importance value of having more than locally significant qualities because it is found throughout the west, even though the presence of crucial big game winter range influenced OHV travel restrictions on portions of Hurricane Cliffs (Cedar City Field Office 2013a, 2013b). Burrowing owl habitat was subject to the same determination. The Sand Cliff Signatures in Freemont Canyon, which is a site containing historic inscriptions from seventeenth century pioneers and is listed on the NRHP, did not meet importance criteria according to the BLM's evaluation either; they cited that, although it is a historic property, it is only significant on a local level and does not have historic or cultural qualities that are exemplary or unique.

This determination of having more than local significance is often pivotal in fulfilling the importance criteria. In the most recent Missoula RMP for instance, Bear Creek Flats was removed as an ACEC because previous ponderosa pine groves and riparian habitat of concern is now more substantial throughout the planning area and therefore no longer significant on a "more than local" scale (Missoula Field Office, 2018; Ward & Carey, 2022). Making this decision of whether something is more than locally significant hangs on a comprehensive understanding of the feature in question, particularly the knowledge of where else on the landscape it is present. On a field office scale, initial planning documents can indicate which features are likely to fulfill the importance criteria, but a large-scale inventory process would require a more careful set of data collection and analysis guidelines to account for importance value considerations. Specifically, future applications of this suitability model could account for local significance using a spatial parameter. For example, a modified rarity index from Geneletti's (2003) methods could be used to calculate the ratio of occupied and unoccupied land within a BLM jurisdictional boundary or

state boundary for a certain feature. A threshold value could determine whether or not the feature was “rare” enough to be considered more than locally significant. Determining local significance based on a quantitative methodology would not only increase the accuracy of suitability modeling, but also standardize the interpretation of the concept across the agency.

Still, the local significance hurdle is problematic. In the case of maintaining intact landscapes, biodiversity, and wildlife corridors throughout the Great Basin, it should be a goal to protect habitat and ecosystems on large scales that are likely *not* more than locally significant. Even more worrisome, determining which habitats, cultural sites, and ecosystems deserve protection based on their uniqueness overlooks a necessity, especially in the face of climate change and rapid loss of biodiversity, to protect *all* instances of these important features to support ecosystem stability (Biggs et al., 2020).

Likewise, for tribes, sites of cultural value are often those that are locally significant to them and their history. And even without more than local significance, clarification is needed around why many culturally significant areas are found to not possess characteristics that are worthy of heightened protection. Features such as riparian corridors, archeological sites, and historic trails, especially those explicitly identified as culturally important by tribes, should certainly at least meet the second importance criteria as climate change and increased visitation pressure and threaten sensitive resources. From a spatial standpoint, future suitability analyses should continue to rely on existing ethnographic studies to guide their inventory; however, revisions to BLM Manual 1613 and a more substantial tribal consultation process are necessary to ensure indigenous knowledge and value is accounted for in land use planning.

Beyond meeting the R&I criteria, nominations are also subject to needing “special management attention,” which is often where nominations fall out of contention if they overlap with existing special designations or are not currently subject to external threats such as visitation or OHV use ((BLM Manual 1613.12; Ward & Carey, 2022). No nominations submitted to the CCFO were excluded due to special management attention, likely because none of them overlapped significantly with existing protected areas. Future suitability models could account for this by excluding lands under an existing heightened conservation status from the analysis, but it is worth asking whether the way in which this requirement currently influences designation of ACECs is successful. These concepts of local significance, management, and the inclusion of tribal data are discussed in detail in Section 6.

5.3 Future Weighting Considerations

Due to the vector-based suitability workflow developed for this model, each layer was given an equal weight by calculating the count of overlaps. The method is simple and is designed to be easily replicated in other areas, but it would be beneficial to weight layers differently based on how well they fit the R&I criteria. For example, the Parowan Gap ACEC was the least correlated with the modeled areas of high suitability even though the model included Parowan Gap. This was because there were fewer other features present within the ACEC polygon, lowering the count of polygons; however, the presence of one important feature that satisfies both the relevance and importance criteria is enough for designation. Thus, these areas could be weighted more heavily to ensure the model estimates high suitability in the correct places. Cultural features submitted by tribes in particular should have higher weighted values in accordance with recent executive guidance encouraging stronger tribal consultation (Biden, 2021). Likewise, understanding habitats and migration corridors for a species like mule deer is important even if

their presence alone does not qualify for an ACEC designation; features such as these could have smaller weights in the suitability analysis.

Multiple methods exist for weighting features in multi-criteria analyses. In the vector space within the Esri GIS environment, the simplest way to weight features is to duplicate them as new layers and rerun the Count Overlap tool. This is useful in that most of the data used to quantify the R&I criteria are polygon layers. However, most suitability analyses are done in the raster space. A weighted linear combination is one common methods, in which each map layer is assigned a value and the sum of the values returns a total score (Drobne & Lisec, 2009; Dickson, Zachmann & Albano 2014). ArcGIS also has a raster calculator tool that can classify and multiply pixel values to easily determine suitability (Kumar & Shaikh, 2013). Subsequent analyses of this nature could be done in either space, though computation in raster format is less complex and each polygon layer could be easily converted to a raster with the Rasterize Feature function inside of ArcMap or ArcGIS Pro (Chang 2006).

Regardless of which method of weighting is most useful, there remains a question of how to determine appropriate weights of each feature. Millar's (2016) survey of existing ACECs found that some relevance criteria were much more common than others, particularly natural systems or processes, cultural values, scenic values, and wildlife resources. Based on the statistics of current ACEC designations, features that result in a higher frequency of designations, such as ESA-listed species and vulnerable cultural sites, could be weighted higher. Another weighting strategy could be to assign more substantial weight to areas that border existing protected land, prioritizing heightened connectivity throughout the west.

Though weighting could result in a more precise picture of where suitability might be highest across a landscape, predicting which features carry more weight is difficult given the varying interpretations of agency field offices. For an initial re-inventory, a strict feature overlap count like the one modeled here—along with a more succinct interpretation of Importance value—is likely an adequate measure to establish where the BLM should focus their energy and consider heightened conservation status.

5.4 Accuracy of Methodology

This data collection and creation process involved digitizing static maps and estimating value across species, habitat, and cultural features. Particularly, the lack of publicly available wildlife and plants data resulted in more subjective decisions around what to include and from where. Without individual species data, the range of many species had to be based purely on sightings from the last decade, which were estimated in large, square polygons from UDWR. Similarly, plant occurrences were based on digitized estimates from a 2005 Utah Natural Heritage Program report that only described each plant's buffered range at a large scale. Modeled sensitive soil data used in the analysis also left room for significant error, differing from the CCFO soils dataset shown in Map 2-4 of the AMS (Cedar City Field Office, 2013a). Although this process still resulted in a reasonably useful suitability model, the use of more accurate, current, georeferenced data could significantly lower the error margin in this type of analysis moving forward. Reliable data is available to the BLM as they move through their resource management plans and much of it should be straightforward to procure and use for a larger-scale inventory as well.

Furthermore, it is important to consider how ecological and cultural features should be buffered throughout this modeling process. The CCFO mentions buffer zones as important for raptor habitat, riparian systems, and cultural resources, even citing a recent ethnographic report that specifies a “ethnographic landscape boundary” around Parowan Gap (Cedar City Field Office,

2013a). Though buffer distances for riparian corridors are well documented (Bentrup & Kellerman, 2004; Wenger, 1999), little work has been done on buffering cultural and scenic features and it is often site-specific or based on loose measures of value (Chen, Li & Wang, 2009; Robinson et al., 2010). This model provides initial justifications for varying buffer distances based on sight distance to the horizon and groundwater tables, but the approach compromised accuracy for consistency: all trails and scenic highways were buffered by three miles despite differences in mountains, cliffs, and surrounding scenery that might limit the scope of view, and all tribal informed sites of importance were buffered by 500 meters despite the variety in features accounted for that might need more substantial buffer distances. Further research is needed to determine the most suitable distances for features such as culturally significant mountain peaks and historic trails. As mentioned above, it is likely that ethnographic studies and tribal consultation could facilitate much of this process. Together with the acquisition of current, high-quality data from partners like the Natural Heritage Program and through increased tribal consultation, this suitability modeling process can be substantially refined to improve accuracy and serve as the first step of a large-scale ACEC inventory process.

6. POLICY

6.1 Relevance and Importance Criteria

The results of this analysis highlight where the R&I criteria fall short compared to FLPMA's intentions. On a high level, the act stresses that "public lands be managed in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values; that, where appropriate will preserve and protect certain public lands in their natural condition..." (43 U.S.C. § 1701). ACECs are meant to facilitate this protection through providing special management attention to specific resources and processes, and FLPMA explicitly calls on the Secretary to "give priority to the designation and protection of areas of environmental concern" (43 U.S.C. § 1711). The act articulates a federal priority to protect landscapes of value, an intention that the guiding designation criteria must align with. However, the current R&I language precludes the agency's ability to use the ACEC designation effectively in four ways: first, the lumping of cultural, ecological, scenic, and historic value with hazard criteria limits prescriptive special management for each of the two categories; second, the ambiguity of the importance criteria and the clause "more than local significance" neglect essential cultural value and ecosystem management; third, this vague language, specifically around the importance criteria, hinders agency-wide consistency and inclusive public and tribal engagement; and fourth, the requirement of special management attention counters congressional intent of the designation and further contributes to lack of effective designation across the agency. A detailed analysis of each of these deficiencies, as well as suggestions to address each of them, is offered below.

The R&I criteria address two distinct categories of "environmental concern." The first three relevance criteria each cover a wide range of potential historical, cultural, scenic, and ecological values, while the fourth criterion, encompassing natural hazards such as avalanches, seismic areas, and cliffs, is a diversion in purpose. Similarly, importance criteria 3-5 address the protection of national priority and public safety, deviating from the first two that focus on value of the feature or landscape. FLPMA's definition categorizes the criteria in a more methodical fashion, specifying ACECs as areas "where special management attention is required...to protect and prevent irreparable damage to important historic, cultural, or scenic values, fish and wildlife resources or other natural systems or processes," separating out the need to "protect life and safety from natural

hazards” as a final clause (43 U.S.C. § 1702 (a)). While the phrase “critical environmental concern” certainly includes hazardous areas, the protection of these areas should not be subject to the same management guidelines as the protection of critical habitat or important cultural sites. Reorganizing the criteria to separate the two purposes in a similar manner as FLPMA articulated would allow the BLM to develop more tailored management strategies based on the intention of the designation and focus on the value criteria over the hazard criteria, as they lean on value criteria far more often to guide designations (Millar, 2016).

These value-based criteria also demand a reevaluation. Specifically, as demonstrated in the CCFO case study, the first two importance criteria often prevent important resources from being protected through an ACEC designation. The first criterion contains the requirement to have “more than locally significant qualities,” which hinders the designation’s capacity to safeguard key ecosystems. The protection of multiple, similar areas is an imperative mechanism to buffer against climate change because greater redundancy of ecological systems increases their resilience and stability (Biggs et al., 2020). Doing so also facilitates large landscape connectivity and supports biodiversity across jurisdictions (Dickson, Zachmann & Albano, 2014; Stein, Scott & Benton, 2008). To account for these systems, the BLM should remove the local significance clause and add a new criterion that assesses suitability based on the need for ecological redundancy. An area could be considered suitable if it contained habitat that was biodiverse, similar to neighboring protected areas, or facilitated connectivity between habitat patches of migratory species. Removing the requirement of more than local significance would also account for the local importance of cultural sites such as springs or geologic features, which are inherently valuable because they are place based on a local level. Tribal nominations should be considered for their individual, local value, especially given that the AMS forecasts increased exposure and visitation to many of these sites (Cedar City Field Office, 2013a).

The second importance criterion also presents a dilemma. While a broad set of features should fulfill its requirement—which states the area must have “qualities or circumstances that make it fragile, sensitive, rare, irreplaceable, exemplary, unique, endangered, threatened, or vulnerable to adverse change”—, it is currently subject to a narrow interpretation: as discussed above, there were many important features and sites in the CCFO area that were found to not have “qualities or circumstances that [made them] fragile, sensitive, rare, irreplaceable, exemplary, unique, endangered, threatened, or vulnerable to adverse change” (BLM Manual 1613.11). For example, the Utah Professional Archaeological Council nominated an ACEC around the Beaver River for its cultural resources. It was found to meet the first relevance criterion, but not the second importance criterion, both of which include qualities of sensitivity or rarity. The cultural significance of the Beaver River described in the SEZ reports, as well as its riparian area that is certainly vulnerable to adverse changes, should be sufficient reason to garner fulfillment of the importance criteria.⁷ Two historic trails present in the area were also found to not meet the second importance criteria in the draft ACEC report, yet the BLM cited the trails as historic sites and forecasted that interest in these trails is expected to increase in the coming years (Cedar City Field Office, 2013a, 2013b). In essence, the agency determined that despite increased trail use and historic value, neither trail possessed qualities that were unique, irreplaceable, or vulnerable, therefore excluding them from ACEC candidacy.

⁷ Climate change and human-induced stressors to riparian zones include changes in flow and flooding, alteration and removal of riparian vegetation, wildfire, and pollution (see Dwire, Mellmann-Brown, & Gurrieri, 2018).

Returning to the intentions of FLPMA can guide revision, or potentially even removal, of both the first and second importance criterion: is the current language truly sufficient in designating ACECs that protect environmental resources? How can it better consider and prioritize cultural values? Can the “vulnerable to adverse change” clause be altered or expanded to include resilience to and impacts of climate change? Clarification here, coupled with reorganizing of the hazard criteria and removing the more than local significance clause, will help to realign legislative intention with agency regulation, increase consistency across states and field offices, and facilitate better communication across the BLM. Consistency and communication across the BLM are particularly crucial now, as large landscape conservation planning becomes a key strategy in the face of rapid development, increased recreation, energy development, and climate change (Baldwin et al., 2018; National Fish, Wildlife and Plants Climate Adaptation Partnership, 2012). Many stakeholders involved in landscape-scale, collaborative processes are exploring creative conservation strategies to expand connected lands across jurisdictions, increase ecosystem resilience, and meet 30x30 goals: ACECs offer a straightforward way for the BLM to contribute to these efforts.⁸

New or updated ACEC regulations can also bolster public participation in the nomination process if people have a clearer idea of which values will qualify for designation. Currently, there are substantial differences between what “counts” across field offices. For instance, while the CCFO did not nominate any ACECs that considered historic trails, the Kanab field office determined portions of the same trail, the Old Spanish National Historic Trail, to meet the importance criteria (U.S. Department of the Interior, 2018). These discrepancies cloud an already ambiguous nomination process—clear guidelines that are well-communicated to the public is one step towards a more inclusive process. Further actions to facilitate engagement, particularly of tribes, are discussed in the next section.

6.2 Special Management of ACECs

ACECs by definition are areas where “special management attention is required,” suggesting Congress intended on giving heightened protection to these areas (43 U.S.C. § 1702(a)). The phrase is unique in that it both defines the purpose of the area and is also a criterion for designation: BLM Manual 1613 specifies that in order to be designated as an ACEC, “an area must require special management attention to protect the important and relevant values” (1613.12). Even when areas are nominated because they contain important historical, cultural, scenic, or ecological value, they often fall out of contention when the BLM determines special management of the valuable resources is not required (Sheldon & Baldwin, 2015; Ward & Carey, 2018).⁹ The use of special management attention as a criterion hobbles the agency’s ability to administer the designation in accordance with FLPMA, which states in the same definition that the purpose of an ACEC is to “protect and prevent irreparable damage to important historic, cultural, or scenic values, fish and wildlife resources, or other natural systems or processes, or to protect life and

⁸ Landscape Conservation Design is one approach to creating a robust, connected, resilient network of lands through collaborative planning (see Campellone et al., 2018).

⁹ For example, in the recent Missoula RMP, Chamberlain Meadows and West Fork Buttes proposed ACECs were both found to meet the R&I criteria, but did not require special management attention (see Missoula Field Office Proposed Resource Management Plan and Final Environmental Impact Statement Volume I, (2020),

https://eplanning.blm.gov/public_projects/lup/58107/20012825/250017616/Missoula_PRMP_FEIS_Vol_1.pdf)

safety from natural hazards” (43 U.S.C. § 1702(a)). Here lies another circular argument: if an area has value or resources worthy of protection, shouldn’t special management to protect them always be required as FLPMA stipulates? The BLM often dismisses ACEC nominations where they do not see sufficient threats to the area that require special management attention, yet climate change, coupled with increased visitation across public lands and biodiversity loss, jeopardizes the future of all important values the ACEC designation seeks to protect. Revisions to the R&I criteria should remove special management as a criterion altogether, shifting the focus from whether valuable areas need special management to what specific special management valuable areas need.

Currently, the phrase leaves ample discretion to the agency to decide how ACECs are managed, but specific management guidelines are absent from the current ACEC regulations—and often from RMPs as well. Of the entire ACEC process, Sheldon and Baldwin (2015) assert that “the most significant shortcoming...was the failure to identify and describe the special management prescriptions necessary to protect [these areas and their values].” Though this paper focuses on the inventory and designation of ACECs, effective implementation of the areas requires strong, specific management prescriptions. Moving forward, the BLM should include more specific details about the special management necessary in draft RMPs and Federal Register notices and consider rulemaking or regulatory revisions to parameterize special management of all ACECs. Additionally, new special management guidelines should require tribal consultation in the development of management standards, as local tribal members are the only ones who are qualified to judge value of their cultural and historic resources. In fact, tribes must be involved in decision making throughout the entirety of the ACEC planning process, as reviewed in Section 6.3.

It is clear that BLM Manual 1613 needs substantial updates and revisions, but it is also important to underscore the reliance the agency has on this specific, non-regulatory document. As illustrated in the CCFO case, the R&I and Special Management criteria language in the manual almost exclusively informs the BLM’s ACEC process, while FLPMA’s directive is neglected throughout. The role of a non-enforceable directive in BLM planning is not novel—the agency often relies on these manuals for land use planning instruction (Elliott, 2022). However, the sole use of BLM Manual 1613 leaves no room for agency accountability in ACEC planning. Revisions to this manual can be a realistic, short-term strategy for improvement, but a more substantial, regulatory guide would ensure these areas were prioritized in the way FLPMA intended.

6.3 Tribal Consultation in ACEC Planning

Currently, regulatory language around external engagement in the ACEC process is passive and vague. BLM Manual 1613 only mentions “the public has an opportunity to submit nominations or recommendations for areas to be considered for ACEC designation” (1613.4). This slant guidance leads to a disparate public engagement approach: in a survey of 36 RMPs across the western states, Sheldon and Baldwin (2015) found significant inconsistencies among field offices in how they communicated the ACEC process to the public, as well as where they posted public resources and information about nomination. The CCFO case reinforced the presence of these inconsistencies, as the field office’s nomination decisions were buried in planning documents and often did not elaborate on why an area did or did not meet the designation criteria. Land managers could facilitate an honest, intentional public process more easily if they had more specific federal direction around where, when, and how to share information and engage the public. Perhaps most importantly, this direction must include provisions specific to tribal consultation. Indigenous knowledge is *essential* to making determinations of value across public lands, and the current lack

of tribal engagement is contributing to an ongoing exclusion of input throughout BLM land use planning.

Differences in the collection and interpretation of tribal data accounted for the most significant discrepancies between the CCFO potential ACECs and the model results found here; there was not a single nomination submitted by a tribe or tribal coalition. This is common in the ACEC process, where conservation groups or other nonprofits, who have paid staff that can meticulously follow the planning process, are often the ones who submit cultural nominations. This is true in the CCFO, where the Utah Professional Archaeological Council nominated areas of cultural significance such as the Beaver River. When tribes do submit ACEC nominations, they have been historically dismissed. A coalition of over 60 tribal governments recently passed a resolution calling on the DOI to develop a stronger process for ACEC designation (Richards, 2021). The coalition cited 14 million acres worth of ACEC nominations in Alaska, all of which were rejected in the latest proposed RMP. They argue that the current planning process falls short of tribal consultation and that “the BLM has the duty to collaborate directly with sovereign nations and communities in inclusive land management processes” (Affiliated Tribes of Northwest Indians, 2021). Legislative guidance and recent executive initiatives affirm this duty, crafting a strong case for the BLM to spend effort and resources on improving tribal consultation.

FLPMA requires the Secretary to coordinate with other federal agencies and departments, state and local governments, and tribes “to the extent practical” throughout the land use planning process, though it affords great agency discretion in defining and determining practicality (43 U.S.C. § 1712(c)(9)). The White House set further intentions of increased tribal consultation during the Tribal Nations Summit in November of 2021. Among the initiatives released was a joint secretarial order by the DOI and the U.S. Department of Agriculture that requires that agencies “collaborate with Indian Tribes to ensure that Tribal governments play an integral role in decision making related to the management of Federal lands...[and] engage affected Indian Tribes in meaningful consultation at the earliest phases of planning and decision-making related to the management of Federal lands” (Order No. 3403). The order also specifies that agencies give “due consideration to Tribal recommendations on public lands management.” With this federal encouragement, the only question that remains is *how* can the BLM revise regulations to ensure tribal consultation is a regular and sizeable element in the ACEC inventory and designation process?

As discussed above, revising the R&I criteria to prioritize cultural value on a local scale and including tribes in management standard development are two ways in which the BLM can bolster tribal input throughout the planning process. However, the ACEC regulations also must be explicit in requiring tribal input and data in both the inventory and nomination stages. Revision of BLM Manual 1613, or even a rulemaking to create a new regulation around tribally inclusive management, should require consultation with any tribes that value land within the planning area in each of these three steps every time the planning area engages in a planning or revision process.¹⁰ Furthermore, not only is it essential for the BLM to inventory lands and nominate ACECs based on tribal input, but also the nominations would be most appropriately assessed by tribes themselves. Here, regulations could require BLM offices to rely on a collaborative council of agency staff and tribal members to determine which nominations are suitable for designation.

¹⁰ A rulemaking around tribal inclusion in the planning process would be in line with Secretarial Order No. 3403 and could provide guidance for the inventory, nomination, designation, and management of all special areas, not just ACECs.

Intentional tribal consultation is also important for data collection, which the BLM does in the initial steps of planning. Current regulations mention state and local governments, state historic or natural heritage programs, conservation organizations, and public interest groups as potential information sources, while tribal data is absent from the list (BLM Manual 1613.2). The NRHP, or existing studies like the Utah SEZ reports, often have some cultural data, but many times the locations of sacred sites are not publicly available (Thomas, 2022). Tribal consultation thus becomes imperative to mapping where value exists on the landscape, both for future spatial analyses and ACEC planning in general. Tribal groups around the planning area, who likely value large portions of the landscape as sacred, are the only ones who can identify specific, important areas or features that are in the greatest need of heightened protection.

Revising regulations to require tribal consultation throughout the process is in the BLM's best interest, as it would support new federal goals and respond to requests like that of the Affiliated Tribes of Northwest Indians. At the very least, these revisions should require the BLM to use tribally informed data in the inventory process, prioritize of tribal input in the nomination process, and collaborate with tribal leaders and coalitions in determining ACEC suitability and subsequent management guidelines. Further rulemaking could impose these requirements across every special designation under the BLM, meeting the demands set out by Secretarial Order No. 3403.

6.4 Data Collection Requirements

Revisions to the nomination criteria and the addition of tribal consultation would significantly improve the ACEC inventory and designation process; however, guiding policy must require the collection and inventory of spatial data in the first place. Without adequate inventory data, the circular planning process is incomplete: “to be included in planning an area must meet criteria for possible designation as an ACEC, a determination that rests on whether there is inventory data indicating that an area qualifies—data that might not be collected” (Sheldon & Baldwin, 2015). Sheldon and Baldwin's (2015) review of ACEC regulatory deficiencies emphasizes that current regulations fail to require the collection of inventory data on resources and values, despite the legislative direction for the Secretary to keep a current inventory of all public lands, along with their resources and values, that reflects change in conditions (43 U.S.C. § 1711). FLPMA mandates that ACEC inventory and designation is prioritized, but the guiding BLM Manual 1613 and CFR § 1610 simply mention that consultation of the “inventory data” is a requirement, failing to specify that this inventory data must actually be collected (BLM Manual 1613.21 B; CFR § 1610.7-2 (a)). Funding further constrains inventory from happening outside of designated RMP revision cycles, during which time there is often less money available to support ground truthing and data collection efforts (Ward & Carey, 2022). Here, there is an opportunity to strengthen regulations to require inventory of land for ACEC suitability while leveraging spatial methods to reduce the cost and time it takes to maintain this inventory.

Sheldon and Baldwin (2015) suggest that new regulations should assign priority to ACEC inventory and guide national inventory action. Many special designations under the National Conservation Lands system (NCL) have an additional manual or document specifically for inventory. As an example, BLM Manual 6310 establishes inventory procedures for Lands with Wilderness Characteristics (LWC), directing that every time the BLM undertake a land use planning process, they “will consider whether to update a wilderness characteristic inventory or conduct wilderness characteristics inventory for the first time” (BLM Manual 6310 1.6 A). It requires a minimum standard of new information and an evaluation of the information and defines

procedures for identification of new areas where inventory is needed that include reviewing existing land status and available inventory data (BLM Manual 6310 1.6 B). A similar ACEC inventory manual would go hand in hand with a shift to more spatially informed methods: this manual could reinforce the priorities stipulated in FLPMA and provide guidance around where and how to collect spatial data for consideration of ACEC potential.

Inventory guidelines could also parameterize data quality needed for analysis as other regulations have done: the 2012 Forest Planning Rule requires agency officials to “use best available science information” during forest planning (36 CFR § 219.6), while LWC inventory can be done using any available information, as well as ground truthing when necessary (BLM Manual MS-6320). Results of the CCFO case study highlight a need for current, accurate, fine scale geospatial data. Ideally, this new inventory regulation would require the BLM to keep an updated database of layers relevant to the guiding ACEC criteria, thus making it simpler and more convenient for them to prioritize ACEC designation in the planning process.

A new inventory manual is one long-term strategy to improve the BLM’s administration of ACECs; however, given the current political climate and timeliness of 30x30, a more immediate inventory directive that incorporates spatial strategies would bolster the ACEC designation’s role in conservation quickly and effectively. On a scale across all BLM lands in the western United States, adequate staff capacity and funding and the acquisition of data across states and field offices are significant challenges to this type of inventory process. Existing studies could help to refine scale if needed: the BLM could prioritize conservation of areas that have been previously identified for their high biodiversity and connectivity potentials such as the Great Basin, the Mojave Desert, southeastern Oregon, and the Channel Islands (Belote et al., 2016; Dickson et al., 2014; Dickson et al., 2016; Jenkins et al., 2015). However, the BLM already has access to many of the spatial datasets necessary for analysis, and if they can manage to gather adequate data and consult tribes and experts to fill in the gaps, they should be able to replicate the spatial methods presented in this analysis on a larger scale. Ultimately, an Executive Order or an agency-driven initiative coupled with an initial suitability model could provide substantial guidance around where the BLM should spend resources ground truthing potential ACECs.

6.5 BLM Planning 2.0

Recent agency efforts to revise the land use planning process corroborate the need for R&I revision and tribal consultation. In December 2016, the BLM issued a set of revisions in the Planning 2.0 Rule, identifying that the planning process had not been updated in over thirty years and was not equipped to meet current day challenges (Resource Management Planning, 2016). The final rule was developed in response to feedback the agency gathered through collaboration with a diversity of stakeholders, and the stated outcomes included an enhanced, earlier public engagement process, stronger partnerships with state, local, and tribal governments, adaptive management planning requirements, and a specific definition of sustainable yield (Bureau of Land Management, 2016). Though it was later repealed by Congress in 2017 under the Congressional Review Act, the rule provides insight into where the agency itself identified gaps in planning regulations.

The rule altered substantial language around ACEC planning. Adjustments to wording around designation and protection of the areas were added to give priority to the designation and protection of ACECs, as stated in FLPMA. It included a new provision to address public comment requirements—which include opening a public comment period on proposed designations—when an RMP or RMP revision includes ACEC nominations. Furthermore, it required the BLM to post

the AMS, as well as identification and rationale of potential ACECs, on the BLM website and make the documents widely available to the public.¹¹ These revisions indicate the agency acknowledged a need for a more inclusive, widespread nomination process.

In addition to these broad level adjustments, the BLM removed “more than local significance” from the importance criteria descriptions, explaining the phrase “is vague and unnecessary [and]...that the importance criteria is based on the degree of significance (*i.e.*, substantial significance and values); a local value, resource, system, process, or natural hazard could have ‘substantial’ significance” (Resource Management Planning, 2016). This decision reiterates the necessity to remove the phrase from the designation requirements. Moreover, the rule established a requirement to initiate tribal consultation during the preparation of management plans and expresses a need to incorporate new data resources and geospatial tools into the land use planning process to support iterative planning as on-the-ground conditions change. The rule reinforces the specific places in which the ACEC regulations require revision, while demonstrating support for methods similar to those used here in future land use planning processes.

7. CONCLUSION

Areas of Critical Environmental Concern offer an invaluable opportunity for the BLM to enhance their conservation efforts and contribute to 30x30, yet current administration of the designation is inadequate and fails to meet FLPMA’s conservation priorities. Most pressing is the need for an inclusive, substantive inventory and designation process that considers diverse landscape values in the face of a changing climate without depleting agency resources. This paper suggests a spatial suitability assessment as a strategy to bolster the BLM’s review of these areas, along with improvements to the guiding policy based on the results of the assessment. Specifically, the agency should consider the following revisions, which could be made to BLM Manual 1613 or achieved through an additional rulemaking:

1. The Relevance and Importance criteria should be reorganized into two new categories of value and health and human safety, in which the value category considers both relevance and importance together.
2. A new criterion or revision to an existing criterion should address the need for habitat and landscape redundancy as a connectivity tool and buffer against biodiversity loss and climate change.
3. The “more than local significance” clause in the first importance criteria should be removed as indicated in BLM Planning 2.0 and “importance” of a resource should instead be derived from historic, cultural, and ecological value evaluated in the relevance criteria. Revisions should also address this requirement in NEPA by stipulating that, though the rule “generally requires qualities of more than local significance,” more than local significance is not always necessary for the derivation of importance.
4. Special management attention should be removed as a requirement, as any area containing valuable resources worthy of an ACEC designation should also be worthy of special management attention.
5. The BLM should be required to consult with surrounding area tribes before submitting internal nominations and asking for external nominations, as well as while determining suitability and developing management guidelines. Revisions should also ensure these steps are consistently communicated to the public through online and community resources.

¹¹ Current regulations do not require the AMS to be made available to the public.

6. Inventory requirements should be updated to specify that data must be collected and analyzed for ACEC suitability. These requirements should also stipulate data quality standards.

With clear guiding policy in place, the BLM could implement a large-scale ACEC inventory process using existing spatial data, most of which they already have access to. As demonstrated in this case study, it is possible to identify initial hot spots of suitability potential that require further ground truthing by quantifying selection criteria and performing a simple set of spatial manipulations. An immediate agency directive or a Secretarial or Executive Order to re-inventory all BLM lands using these revised criteria, and an adapted version of the spatial methods outlined above would best facilitate uniform inventory across the agency, ensure inclusion of tribal data, assist the BLM in contributing to 30x30, and lower the cost and time needed to survey on the ground.

The administration is calling on land managers to engage in local collaboration, safeguard lands and waters, and support conservation and restoration efforts of those who live on and value the diverse lands of the United States in *Conserving and Restoring America the Beautiful* (U.S. Department of the Interior, 2021). There is an immediacy in this moment that demands action on every level, and the BLM possesses a tool that can meet this demand without congressional or executive permission. If they can realign with their mandate to prioritize areas of critical environmental concern and truly discern where conservation value exists across the West, they are well equipped to mitigate biodiversity loss, promote connectivity and community livelihood, and safeguard resources and places for generations to come.

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APPENDIX I
List of Additional Relevance Data for Modeling Suitability

	Key Provisions
The Federal Land Policy and Management Act	<p>The term “areas of critical environmental concern” means areas within the public lands where special management attention is required (when such areas are developed or used or where no development is required) to protect and prevent irreparable damage to important historic, cultural, or scenic values, fish and wildlife resources or other natural systems or processes, or to protect life and safety from natural hazards (43 U.S.C. § 1702 (a))</p> <p>The Secretary shall prepare and maintain on a continuing basis an inventory of all public lands and their resources and other values (including, but not limited to, outdoor recreation and scenic values), giving priority to areas of critical environmental concern. This inventory shall be kept current so as to reflect changes in conditions and to identify new and emerging resource and other values (43 U.S.C. § 1711)</p>
43 C.F.R. § 1610 Designation of areas of critical environmental concern	<p>Areas having potential for Areas of Critical Environmental Concern (ACEC) designation and protection management shall be identified and considered throughout the resource management planning process (see §§ 1610.4-1 through 1610.4-9).</p> <p>(a) The inventory data shall be analyzed to determine whether there are areas containing resources, values, systems or processes or hazards eligible for further consideration for designation as an ACEC. In order to be a potential ACEC, both of the following criteria shall be met:</p> <p>(1) Relevance. There shall be present a significant historic, cultural, or scenic value; a fish or wildlife resource or other natural system or process; or natural hazard.</p> <p>(2) Importance. The above described value, resource, system, process, or hazard shall have substantial significance and values. This generally requires qualities of more than local significance and special worth, consequence, meaning, distinctiveness, or cause for concern. A natural hazard can be important if it is a significant threat to human life or property.</p> <p>(b) The State Director, upon approval of a draft resource management plan, plan revision, or plan amendment involving ACECs, shall publish a notice in the Federal Register listing each ACEC proposed and specifying the resource use limitations, if any, which would occur if it were formally designated. The notice shall provide a 60-day period for public comment on the proposed ACEC designation. The approval of a resource management plan, plan revision, or plan amendment constitutes formal designation of any ACEC involved. The approved plan shall include the general management practices and uses, including mitigating measures, identified to protect designated ACEC (43 CFR § 1610.7-2).</p>
BLM Manual 1613	<p>To be considered as a potential ACEC and analyzed in resource management plan alternatives, an area must meet the criteria of relevance and importance, as established and defined in 43 CFR §1610.7-2.</p> <p>A. Relevance. An area meets the “relevance” criterion if it contains one or more of the following:</p>

5. A significant historic, cultural, or scenic value (including but not limited to rare or sensitive archeological resources and religious or cultural resources important to Native Americans).
6. A fish and wildlife resource (including but not limited to habitat for endangered, sensitive, or threatened species or habitat essential for maintaining species diversity).
7. A natural process or system (including but not limited to endangered, sensitive, or threatened plant species; rare, endemic, or relic plants or plant communities that are terrestrial, aquatic, or riparian; or rare geological features).
8. Natural hazards (including but not limited to areas of avalanche, dangerous flooding, landslides, unstable soils, seismic activity, or dangerous cliffs). A hazard caused by human action might meet the relevance criteria if it is determined through the resource management planning process to have become part of a natural process.

B. Importance. The value, resource, system, process, or hazard described above must have substantial significance and values in order to satisfy the “importance” criteria. This generally means that the value, resource, system, process, or hazard is characterized by one or more of the following:

6. Has more than locally significant qualities that give it special worth, consequence, meaning, distinctiveness, or cause for concern, especially compared to any similar resource.
7. Has qualities or circumstances that make it fragile, sensitive, rare, irreplaceable, exemplary, unique, endangered, threatened, or vulnerable to adverse change.
8. Has been recognized as warranting protection to satisfy national priority concerns or to carry out the mandates of the FLPMA.
9. Has qualities that warrant highlighting to satisfy public or management concerns about safety and public welfare.
10. Poses a significant threat to human life and safety or to property (1613.11).

Special Management Attention. To be designated as an ACEC, an area must require special management attention to protect the important and relevant values... “Special management attention” refers to management prescriptions developed during preparation of an RMP or amendment expressly to protect the important and relevant values of an area from the potential effects of actions permitted by the RMP...[the management standards] would not be prescribed in the absence of the designation (1613.12).

APPENDIX II
List of Additional Relevance Data for Modeling Suitability

Relevance Criterion	Potential Data
1. A significant historic, cultural, or scenic value (including but not limited to rare or sensitive archeological resources and religious or cultural resources important to Native Americans).	Archeological sites, important sites to tribes, paleontological features, National Historic Highways, Backcountry Byways, Visual Resource Inventory (high sensitivity), wilderness areas and other existing specially designated areas (likely within 0-3 miles), other national/state scenic designations, Traditional Cultural Properties, sites listed on the National Register of Historic Places, Wild and Scenic Rivers
2. A fish and wildlife resource (including but not limited to habitat for endangered, sensitive, or threatened species or habitat essential for maintaining species diversity).	ESA listed animal species and associated habitat, critical big game habitat, wildlife corridors, connectivity hot spots, State Wildlife Action Plan data, stream segments important to fish species and fish passage
3. A natural process or system (including but not limited to endangered, sensitive, or threatened plant species; rare, endemic, or relic plants or plant communities that are terrestrial, aquatic, or riparian; or rare geological features).	ESA listed plant species and associated habitat, geological features, sensitive riparian areas, other sensitive plant occurrences, carbon sinks, areas with high biodiversity of plant species
4. Natural hazards (including but not limited to areas of avalanche, dangerous flooding, landslides, unstable soils, seismic activity, or dangerous cliffs). A hazard caused by human action might meet the relevance criteria if it is determined through the resource management planning process to have become part of a natural process.	Steep slopes in problematic avalanche and landslide zones, seismic activity data, steep or dangerous cliff areas

APPENDIX III
Count of Overlapping Polygon Layers in Each Potential ACEC

Western Wildlife			
OID_	OVERLAP_OID	ORIG_OID	ORIG_NAME
6	6	4	EthnographicAreas_Original_1
12	12	0	IndianPeaktoWallaces_Trail_Buff_1
20	20	0	SageGrouse_Final
29	29	11	Sensitive_Plants
38	38	0	UT_prarie_dog_CC_1
1104	376	8	EthnographicPoints_500m
		Count	6
Spring Creek Canyon			
OID_	OVERLAP_OID	ORIG_OID	ORIG_NAME
193	116	1	Ponderosa_Pine
194	116	0	UT_prarie_dog_CC_1
533	237	0	MuleDeer_Crucial
570	249	0	Spotted_Owl_1
794	307	0	Dominguez_Escalante_CC_1
1193	392	20	Sensitive_Plants
			VRM Class II
		Count	7
Ponderosa Pine			
OID_	OVERLAP_OID	ORIG_OID	ORIG_NAME
7	7	5	EthnographicAreas_Original_1
12	12	0	IndianPeaktoWallaces_Trail_Buff_1
35	35	29	Sensitive_Plants
38	38	0	UT_prarie_dog_CC_1
859	323	0	High_Soil_Sensitivity_Dissolve_1
		Count	5
Pinyon Penstemon			
OID_	OVERLAP_OID	ORIG_OID	ORIG_NAME
37	37	33	Sensitive_Plants
38	38	0	UT_prarie_dog_CC_1
147	93	0	High_Soil_Sensitivity_Dissolve_1
		Count	3
Parowan Gap			
OID_	OVERLAP_OID	ORIG_OID	ORIG_NAME
38	38	0	UT_prarie_dog_CC_1
63	51	8	Burrowing_owl_1
81	60	3	EthnographicAreas_Original_1
169	104	0	MuleDeer_Crucial
181	110	0	OldSpanishTrail_CC_1

201	120	0	SageGrouse_Final
339	172	0	Dominguez_Escalante_CC_1
549	242	0	Scenic_Byways1
		Count	8
Mineral Mountains			
OID_	OVERLAP_OID	ORIG_OID	ORIG_NAME
13	13	0	MuleDeer_Crucial
111	75	8	EthnographicAreas_Original_1
112	75	0	High_Soil_Sensitivity_Dissolve_1
			VRM Class II
		Count	3
Eastern Wildlife			
OID_	OVERLAP_OID	ORIG_OID	ORIG_NAME
11	11	0	High_Soil_Sensitivity_Dissolve_1
13	13	0	MuleDeer_Crucial
20	20	0	SageGrouse_Final
38	38	0	UT_prarie_dog_CC_1
45	42	0	Beaver_River_Final
55	47	0	Burrowing_owl_1
67	53	0	Dominguez_Escalante_CC_1
77	58	1	EthnographicAreas_Original_1
203	121	0	Sensitive_Plants
528	235	0	OldSpanishTrail_CC_1
531	236	0	Ponderosa_Pine
614	262	0	Boneville_cutthroat_1
		Count	12
Granite Peak			
OID_	OVERLAP_OID	ORIG_OID	ORIG_NAME
11	11	0	High_Soil_Sensitivity_Dissolve_1
13	13	0	MuleDeer_Crucial
			VRM Class II
		Count	3