Ecosystem Representation in the Custer Gallatin National Forest

These comments address the role of ecosystem representation in the Custer Gallatin National Forest's land management planning process – particularly its evaluation of areas that may be suitable for inclusion in the National Wilderness Preservation System (NWPS). As explained below and illustrated by the accompanying maps and data, the Custer Gallatin National Forest hosts numerous ecosystem types that are poorly-represented in the NWPS both regionally and nationally. Given the central importance of ecosystem diversity to conserving biological diversity and satisfying the requirements of the 2012 National Forest System Land Management Planning Rule, 36 C.F.R. part 219, the ongoing wilderness evaluation and planning process presents a crucial opportunity for the Custer Gallatin National Forest to increase the diversity of ecosystems that are protected as part of the NWPS or through other special designations.

I. Ecological Importance of Ecosystem Representation in Wilderness and Other Protected Areas

Wilderness and other protected conservation areas are the cornerstones of most regional, national, and international efforts to conserve biological diversity and ecological processes of natural ecosystems (Bertzky *et al*. 2012). Research has shown that protected areas reduce the loss, degradation, and fragmentation of natural habitats (Bruner *et al*. 2001; Naughton-Treves *et al*. 2005) and slow the rate of extinction of threatened species that occur therein (Butchart *et al*. 2012). Conversely, federal public lands in the United States that are managed for a variety of uses including mining, logging, and motorized recreation – and not primarily for conservation purposes – do not have the same benefits. Recognizing the central importance of protected areas in conserving biological diversity, the International Convention on Biological Diversity recommends that at least 17% of the world's terrestrial areas be conserved by 2020 (Woodley *et al*. 2012). To that end, the NWPS already serves as the world's largest national system of highly-protected conservation areas.[1]

Wilderness and other protected areas, however, can help achieve biodiversity targets only if they are located in the right places – that is, if they are ecologically representative of terrestrial ecosystems. This "representation" approach assumes that for protected areas to conserve genetic, species, and community diversity – as well as the composition, structure, function, and evolutionary potential of natural systems – they

[1] The NWPS contains 21 million hectares in 690 units, covering nearly 1/5 of what the International Union for Conservation of Nature (IUCN) classifies as "category 1 areas," or the most natural and highly protected areas worldwide. By contrast, the IUCN classifies general Forest Service matrix lands as "GAP Status 3" – "Area having permanent protection from conversion of natural land cover for the majority of area. Subject to extractive uses of either broad, low-intensity type (eg. Logging) or localized intense type (eg. Mining)." – which is not considered a "protected" category for biodiversity purposes.

must encompass the full variety of ecosystems (Olson & Dinerstein 1998; Margules & Pressey 2000). In other words, protection of distinct ecological communities in turn protects the species that rely on them and the natural ecological processes that are characteristic of those ecosystems (Rodrigues *et al*. 2004; Bunce *et al*. 2013). According to the Convention on Biological Diversity, the percentage of terrestrial ecosystems protected by 2020 (with a target of 17%) is one indicator of how well ecosystems are represented throughout the global network of protected conservation areas (Woodley *et al*. 2012).

Despite its importance, our analysis of ecosystem representation in the NWPS (Dietz *et al.* 2015) – which is described in detail below – shows that the NWPS suffers from a significant under-representation of many ecosystems. Over 20% (117) of the 553 types of unique ecosystems occurring on federal lands in the contiguous United States are not included in the NWPS. Even more concerning is that less than half of those 553 ecosystems are more than nominally represented: only 244 ecosystem types have at least 5% of their federal land area protected in the NWPS. And at a more reasonable 20% target for biodiversity conservation purposes, that number falls to only 113 ecosystems with at least 20% of their federal land area protected in the NWPS. 95% of that diversity was achieved by 1994, and wilderness designations over the past 15 years have added only 1 new ecosystem type above the 20% threshold. Moreover, there is not a clear correlation between how rare an ecosystem is on federal lands and how well it is represented in the NWPS. We found that there are many ecosystem types that are common on federal lands (covering over 100,000 hectares) but are poorly represented in the NWPS.

Following the 50th anniversary of the Wilderness Act (signed into law on September 3, 1964), it is important to begin to remedy this under-representation of ecosystems in the NWPS. Human population growth, climate change, and pressure for development and extraction of natural resources make wilderness and other protected areas increasingly vital to conserve biological diversity. Given those pressures and stressors, we must establish a network of connected wilderness and other protected areas that represent the full expression of ecosystem diversity.

II. Regulatory Requirements to Evaluate Ecosystem Representation

Given the regional, national, and global importance of ecosystem representation in the NWPS and other protected areas, the 2012 National Forest System Land Management Planning Rule requires the Forest Service to evaluate and incorporate ecosystem representation into its forest assessment and planning processes. Indeed, protecting ecosystem diversity is a central purpose of forest planning under the Rule:

> Plans will guide management of [National Forest System] land so that they are ecologically sustainable and contribute to social and economic sustainability; ***consist of ecosystems and watersheds with*** ecological

> integrity and ***diverse plant and animal communities***; and have the capacity to provide people and communities with ecosystem services and multiple uses that provide a range of social, economic, and ecological benefits for the present and into the future.

36 C.F.R. § 219.1(c) (emphasis added).

To satisfy the 2012 Planning Rule's ecosystem diversity mandate, forests are first required to identify and evaluate existing designated areas, including wilderness, and the potential need and opportunity for additional designated areas as part of the assessment phase. *Id.* § 219.6(b)(15). In doing so, the assessment should consider, among other things, whether there are "specific land types or ecosystems present in the plan area that are not currently represented or minimally represented within the wilderness system or system of research natural areas." Forest Service Handbook (FSH) 1909.12, ch. 10, § 14 (Feb. 14, 2013 draft).

Next, during the plan development or revision phase, the Forest Service is required to "[i]dentify and evaluate lands that may be suitable for inclusion in the [NWPS] and determine whether to recommend any such lands for wilderness designation." 36 C.F.R. § 219.7(c)(2)(v). In evaluating potential wilderness areas, the agency must, among other things, "[e]valuate the degree to which the area may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value." FSH 1909.12, ch. 70, § 72.1(4); *see also* 16 U.S.C. § 1131(c)(4) (wilderness, as defined by the Wilderness Act of 1964, "may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value"). "Such features or values may include[r]are plant or animal communities or rare ecosystems," with rare being "determined locally, regionally, nationally, or within the system of protected designations." FSH 1909.12, ch. 70, § 72.1(4).

In addition to identifying and evaluating areas to recommend for wilderness designation, the 2012 Planning Rule also requires the agency to "[i]dentify existing designated areas other than [wilderness] and determine whether to recommend any additional areas for designation." 36 C.F.R. § 219.7(c)(2)(vii). Those special designations may include, for example, ecological areas, botanical areas, or Research Natural Areas (RNAs), which are designed to "[m]aintain a wide spectrum of high quality representative areas that represent the major forms of variability . . . that, in combination, form a national network of ecological areas for research, education, and maintenance of biological diversity . . . [and s]erve as a baseline area for measuring long-term ecological changes." Forest Service Manual 4063.02; *see also* 36 C.F.R. § 219.19 (Forest Service may designate RNAs as part of planning process).

Complementing the requirement to consider ecosystem representation in determining suitability for wilderness and other special designations, the 2012 Planning Rule directs that plans generally provide for ecological sustainability and integrity and "the diversity

of plant and animal communities and the persistence of native species." 36 C.F.R. §§ 219.8-219.9. The Forest Service cannot satisfy those substantive mandates without adequately protecting ecosystem diversity in the plan area. For example, plans "must include plan components, including standards or guidelines, to maintain or restore the diversity of ecosystems and habitat types[, including r]are . . . plant and animal communities." *Id.* § 219.9(a)(2). With conflicting management and resource demands and human-caused stressors such as climate change that threaten ecosystem diversity and integrity, plans simply cannot restore or maintain the diversity of plant and animal communities absent a robust network of protected areas that adequately represent that diversity.

Collectively, these various procedural and substantive mandates commit the agency to a meaningful evaluation and consideration of under-represented and rare ecosystems, and to formulating and adopting plan components, recommendations, and designations that adequately protect and preserve the forest's diversity of plant and animal communities. In doing so, the agency is required to use "the best available scientific information." *Id.* § 219.3. As described in the methodology section below, we believe our analysis of ecosystem representation represents the best available scientific information, and we encourage the Forest Service to incorporate it into its wilderness evaluation and the broader planning process.

III. Methods and Analysis of Ecosystem Representation

Because the Custer Gallatin Forest Assessment did not address it, we conducted an analysis of ecosystem representation in wilderness at the national- and forest-level scales to provide the best available scientific information for the ongoing wilderness evaluation and forest planning processes.

According to the U.S. Geological Survey (USGS), the contiguous United States contains 565 terrestrial, non-developed ecosystems. In this study, we analyzed representation of those ecosystems by comparing their areas in the NWPS with their areas on federal land at both the national and forest levels in order to calculate a percent representation:

> Equation 1: *(area of ecosystem in the NWPS/area of ecosystem on federal land)*100*[2]
>
> Equation 2: *(area of ecosystem in the NWPS on the* Custer Gallatin *NF/area of ecosystem on the* Custer Gallatin *NF)*100*

[2] We used federal land, as opposed to all land, within the contiguous United States to better assess where ecosystems are under-represented on lands potentially available for wilderness designation.

We conducted these calculations at the finest scale for which consistent, spatially-explicit vegetative land-cover data is available: the 6th level of the National Vegetation Classification System (NVCS 2008).[3] That data is from the USGS Gap Analysis Program (GAP) national land-cover data version 2 at 30-meter resolution (USGS 2011).

We obtained spatial data of the NWPS from the University of Montana College of Forestry and Conservation's Wilderness Institute at wilderness.net, which maintains the most up-to-date spatial data on wilderness areas. To map federal land area, we used the U.S. Protected Areas Database (PAD-US) version 1.3 (USGS 2012), which includes geographic boundaries, land ownership, land management, management designation, parcel name, area, and protection category.[4]

We overlaid the NWPS and all federal lands with land-cover data in a Geographic Information System (ArcGIS 10.2) to calculate and compare the total area of each ecosystem within the NWPS and federal land. We then calculated the percent of each ecosystem within the NWPS based on all area occurring on federal land (Equation 1, above).[5] This was part of a national assessment that we conducted (Dietz *et al.* 2015).

We did the same calculations at the forest level. We extracted land-cover data and clipped it to the forest boundary, and then calculated the percent of each ecosystem within the Custer Gallatin's 3 existing wilderness areas based on all federal land area occurring on the Forest (Equation 2, above).

Next we classified representation for each scale into four classes (<5%, 5-9.9%, 10-19.9%, ≥20%) and mapped them across the entire national forest. We considered ecosystems with <19.9% of their total area in the NWPS as inadequately represented. Ecosystems that represent human development or interaction with the landscape (i.e. Developed, High Intensity or Pasture / Hay) were excluded from the analysis.

We then brought the USFS wilderness inventory data for the Custer Gallatin National Forest into ArcMap and created a new shapefile that included only the inventoried areas. This allowed us to focus our analysis on the areas that are potentially suitable for wilderness designation by tabulating the area of each ecosystem occurring within each wilderness inventory area (see attached matrix, "Ecosystem Composition of Wilderness

[3] The NVCS classifications are as follows: 1) Class; 2) Subclass; 3) Formation; 4) Division; 5) Macrogroup; **6) Group (a.k.a. ecological system, to which we refer in this study as "ecosystem")**; 7) Alliance; and 8) Association.

[4] The PAD-US is a national inventory of terrestrial and marine protected areas that are managed to preserve biological diversity and other natural, recreation, and cultural uses.

[5] For example, when we say "boreal aspen-birch forest has 19% representation in NWPS," we mean that 19% of all federal land encompassing that ecosystem type is protected as wilderness in the NWPS.

Inventory Areas.xlsx"). Values within the matrix are the estimated acres of each ecosystem occurring within each wilderness inventory area.

We used these data to calculate the proportion (%) of each wilderness inventory unit that is composed of ecosystems inadequately represented in the NWPS by each of the 3 lower representation classes (<5%, 5-9.9%, 10-19.9%) and for both scales of representation. For example, we calculated that 30% of Inventory Unit #5 is in under-represented ecosystem types.

IV. Results

Our analysis shows that a majority of the wilderness inventory units contain high proportions of underrepresented ecosystems at both the forest level and national scales (Tables 1 & 2; Maps 2 & 3). Out of the 73 wilderness inventory areas on the Custer Gallatin, 63 units have over 50% coverage coverage of underrepresented ecosystems on the federal level. On the forest level, 28 units are mostly composed of underrepresented ecosystems. Cumulatively, over 65% of the inventory area is underrepresented on the federal level. On the forest level, underrepresented ecosystems span approximately 39% of the inventory area.

In many instances, the addition of one wilderness inventory unit would elevate an underrepresented ecosystem into adequate representation on the forest level (Table 4). For example, adding Wilderness Inventory Units #13 elevates both the Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland, as well as the Western Great Plans Riparian Woodland and Shrubland, to >20% representation. Similarly, if Wilderness Inventory Unit #34 were established as wilderness, two ecosystems would be adequately represented at the forest level (Northern Rocky Mountain Montane-Foothill Deciduous Shrubland, Northern Rocky Mountain Ponderosa Pine Woodland and Savanna). In addition to these four ecosystems, 15 more would be adequately represented on the forest level with the addition of one wilderness inventory unit.

More broadly, our analysis found that 43 of the 76 ecosystem types found on the Custer Gallatin are underrepresented in wilderness on the forest level (Table 3, Tabs 1 & 2). The story is even extreme on the federal level, with only 26 out of the 76 ecosystems showing adequate representation (Table 3, Tabs 1 & 3) Underrepresented ecosystems on the forest level cover over 36% (1,263,164 acres) of the Custer Gallatin National Forest, with federally underrepresented ecosystems spanning over 60% (2,088,877 acres) of the forest.

Notably, many under-represented ecosystem types on the Custer Gallatin are also some of the most common (Table 3, Tabs 2 & 3). For example, the Middle Rocky Mountain Montane Douglas-fir Forest and Woodland spans roughly 14% of the forest (490,373 acres) and is underrepresented in both forest and federal levels of representation. Other common ecosystems spanning over 100,000 acres of the forest but showing

inadequate representation on both forest and federal levels include the Northwestern Great Plains – Black Hills Ponderosa Pine Woodland and Savanna, the Northwestern Great Plains Mixedgrass Prairie, and the Inter-Mountain Basins Big Sagebrush Steppe. Both the Northwestern Great Plains Mixedgrass Prairie and the Inter-Mountain Basins Big Sagebrush Steppe fall into the most severe category of underrepresentation on federal and forest levels (<5%).

The attached maps and tables depict these results in detail, showing the following:

Map 1 "USFS Wilderness Inventory Units, Custer Gallatin National Forest": Depicts each unit (polygon) in the wilderness inventory, outlined in black with hash marks, and with the forest boundary shaded green.

Map 2 "Ecosystem Representation on the Federal Level": Color depiction of the results of Equation 1 (above), showing the level of representation in the NWPS of each ecosystem type at the national scale. For example, areas shown in red depict ecosystems that are represented in the NWPS at less than 5% of all available federal land. [inventory units outlined in black with cross-hatching]

Map 3 "Ecosystem Representation on the Forest Level": Color depiction of the results of Equation 2 (above), showing the level of representation in the NWPS of each ecosystem type at the forest level. [inventory units outlined in black with cross-hatching]

Table 1, Tabs 1 & 2 "Custer Gallatin National Forest Inventory Representation": Proportion (%) and acreage of each wilderness inventory unit composed of under-represented ecosystem types on the Custer Gallatin National Forest based on forest-level (Tab 1) or national-level (Tab 2) representation. Representation of each ecosystem type was quantified based on all available area on federal land and the individual forest. All ecosystems with <20% representation in the NWPS at each scale were broken into 3 levels of representation (<5%, 5-9.9%, and 10-19.9%). This table allows one to prioritize potential wilderness inventory units by proportion of land area as well as acreage that is composed of underrepresented ecosystems, at three levels.

Table 2 "Ecosystem Composition of Wilderness Inventory Areas": Values within the matrix are the estimated acres of each ecosystem type occurring within each wilderness inventory unit. This table depicts the specific ecosystem composition of each inventory unit.

Table 3, Tabs 1-3 "Custer Gallatin National Forest Ecosystems Representation": These tables depict which ecosystems are under-represented at the forest-level and national scales. Tab 1 shows a complete list of ecosystem types found on the Custer Gallatin National Forest, and the proportion of each type in the NWPS at the forest-level and national scales. Tabs 2 and 3 show representation breakdowns at the three levels (<5%, 5-9.9%, and 10-19.9%) at the forest-level and national scales.

Table 4 "Wilderness Inventory Unit Analysis of Ecosystem Composition": This table shows the estimated acres of each ecosystem type occurring within each wilderness inventory unit. This table also shows how many acres of additional protection are needed to elevate a particular ecosystem into adequate representation, and how many units would be needed (if applicable) to achieve adequate representation on the forest level.

V. Recommendations

Sufficient ecosystem representation in the NWPS and other protected areas is crucial to achieving ecological integrity of the diverse plant and animal communities found in the Custer Gallatin National Forest. As described above and depicted in the attached maps and tables, our analysis shows that under-representation of ecosystems in the NWPS is a significant problem on the Custer Gallatin Our analysis also shows that the majority of lands in the wilderness inventory units contain under-represented ecosystem types. Thus, the ongoing wilderness evaluation and planning process presents the Forest Service with a critical opportunity to prioritize protection of ecosystem diversity and begin to remedy the under-representation of numerous ecosystem types in the NWPS.

To that end, we urge the Custer Gallatin National Forest to use the representation information in the attached tables and maps and described above to evaluate the importance of each inventoried area in achieving diverse ecosystem representation in wilderness at the regional and national scales.[6] In addition, the forest should use this information more broadly in its planning process and determinations whether to designate or recommend for designation other areas such as RNAs, ecological or botanical areas, etc. As described above, we believe that this information is the best available science on ecosystem representation, which the agency is legally required to use in its planning process.

If you have any questions about the analysis or data, or would like to have the data in another format, please contact Phil Hartger (phil_hartger@tws.org).

[6] For example, Region 5 has made exceptional efforts to incorporate our analysis into the wilderness evaluation processes for the Inyo, Sequoia, and Sierra National Forests. The Region's wilderness team prepared a data summary for each inventoried unit, ranked by percent composition of under-represented ecosystems, to assess the relative opportunities in each unit to enhance ecosystem diversity. Those summaries are attached hereto.

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