Developing Standardized Strategic Response Categories for Fire Management Units

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Introduction: Fire Management Units, Strategic Objectives, and Response Categories

Federal wildland fire policy requires that publicly owned lands with burnable vegetation have a fire management plan (FMP); this applies to the five primary Federal fire agencies (Bureau of Indian Affairs, Bureau of Land Management, National Park Service, U.S. Fish and Wildlife Service, and Forest Service). FMPs are based on land and resource management plans and are intended to provide guidance for managers responding to wildland fire incidents. FMPs summarize information on the basis of fire management units (FMUs), which divide landscapes into smaller geographic areas according to biophysical and socioeconomic characteristics. FMU-level guidance for incident response is tailored according to these characteristics <http://wfdss.usgs.gov/wfdss/pdfs/Geospatial_data_stnd.pdf>.

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FMUs are thus fundamentally premised on spatial information. Variation in FMU management guidance reflects underlying spatial variation in factors influencing fire occurrence and behavior; in jurisdictional boundaries; and in the pattern, density, and extent of fire-susceptible resources and assets and their respective degrees of susceptibility to fire (considering both beneficial and negative impacts).

Management guidance for FMUs describes FMU-specific objectives, desired conditions, and approved wildland fire management strategies. Agency administrators rely on this information to navigate complex decision processes for managing active wildland fire incidents, specifically setting overarching incident strategies consistent with strategic objectives and management requirements of land and resource management plans and FMPs. This guidance, coupled with the spatial decision support tools and decision documentation functionality within the Wildland Fire Decision Support System (WFDSS), helps agency administrators develop risk-informed responses to incidents.

The same five Federal fire agencies are required to use the WFDSS for incident response. Increasingly, the WFDSS is also being used to house data relating to FMUs, including geospatial polygon boundaries and FMU strategic objectives. Though neither exhaustive nor required, the coverage of uploaded FMUs is quite extensive (thousands of FMUs), and we anticipate continued uploading and refinement of data from the field. Spatial data on FMUs are uploaded four times a year, and written objectives are uploaded by individual units as appropriate. The spatial size of the FMUs that were uploaded into WFDSS varies greatly—from less than an acre to more than 8 million acres. The median size is approximately 29,000 acres. For more information on FMU geospatial data, see the WFDSS Web site at <http://wfdss.usgs.gov/wfdss/WFDSS_FMU_Downloads.shtml>.

We undertook an exploration of these data to better understand how fire management objectives and corresponding planned incident responses vary across landscapes and ownerships throughout the United States. By capturing com-

mon themes across FMUs, we were able to establish a broad set of four standard response categories for purposes of classification. In this paper, we describe our methods for assigning FMUs to each of these categories, and we present results for the FMUs for which we have data.

Our results reflect a work in progress, but we believe it is important to review lessons learned to date, including the importance of clarity and completeness in the definition of objectives and the distinction between "fundamental" and "means" objectives (see box, Defining Objectives). Further, we illustrate how this information can be used to evaluate the consistency of incident decisions with FMP and FMU objectives, and we highlight how a stronger integration of FMU information within WFDSS could facilitate development of spatial FMPs. Because FMPs and FMUs evolve over time as new information becomes available and as conditions change, and because field staff best know their landscapes and their management objectives, it will ultimately be more desirable for field units to self-assign FMU-specific response categories.

Assigning Response Categories

The first step in our analysis was to download data for all FMUs with polygons uploaded into WFDSS. This dataset included fields for a unit name, unit description, agency, and, critically, text with strategic objectives. We then comprehensively reviewed these objectives in order to identify and define a standard set of incident response categories. While the *fundamental* objectives (for example, protect homes and infrastructure, protect critical habitat, and restore and maintain fire-adapted ecosystems) across FMUs will vary greatly owing to heterogeneity in biophysical and socioeconomic characteristics, we can come up with a standard set of *means* objectives that describe how incident responses will achieve the fundamental objectives.

We arrived at four broad incident-response categories, with sub-categories defined to further capture nuance. Categories at the extreme ends have little decision space, mandating either a full suppression response (category 1) or effectively the opposite (category 4). Categories 2 and 3 have greater decision flexibility, considering a balance of objectives between suppression costs, values at risk, and ecological benefits from fire (firefighter safety is an omnipresent concern).

We focused only on natural ignitions, where there generally is more flexibility for incident response. For methodological consistency, we categorized FMUs based solely on the strategic objective text. Our response category classification scheme is defined below:

1. Suppress all fires at smallest size, and cost is not a consideration;
2. Suppress all fires, considering tradeoffs:
   A. Consider costs, and
   B. Consider values at risk;
3. Make a real-time agency administrator decision for resource benefits (formerly the fire use go/no go decision):

Defining Objectives

It is not a simple task to articulate objectives: ends can be confused with means, objectives can be confused with management requirements or other constraints, and relationships between objectives may not be immediately obvious. Here, we distinguish between *fundamental* and *means* objectives.

Fundamental objectives relate to aspirations and desired outcomes for the fire management unit's (FMU) geographic area; these can include ecological, economic, social, and cultural dimensions. It is imperative that these objectives are clear, concise, measurable, and consistent with guidance in fire management plans and land and resource management plans.

Means objectives, by contrast, are methods to achieve fundamental objectives. For example, in an FMU that contains or is proximal to an area with a high density of resources and assets that are susceptible to fire-related loss, full suppression might be the means objective to achieve the fundamental objective of resource and asset protection.

Our response categories directly relate to means objectives; that is, they categorize the decision space for how fires will be managed, not the underlying rationale for why they will be managed that way. Our premise is that the most useful information contained within FMU strategic objectives would articulate fundamental objectives as well as means objectives.

A. Resource benefit optional—recognizing ability to manage fire for resource benefits, and
B. Resource benefit promoted—promotes management of fire for resource benefits; and

4. Preplanned agency administrator decisions are used to monitor all fires, and fire is managed as necessary to achieve protection or restoration objectives.

We further identified two additional categories, indicating whether no strategic response was provided (that is, strategic objectives were not uploaded into WFDSS with the polygon boundaries) or where strategic responses were unclear. There were multiple reasons why we identified responses as unclear. In some cases, there exists broader guidance (for example, "fire for resource benefit is authorized park-wide") uploaded into WFDSS, but a lack of FMU-specific text. In other cases, FMUs might have a suggestive descriptor value (for example, "full suppression"), but the actual text itself did not specifically provide information on objectives and response to fire. Some objectives were simply too vague (for example, "make appropriate suppression response to all wildfires"). Lastly, strategic objectives in a small number of cases seemed contradictory (for example, "unplanned ignitions are used to restore and maintain historic fire regimes… unplanned ignitions are generally suppressed to minimize the acreage burned").

Results

These preliminary findings are limited to FMUs within the contiguous United States. (CONUS) and are current as of September 6, 2012. Of a total of 3,165 FMUs with uploaded polygon boundaries, 1,448 FMUs provided strategic response information. Of these, we identified 273 FMUs as "strategic response unclear," leading to a total of 1,175 FMUs with assigned strategic response categories. The total areal extent of FMUs with uploaded polygon boundaries was 455.47 million acres, 58.71 million of which were associated with unclear responses.

Figure 1 displays a color-coded map of strategic response categories for the 3,165 FMUs. The

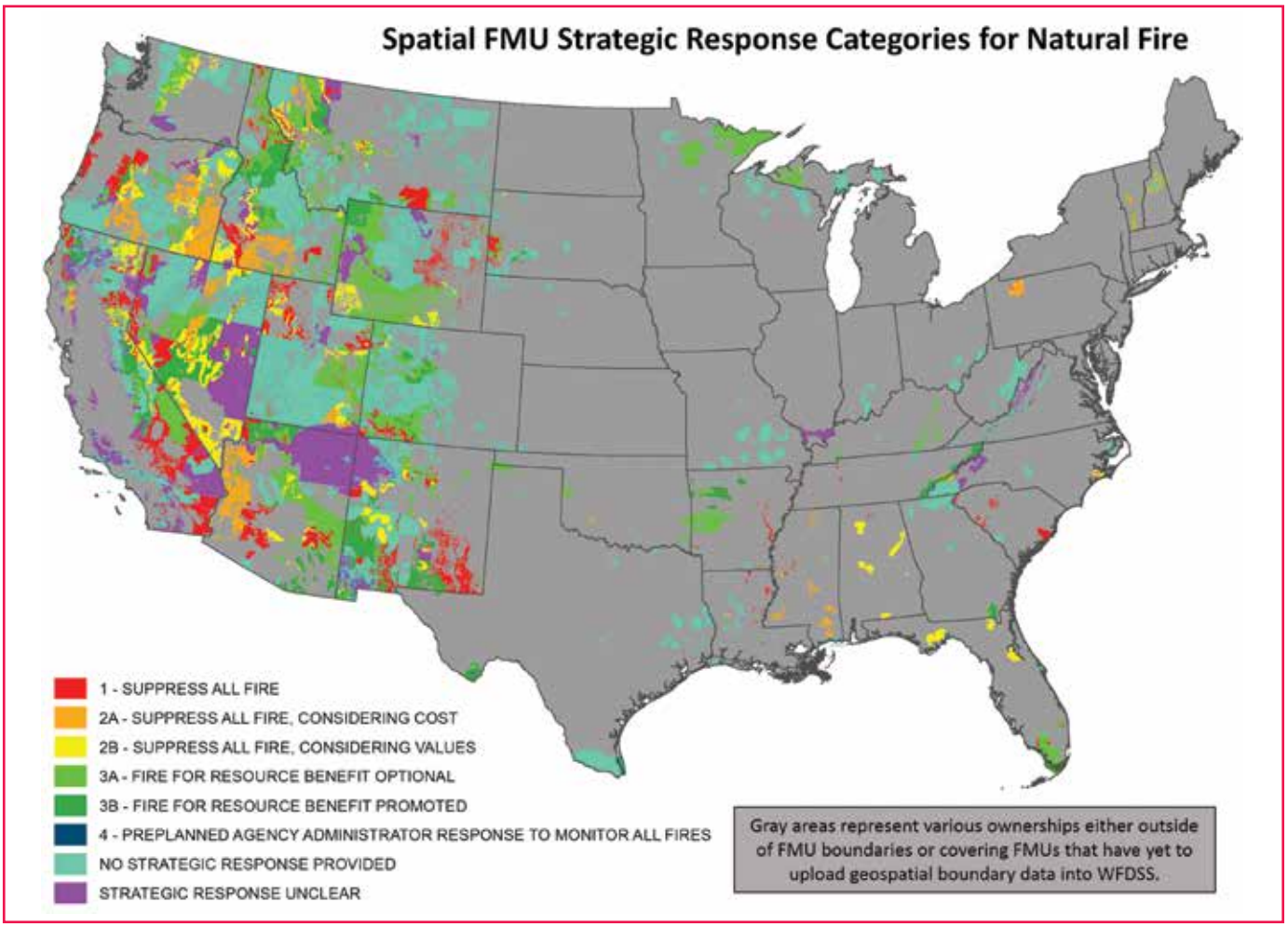

Figure 1. —*Spatial fire management units strategic response categories for natural fires.*

map exhibits spatial heterogeneity throughout the country, with many Western States encompassing the range of strategic responses. Whereas FMUs with categories 1 and 2 appear slightly more spread out, there are large contiguous areas of category 3, especially in the West. This result is influenced by vast tracts of Federal land such as the Frank Church River of No Return Wilderness or the Greater Yellowstone area. Only one FMU, in the Southwest, was assigned to category 4; however, it is expected that adding FMUs from Alaska would increase the extent of category 4 assignments. Figure 2 summarizes the areal percentages of all FMUs in each response category. There exist large areas for which strategic responses either were not provided (37.8 percent) or were unclear (12.9 percent). Category 1 accounted for 9.4 percent, category 2 accounted for 13.7 percent, and category 3 accounted for 26.2 percent of the total FMU area. Exclusive of FMUs that did not provide a strategic response, category 1 accounts for 15.1 percent, category 2 for 22.1 percent, and category 3 for 42.2 percent of FMU area.

Table 1 summarizes the breakdown of FMU strategic response categories according to geographic coordinating areas (GCAs; fig. 3), by areal percentages. Most GCAs have roughly the same areal percentage with either none or unclear strategic responses—about half of the total FMU area within each GCA—but the relative breakdown varies significantly. In the Eastern Area (EAA), East Basin (EBA), Northern Rockies (NRA), Northwest (NWA), Rocky Mountain (RMA), and Southern (SAA) Coordination Centers, the dominant issue preventing assignment of response categories is that information on strategic responses was not provided. In the Northern California (ONA), Southern California (OSA), Southwest Area (SWA), and West Basin (WBA) coordinating areas, unclear responses are as much or more of an issue preventing assignment of response categories.

The OSA has by far the highest areal percentage of category 1 (24.63 percent) followed by the ONA (15.68 percent) and the SWA (13.01 percent). We might expect an even greater degree of category 1 in some locations due to high population densities proximal to flammable landscapes, if and when more data are uploaded and/or clarified. NWA (30.72 percent) had the largest overall areal percentage in category 2 followed by the WBA (22.11 percent). The NRA (38.62 percent), RMA (34.82 percent), EAA (31.03 percent), and SWA (30.37 percent) had the highest areal percentage in category 3.

Table 2 similarly summarizes the breakdown of FMU areal percentage by strategic response category, but according to land management agency. The Forest Service and Bureau of Land Management (BLM) constitute the largest share of uploaded FMU area. By contrast the U.S. Fish and Wildlife Service (UWFWS) and State agencies (STATE) constitute very little area indeed, and of this area most FMUs provided no strategic responses. The Bureau of Indian Affairs (BIA) had the largest degree of unclear responses.

The BLM has the greatest share of category 1 at 14.86 percent, followed by USFWS at 13.34 percent (but this represents a relatively small amount of land, see column 2 in table 2), followed by the BIA at 11.89 percent. BLM has the greatest share of category 2 (16.93 percent) followed by the Forest Service (15.63 percent). The National Park Service has the greatest share of acreage in category 3 (45.48 percent), and a minimal amount in categories 1 and 2.

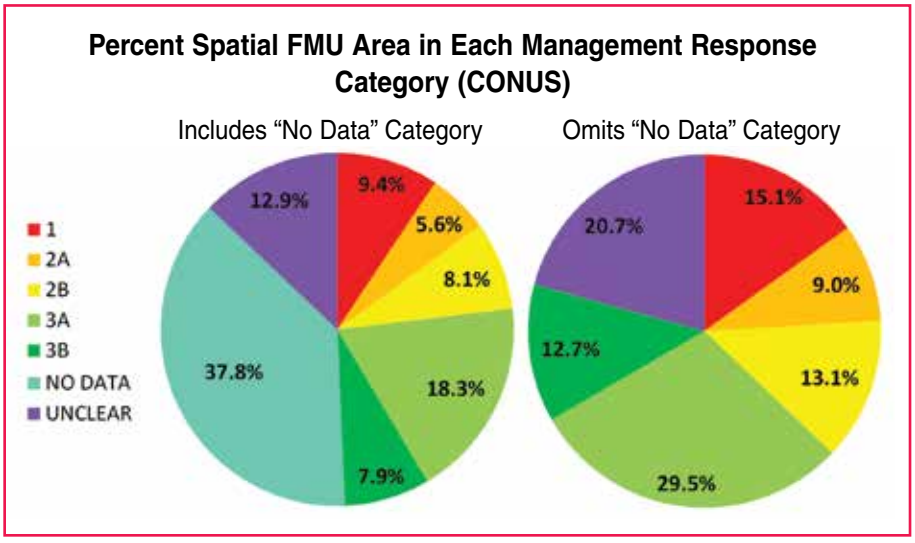

Figure 2.—*Percentage of spatial fire management units area in each management response category (CONUS).*

Table 1.—*Fire management units area percentages in each strategic response category, by geographic coordinating area (CONUS only).*

GCA	TOTAL spatial FMU area	Strategic response category							
		1	2A	2B	3A	3B	4	No data	Unclear
		Areal Percentages							
EAA	**21.02**	0.00	6.43	0.14	31.03	0.00	0.00	57.50	4.90
EBA	**72.62**	8.16	6.15	9.61	17.21	6.21	0.00	47.34	5.31
NRA	**47.83**	7.93	2.15	6.02	24.65	13.97	0.00	41.84	3.43
NWA	**46.09**	6.83	18.55	12.17	11.71	2.45	0.00	42.13	6.16
ONA	**18.70**	15.68	3.91	12.31	6.42	5.62	0.00	34.94	21.13
OSA	**30.69**	24.63	0.00	2.18	14.50	6.91	0.00	26.33	25.45
RMA	**54.65**	7.48	0.07	4.13	31.50	3.31	0.00	51.57	1.92
SAA	**31.06**	6.15	4.80	9.37	21.42	8.95	0.00	41.80	7.50
SWA	**79.08**	13.01	7.01	4.77	16.89	11.73	0.16	21.11	25.32
WBA	**53.75**	5.69	4.22	17.88	8.32	12.08	0.00	25.49	26.31
CONUS	**455.47**	9.38	5.59	8.13	18.34	7.87	0.03	37.78	12.89

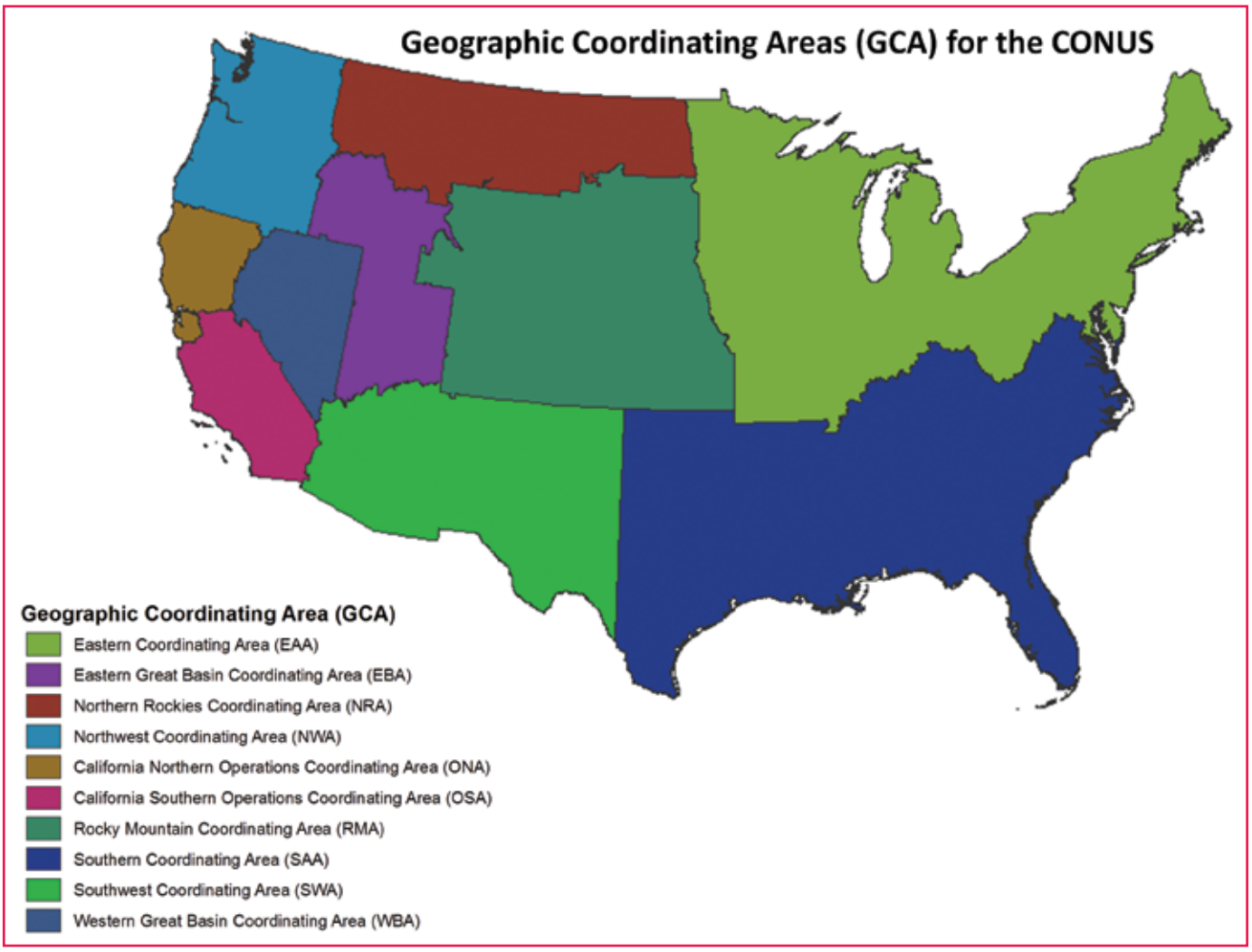

Figure 3.—*Geographic coordinating areas (GCA) for the CONUS.*

Table 2.—*Fire management units area percentages in each strategic response category, by land management agency (CONUS only).*

Land management agency	Total spatial FMU area	Strategic response category							
		1	2A	2B	3A	3B	4	No data	Unclear
		Areal Percentages							
BIA	**46.00**	11.89	1.63	3.41	10.13	0.17	0.00	27.07	45.68
BLM	**170.51**	14.86	9.44	7.48	14.36	5.70	0.00	35.49	12.67
National Park Service	**25.23**	2.26	0.59	0.36	29.50	15.98	0.04	45.84	5.43
State	**9.58**	1.98	0.00	2.71	10.11	1.04	0.00	83.63	0.52
Forest Service	**196.74**	5.16	4.29	11.35	23.28	10.93	0.00	37.58	7.42
USFWS	**7.41**	13.36	0.81	0.27	3.10	5.67	0.00	75.98	0.94
CONUS	**455.47**	9.38	5.59	8.13	18.35	7.87	0.03	37.79	12.89

Some Examples of Clear Strategic Responses

1 Full suppression; fire is not recognized as a natural process. This ecosystem is not suitable for fire; rapid suppression techniques will be emphasized.

1 Because of human development, fire can no longer be tolerated without significant risk or economic loss. All wildland fires, regardless of ignition source, will be a high priority and will receive prompt suppression actions to minimize fire size.

2A Fire suppression strategies will continue to call for suppression of all fires. However, as a cost-saving measure, fires in high-elevation areas with sparse vegetation may be contained or confined; low-risk fires may not always be extinguished as quickly as in the past.

2A All wildland fires will be suppressed using the full range of strategic and tactical operations…. Wildland fires are suppressed at minimum cost….

2B Respond to wildland fires by taking suppression actions commensurate with human and natural resource values at risk.

2B Fire management responses can be direct aggressive control strategies through less intense control actions commensurate with specific incident needs and objectives. These responses should be based on an evaluation of risks to firefighter and public safety, the circumstances under which the fire occurs, including weather and fuel conditions, natural and cultural resource management objectives, protection priorities, and values to be protected.

3A …Wildland fire may be managed through a full range of strategies from prompt and full suppression to management of both human-caused and natural fires for resource benefits.

3A Aggressive suppression action, consistent with firefighter safety, will be taken for wildfires in proximity to private property, highways, or known endangered species locations. Natural fires in remote areas will be allowed to follow a natural course as long as there are no values threatened.

3B Use wildland fire to the extent possible to return fire as a natural ecological process.

3B Use planned fire use and surrogate fire treatments to restore and maintain primary natural resources and their processes where applicable.

4 All fires are to be managed with resource benefit objectives. There are no fire exclusion areas.

Discussion and Conclusions

Several key lessons learned in this study lead to a number of logical future developments in the realm of spatial fire management planning and spatial decision support. First, however, we should address some limitations. In this work, we present only a snapshot of a dynamic management environment. The ultimate aim is not a static color-coded map but rather an evolving system in which clear and complete fire management objectives and planned responses are spatially referenced, updated as necessary, and most importantly, help inform incident management.

Our results are, of course, not binding and are assuredly not correct in all circumstances. Fundamental objectives may have been well-written, but we did not take the step of making inferences if means objectives (that is, incident responses) were omitted. We may have misinterpreted language, and what was unclear to us may be quite clear to the person who uploaded the information. Further, some FMUs might be too heterogeneous for a single response category to be appropriate, thus arguing for further spatial delineation on the basis of areas with consistent response.

Spatial fire management plans (SFMPs) are currently being developed by several U.S. Department of the Interior agencies. In this effort, several units are using fire management zones (FMZs) in lieu of FMUs. The zones represent areas of consistent response categories on the landscape. In future SFMP efforts, the results of the FMU analysis could provide a standard "pick list" of response categories. The pick list would expedite the crosswalk of land and resource management plans to SFMP strategic objectives or FMZ spatial data layers. Greater spatial delineation could provide increased consistency of response categories: unclear or variable FMU responses might become much clearer when further separating the FMU into a wildland-urban interface FMZ and a roadless area FMZ, for instance.

It appears that many fire management units could benefit from a more clear articulation of strategic objectives and corresponding response categories.

Beyond development and refinement of SFMPs, there are a number of other potential uses of this information. One interesting avenue of research would be to examine published incident decisions within WFDSS, apply the same response categorization scheme to decisions, and then examine the alignment of actual decisions with pre-fire incident objectives. Of FMUs with assigned response categories, more than half had response categories that recognized and/or promoted fires for resource benefit. Superficially, it seems unlikely that more than half of natural ignitions in these areas were managed for resource benefits. However, any such analysis would need to consider ignition locations with respect to adjacent FMUs, jurisdictional boundaries, and values-at-risk, and would especially need to consider fire weather; under more extreme weather conditions, agency administrators may be more averse to allowing fires to burn, and fire behavior may be so extreme as to not provide any resource benefits.

It appears many FMUs could benefit from a more clear articulation of strategic objectives and corresponding response categories. It is not our intent to point out the bad apples, so to speak, but we did find many instances where so-called strategic objectives had little to no connection to landscape objectives or to what would be done in response to fire. Some of the least informative examples offered little more than a description of the FMU. This prompted our emphasis on explaining what objectives are and how to define them, as well as providing some examples that we found to be clear and comprehensible.

That field units are uploading into WFDSS geospatial polygons with FMU information and objectives is a great step forward for risk-informed incident response planning. With continued refinement and expansion of FMU-level geospatial data within WFDSS, the fire management community may be able to make progress towards clarity, accountability, and transparency in wildfire incident response. Development of specific SFMP/FMU/FMZ guidance provides clarity for agency administrators in uncertain, complex, and stressful decision environments and could improve communication with the public when smoke is in the air.

Further, these changes may help the fire management community better realize the full potential of the 2009 Federal wildland fire policy reinterpretation and could strengthen ties between planning and investments across the wildfire management spectrum. Ultimately, spatial risk assessments that consider the likelihood and magnitude of potential fire impacts to highly valued resources and assets could be brought to bear to help assign strategic objectives and response categories at the FMU or possibly the FMZ level. ■