Map Library for the Bitterroot National Forest (West Fork RD)

BITTERROOT NATIONAL FOREST

Fire Effects Planning Framework

2004 Fire Effects Map Library

BITTERROOT NATIONAL FOREST

Fire Effects Map Library

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Chapter 1

Introduction

Purpose of this Map Library

These maps were developed to aid resource managers and line officers in determining where and under what conditions fire may create benefits or pose threats to identified ecological conditions or management targets. This spatially explicit representation of potential fire effects will allow for further functional integration of resource and fire management goals by providing information to be used at a variety of scales from long-range planning to current fire incident decision-making.

Short-term, fine-scale use of these maps may occur during Fire Use or suppression events. When the Wildland Fire Implementation Plan (WFIP) is undergoing development, managers can assess potential resource opportunities and concerns in the vicinity of the ignition, strengthening the case for the final go-no-go decision. Different suppression tactics and strategies may also be weighed in light of resource concerns. Mid-term, fine-scale use of these maps may occur when planning prescribed fires or fuel treatments, as these maps may be referenced to understand where to use planned fires. For example, detrimental fire effects, even at the 80th percentile weather condition, may highlight the need for mechanical treatment. Long-term, broad-scale fire management planning may also benefit from this information as it helps managers understand where fires pose fewer ecological risks and allow appropriate expansion of management boundaries for Fire Use.

It is important to note that the methods used here can be easily applied to other resources. With the baseline work completed, crosswalking fire effects on vegetation to understand risks and benefits of fire to other resources requires minimal efforts. Any needs should be brought to the attention of the Forest Fire Ecologist, Tonja Opperman.

Brief Description of Process

The process by which this map library was created will be detailed in a future General Technical Report (GTR). However, for managers using the map library now, it is important to understand some basics about how the maps were created to help ensure fewer misinterpretations.

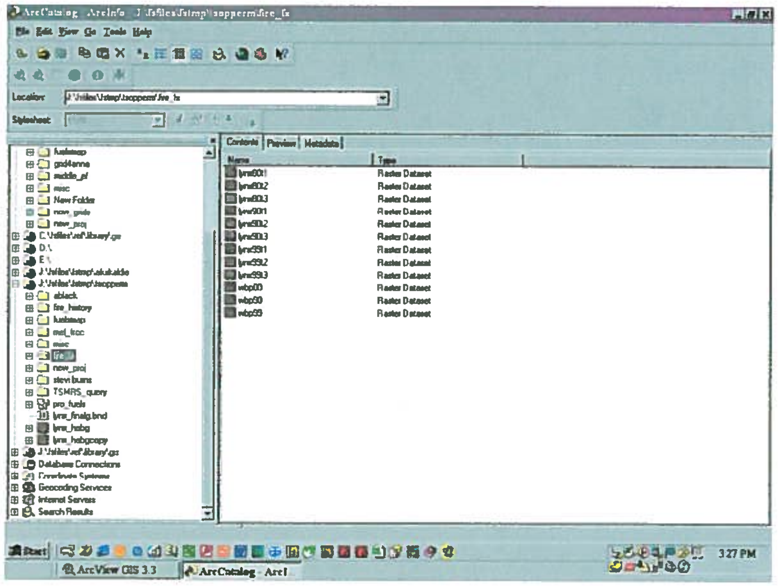
The Bitterroot National Forest (BRF) was divided into 5 geographic areas after consultation with the fire staff: East Stevensville, Bitterroot Face, East Darby, Sula, and West Fork. Historic weather records for representative weather stations in each geographic area were analyzed to determine 80th, 90th, and 99th percentile weather variables. Therefore, we modeled unique weather variables for each of the five geographic areas on the Bitterroot National Forest.

A representative landscape file was developed using 2003 satellite vegetation data acquired by the Forestry Sciences Lab (FSL) in Missoula, Montana. Scientists at the FSL used the vegetation data to create meaningful fuel and vegetation layers that can be utilized by FlamMap (see www.fire.org). FlamMap uses fuels, weather, topography, and vegetation characteristics to predict fire behavior. We used FlamMap to predict whether the type of fire would be a surface fire, a passive crown fire, or an active crown fire.

Once the fire type maps were created in FlamMap for the three weather scenarios, we determined the appropriate fire severity (low, mixed, high) based on vegetative characteristics (species mix, size class, percent cover, and structure) combined with fire type. For example, a surface fire in subalpine fir would be a mixed severity fire, while a surface fire in ponderosa pine would be a low severity fire. Finally, we created rule sets to determine which of these effects would be positive or negative based on movement towards or away from the desired management condition, or range of conditions, for the resource in question (e.g. lynx foraging habitat). We mapped those decisions in a GIS to create the final library.

Using Electronic Data

The entire Bitterroot National Forest was modeled in this effort, though this binder only includes final maps for one District. The forest-wide data grids that were created are stored on the network for access by all employees. The path is **J:\fsfiles\fstmp\tsopperm\fire_fx** and the screen capture below shows all the grids that are currently available. Metadata are also available in this directory for the lynx and whitebark pine datasets. Users should copy the grids to a work area with ArcCatalog or Arcview with Spatial Analyst before adding the grids to a GIS project.



More Information and Updates

The Bitterroot National Forest is the first to test this protocol called the Fire Effects Planning Framework. The framework has been further refined through the making of these data sets, and these data sets in turn have been used to write a guidebook and publication outlining the steps in detail. These publications should be available in 2005. Any questions about the data sets, protocols, interpretations of the existing data, or needs for additional data sets should be directed to the authors. Interested individuals are also encouraged to visit www.fire.org for more information.

Because these data sets rely on vegetation characteristics, they will need to be updated whenever the vegetation changes significantly

Chapter

2

FlamMap Results

Model Description

FlamMap software creates raster maps of potential fire behavior characteristics (rate of spread, flame length, crown fire activity, etc.) and environmental conditions (dead fuel moistures, mid-flame wind speeds, & solar irradiance) over an entire *FARSITE* landscape. These raster maps can be viewed in FlamMap or exported for use in a GIS, image or word processor.

It is not a replacement for *FARSITE* or a fire growth simulation model. There is no temporal component in FlamMap. It uses spatial information on topography and fuels to calculate fire behavior characteristics at one instant.

FlamMap uses the same spatial and tabular data as *FARSITE*; a Landscape (.LCP) File, Initial Fuel Moistures (.FMS) File, as well as optional Custom Fuel Model (.FMD), Weather (.WTR), and Wind (.WND) Files. FlamMap incorporates the following fire behavior models: Rothermel's 1972 surface fire model, Van Wagner's 1977 crown fire initiation model, Rothermel's 1991 crown fire spread model, Nelson's 2000 dead fuel moisture model.

FlamMap Inputs

Historic weather data were downloaded from the KCFAST interface and analyzed in FireFamily+ Software to find 80^{th}, 90^{th}, and 99^{th} percentile weather thresholds that to use in FlamMap simulations. The inputs are shown in the following table.

Table 1. West Fork geographic area weather inputs used in FlamMap. These values derived from historic weather analysis using the West Fork Station (#242907) at 4390 feet elevataion. Years 1961-2003 (Jul 15-Sept 30) were included.

Parameters used for Fuel Conditioning Period:	**80th Percentile (Low)**	**90th Percentile (High)**	**99th Percentile (Extreme)**
Min/Max Temp (F)	43/88	44/88	44/89
Min/Max RH (%)	16/90	14/80	10/65
1-hour TLFM (%)	3	2	2
10-hour TLFM (%)	4	3	2
100-hour TLFM (%)	12	10	8
1000-hour TLFM (%)	15	13	11
Herbaceous moisture (%)	72	54	35
Live Woody moisture (%)	107	91	73
Cloud Cover (%)	0	0	0
4-hour winds, listed from 2400-2000 hours (mph); max winds occur at 1200 and 1600 hours	2,2,2,6,6,2	4,4,4,11,11,4	6,6,6,30,30,6
Parameters used at time of simulated fire event for West Fork area:			
20' Uphill Winds (mph)	6	11	30
Live Fuel Moisture (%)	120	100	80

FlamMap Fire Behavior Maps

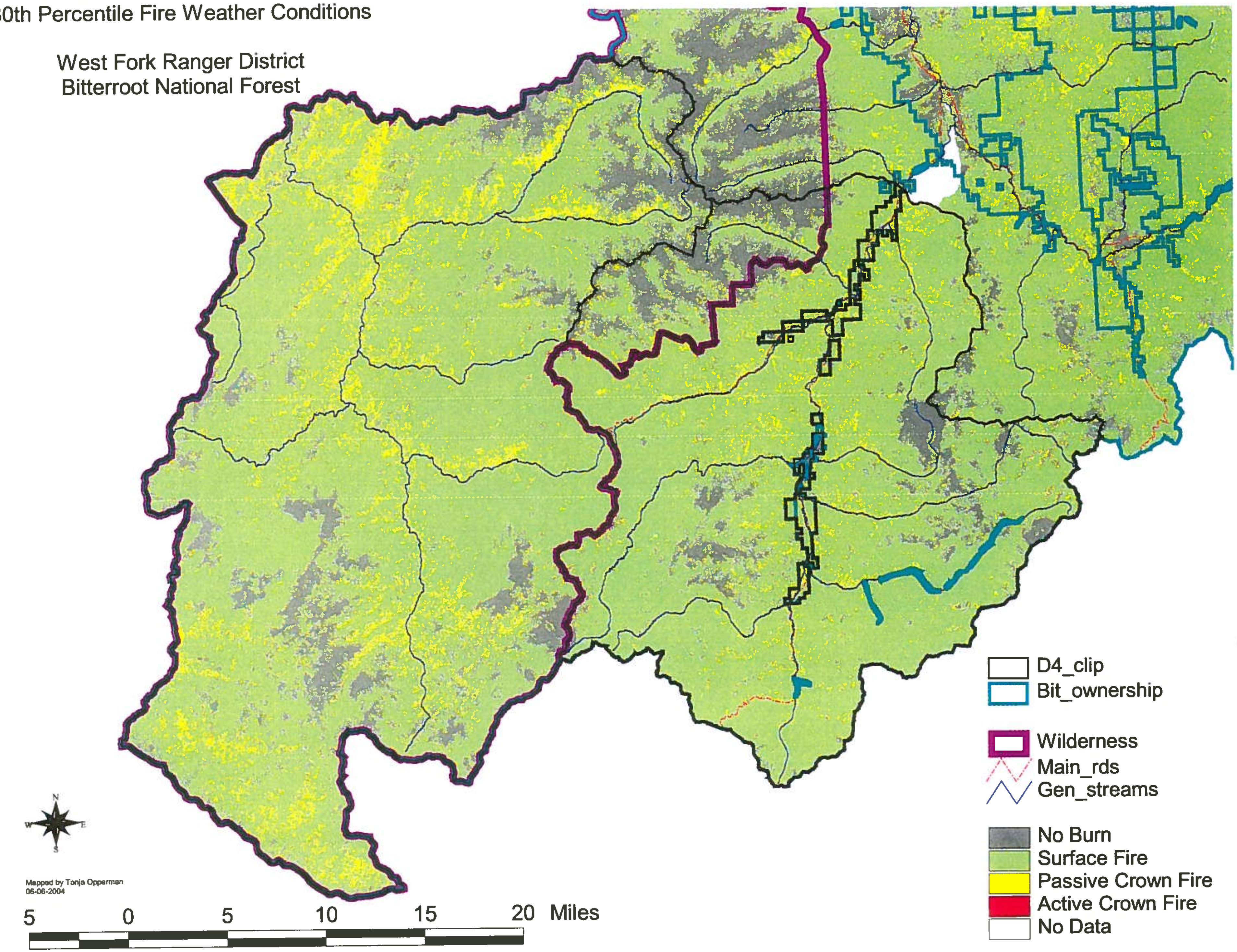
There are three fire behavior maps showing fire type under 80th, 90th, and 99th percentile weather conditions as a result of the weather/fuel moisture inputs shown above, and the landscape file from 2003. The inputs used to create these maps can be validated or refined as they are used during future fire seasons.

Sources

These maps were created with detailed help from local fire behavior experts, Bart Hoag (District Fire Management Officer on the Sula Ranger District), Tobin Kelley (Assistant District Fire Management Officer on the Stevensville Ranger District), and Jack Kirkendall (Forest Fire Management Officer). Additional input was gained at meetings with fire staff at the West Fork Ranger Distric.

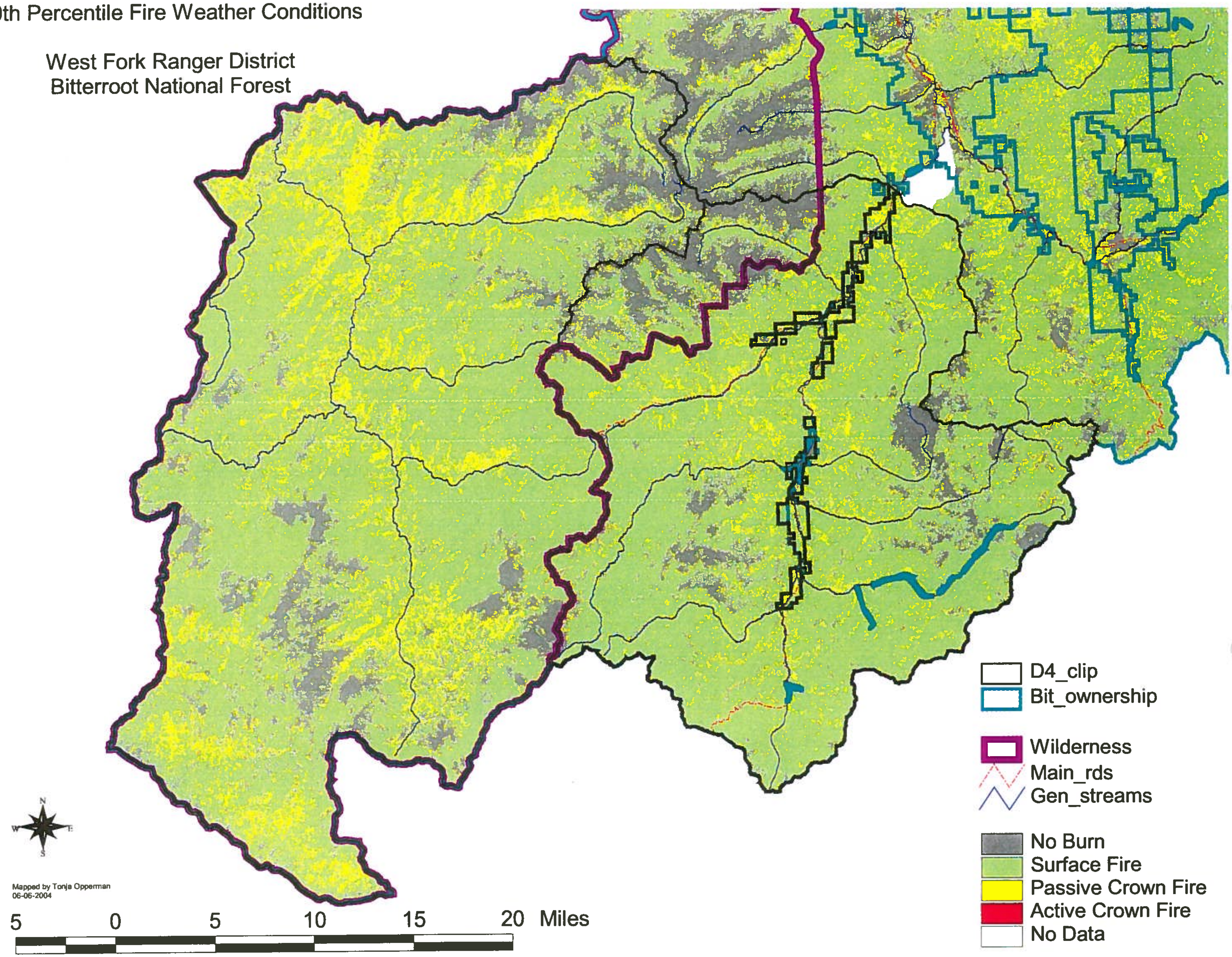
Potential Fire Behavior
80th Percentile Fire Weather Conditions

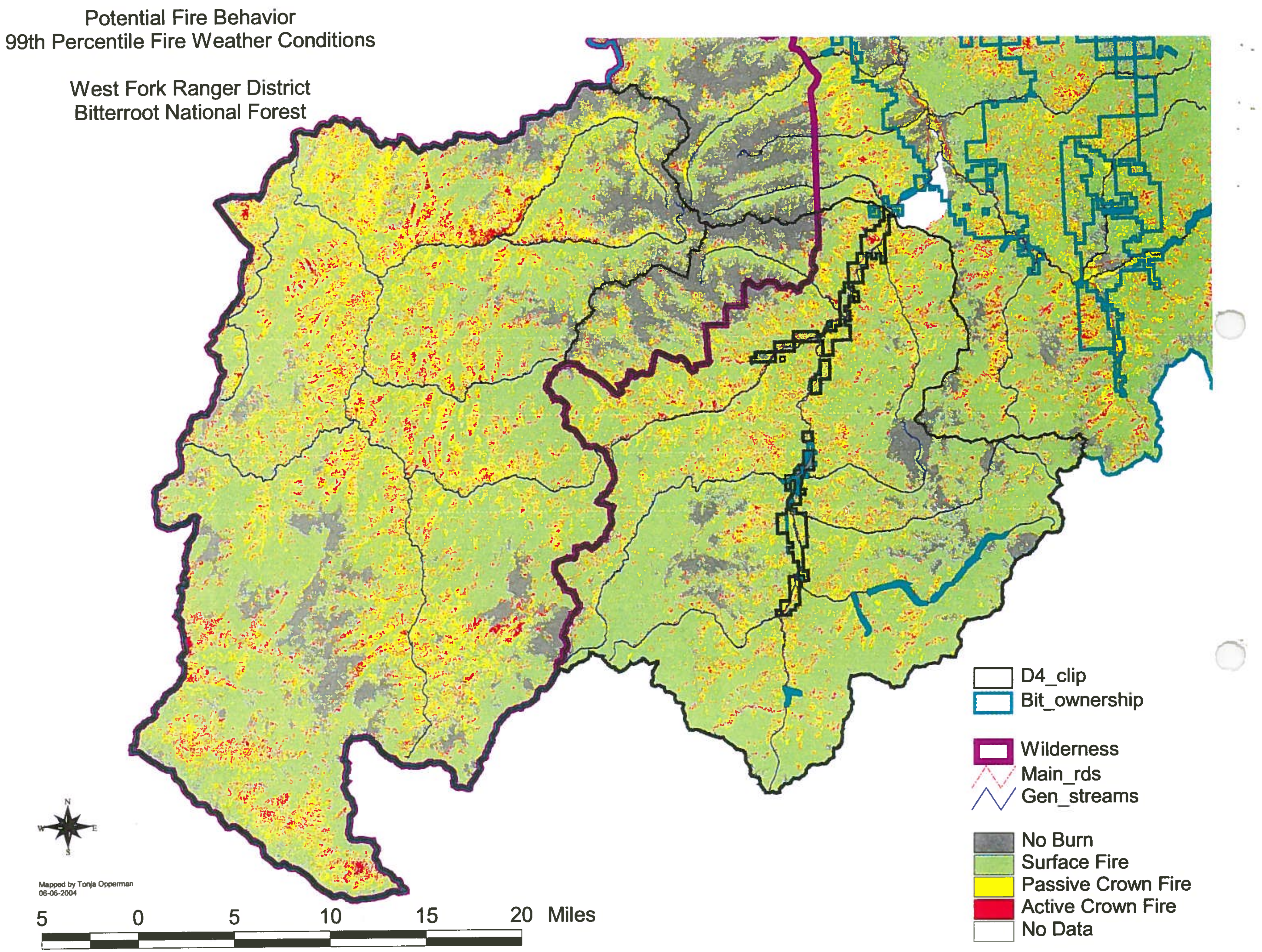
West Fork Ranger District
Bitterroot National Forest



Potential Fire Behavior
90th Percentile Fire Weather Conditions

West Fork Ranger District
Bitterroot National Forest




Potential Fire Behavior
99th Percentile Fire Weather Conditions
West Fork Ranger District
Bitterroot National Forest
D4_clip
Bit_ownership
Wilderness
Main_rds
Gen_streams
No Burn
Surface Fire
Passive Crown Fire
Active Crown Fire
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Mapped by Tonja Opperman
06-06-2004
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Miles

Chapter 3

Whitebark Pine

Summary of Fire Effects

The single most important factor in perpetuating whitebark pine (*Pinus albicaulis*) ecosystems is restoration of the native fire regime. Before fire suppression, whitebark pine stands burned every 30-150 years under a mixed severity fire regime that encompassed small surface fires to crown fires covering thousands of acres.

Nearly any fire is good for whitebark pine. Any fire that creates bare mineral soil for the Clark's nutcracker (*Nucifraga columbiana*) to cache seeds will aid in whitebark pine regeneration, as these birds are particularly drawn to recently burned areas. These birds are known to cache seeds 10-12 kilometers from the source, therefore giving whitebark pine a successional head start in large burn areas. Because slow-growing whitebark pines are so easily out-competed by more shade-tolerant trees on the same site, only large, high severity fires give whitebark pine a competitive edge. In mixed-species stands, mixed and low severity fires can also benefit whitebark pine because it is more fire tolerant than subalpine fir (*Abies lasiocarpa*) and Engelmann spruce (*Picea engelmannii*) and is more likely to survive such a fire.

Fire is not beneficial in whitebark pine stands with a seedling/sapling structure, even though fires in these stands probably occurred historically. Any fire in these stands will likely be of high severity, setting succession back to the shrub/herb stage before these trees, which have managed to successfully colonize the site, can reproduce.

Proximity to additional whitebark pine seed sources should also be considered when determining whether a particular fire is beneficial. Loss of remote stands that are not within several miles of other whitebark pine seed sources will not likely be repopulated with whitebark pine, and will no longer provide a seed source for near by ridges when they burn.

Whitebark pine is also threatened by white pine blister rust (*Cronartium ribicola*), a fungus introduced to North America in about 1900. This somewhat complicates management decisions regarding the use of fire because, although almost all fires can benefit whitebark pine, a fire in an infected stand may consume what are obvious rust-resistant individuals. Losing these precious seed-bearing trees to fire is not beneficial to the long-term survival of the species. Fire in these stands would be beneficial only if these resistant seed trees could be adequately protected via pre-fire fuel reduction efforts (Bob Keane, pers. comm.).

Crosswalks

Because whitebark pine no longer occupies the range it once did on the Bitterroot National Forest, potential habitat was determined by simply including all areas above 6500 feet elevation that were not water or rock (Steve Arno, pers. comm.). Fire effects were determined for all stands in this area based on their current cover types and site potential.

Table 2. Whitebark pine vegetation/fire effects crosswalk where WB=whitebark, AL=alpine larch, AF=subalpine fir, and ES=Engelmann spruce. Multiplier is number that was used to differentiate these benefits/risks after this rule set was multiplied by the species/severity data set. Whitebark-only stands have unique multipliers to aid managers in seeing where pure whitebark pine stands currently exist on the landscape.

Species	Size/ Structure	Fire Severity	Benefits/Risks	Multiplier
WB-AL-AF mix, and WB-ES-AF mix	All	High	**Desirable Effects** for WB to outcompete other conifers	+1
WB-AL-AF mix, and WB-ES-AF mix	All	Low or Mixed	**Highly Desirable Effects** to favor late successional WB	+100
WB-only	Seed/sap	All fires	**Undesirable Effects** b/c WB already established but not reproducing yet	-1
WB-only	All except seed/sap	All fires	**Desirable Effects** to restore native fire regime	+1000
All other species mixes	All	High	**Highly Desirable Effects** to provide potential WB habitat	+100
All other species mixes	All	Low or Mixed	**Desirable Effects**	+1
No Burn	All	None	**Not Habitat** This is rock above 6500'	-100

Caveats

It is imperative for managers to understand that the whitebark pine potential fire effects maps that follow do not account for fire risks and benefits due to white pine blister rust. At this time there is no map available to identify which stands are infected. Therefore, managers and line officers are urged to *proceed with caution* when deciding to use fire in stands that currently support late-successional, cone-bearing whitebark pine trees. However, there is still a great need for high severity, large-scale fires in areas that do not currently support whitebark pine, but have the potential to become seed-caching sites if the proper conditions are created.

Maps

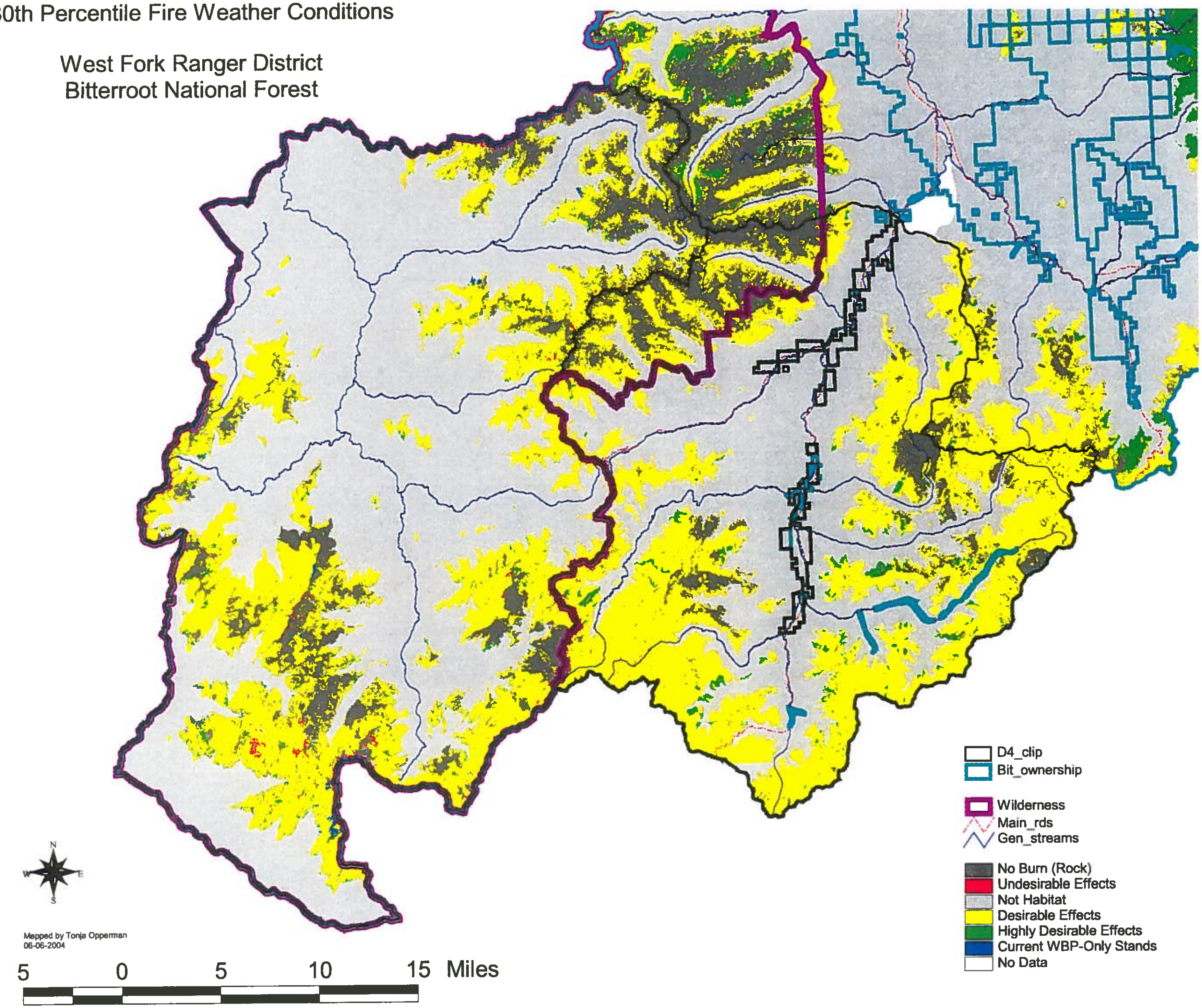
There are three maps showing potential fire risks and benefits in whitebark pine; one for 80th, 90th, and 99th percentile weather conditions. However, all three maps are strikingly similar due to the crosswalks used to arrive at these maps. A lack of fire in recent decades has created a landscape with little seed caching habitat, therefore there are vast landscapes where any fire in any place would be beneficial (however, this does not consider effects due to white pine blister rust). After several decades of stand replacement fire, areas that could potentially support whitebark pine would show more differentiation on maps like these.

Sources

Steve Arno, retired Forest Service Research Ecologist, and Bob Keane, Forest Service Research Ecologist at the Fire Sciences Laboratory in Missoula, MT were consulted for valuable input regarding ecology of whitebark pine in western Montana. "Whitebark Pine Communities: Ecology and Restoration" by D.F. Tomback, S.F. Arno, and R.E. Keane, Island Press, 2001, 440p was also referenced.

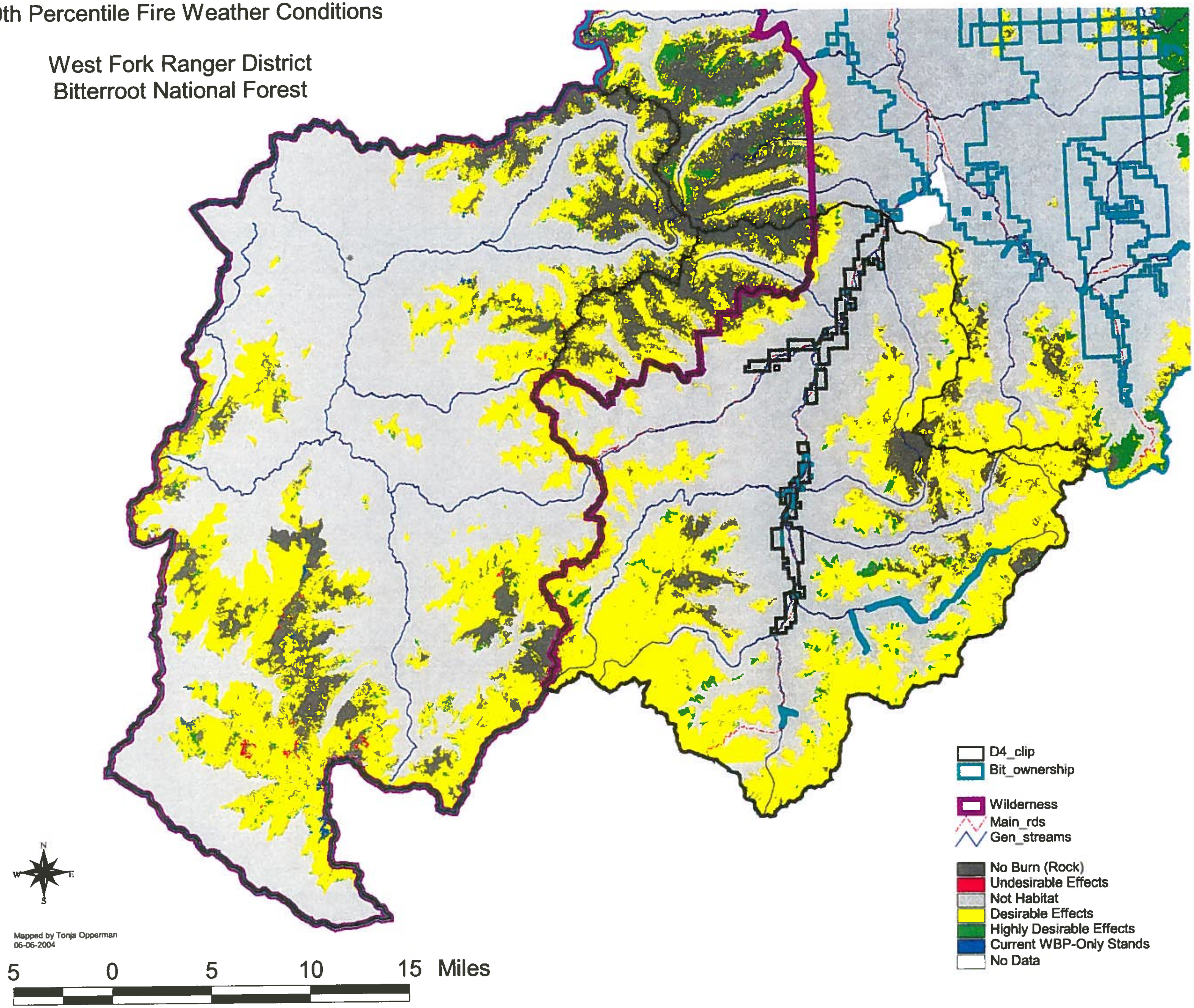
Potential Fire Effects in Whitebark Pine
80th Percentile Fire Weather Conditions

West Fork Ranger District
Bitterroot National Forest



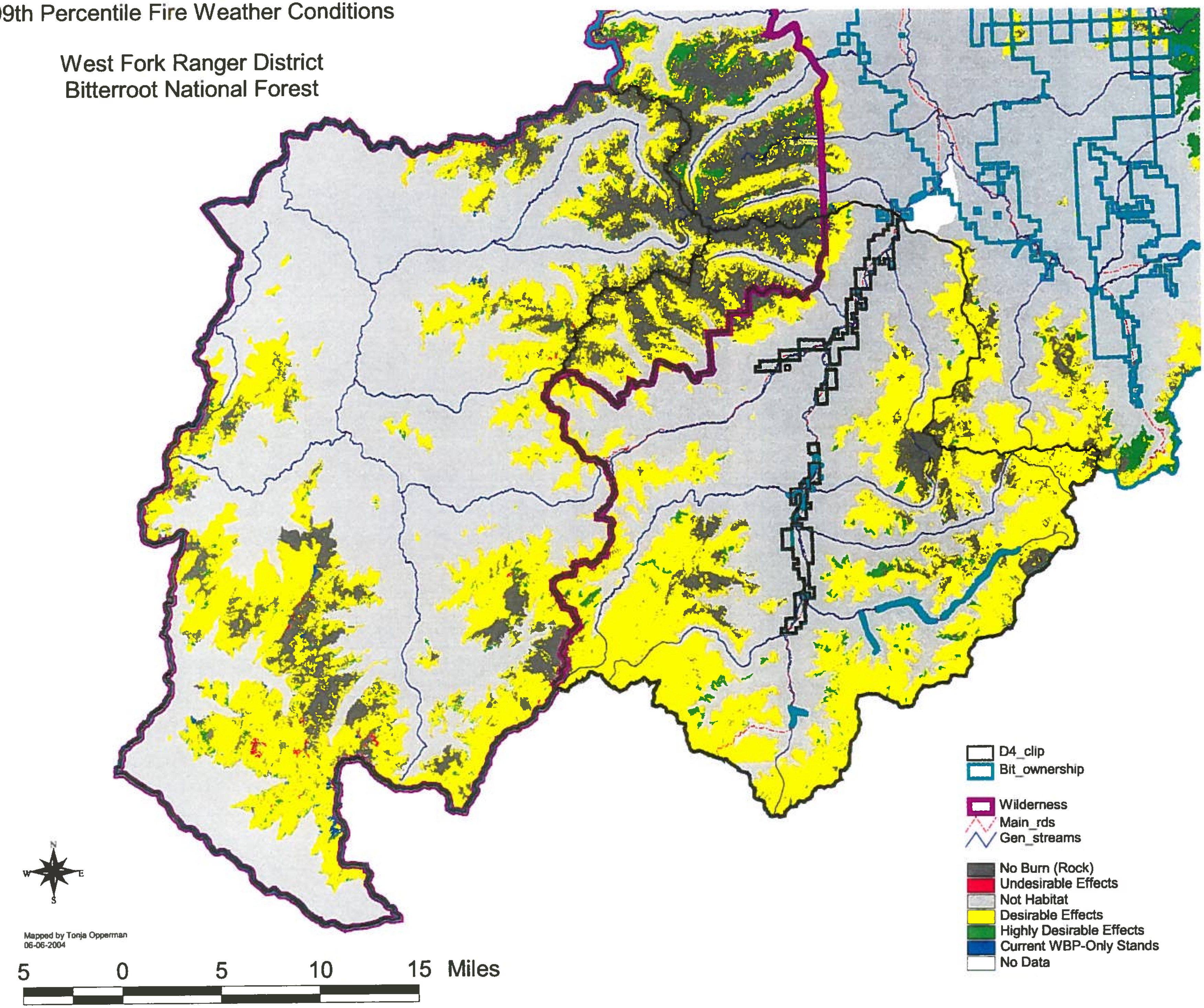
Potential Fire Effects in Whitebark Pine
90th Percentile Fire Weather Conditions

West Fork Ranger District
Bitterroot National Forest



Potential Fire Effects in Whitebark Pine
99th Percentile Fire Weather Conditions

West Fork Ranger District
Bitterroot National Forest



Chapter

4

Lynx Foraging Habitat

Summary of Fire Effects

Lynx (*Lynx canadensis*) require a variety of habitats within close proximity; late-successional, closed forests are used for denning, while early or mid-successional forests provide foraging opportunities. Lynx are adapted to deep snow environments and occupy areas where they are not out-competed by mountain lions at lower elevations. An available map of potential lynx habitat showed areas over 6200 feet in elevation. Winter foraging needs are vital for the long-term survival of lynx, and are the focus of this fire effects library.

Snowshoe hare (*Lepus americanus*) are the preferred winter prey of lynx. It is more important for snowshoe hares to have an appropriate forest structure in which to forage, than to have a particular forest type available. These hares prefer dense understory vegetation that is 1-3 meters tall, and will avoid very young regrowth or open areas. There is currently not enough evidence to suggest a certain spatial distribution of habitats may be preferred by snowshoe hares.

Crosswalks

Due to the habitat needs of snowshoe hares coupled with the focus on winter environments, three post-fire time periods were considered to display fire effects on lynx foraging habitat. During the first 14 years after a fire, there may not be enough regrowth to exist above the winter snow pack and, therefore, to be available for snowshoe hares. During the next 15-39 years after a fire, this forage may be available above the snowpack and provide hare habitat. After 40 years, the forest may no longer have sufficient understory vegetation to provide hare forage. Each forest type experiencing different fire severities follows a unique successional pathway, which was captured in the crosswalk over these three time periods.

Table 3. Shows benefit/risk multipliers used to crosswalk lynx foraging habitat back to fire severity by forest type., where pre-fire "good" foraging habitat becomes "poor" = -10, "good" remains "good" = +1, "poor" remains "poor" = -1, "poor" becomes "good" = +10 and all non-habitat = 0. WB=whitebark pine, DF=Douglas-fir, L=larch, PP=ponderosa pine, LP=lodgepole, ES=Engelmann spruce, AF=subalpine fir, AL=alpine larch, GF=grand fir, C=cedar, QA=quaking aspen, WH=western hemlock, MH=mountain hemlock, and CW=cottonwood.

Species/ Species Mix	Size/ Structure	Fire Severity	0-14 years post-fire	15-39 years post-fire	40+ years post-fire
WB, DF, L, PP, LP, L-mixes, DF-mixes, PP-mixes	Single story	Low	-1	-1	-1
	Single story	Mixed	1	1	-10
	Single or multi-story	High	-1	10	10
Mixtures of DF, ES,AF, WB, LP, AL, L, GF	Single story	Low	-1	-1	-1
	Single story	Mixed	1	1	-10
	Single or multi-story	High	-1	10	10
ES, GF,AL, C, QA, WH, MH, AF, CW	Single story	Mixed	1	1	-10
	Single or multi-story	High	-1	10	10
All forested	Seed/sap	High	-1	10	10
Shrubs	All	Mixed or High	-10	1	1
		No Burn	1	-10	-10
Non-stocked, non-forest, forbs, grasses	All	Low, Mixed, No Burn	-1	-1	-1
Unburnable, Agriculture, No Data	n/a	All	0	0	0

Caveats

A lack of fire in potential lynx habitat has reduced the opportunities for lynx to find available prey in the winter months. The map library that follows shows the benefits and risks of using fire in lynx foraging habitat compared to the current habitat. Other spatially explicit habitat requirements must be considered, such as the amount of potential denning habitat may be available in summer months. It is important for lynx to have both denning and foraging habitats within close proximity to one another.

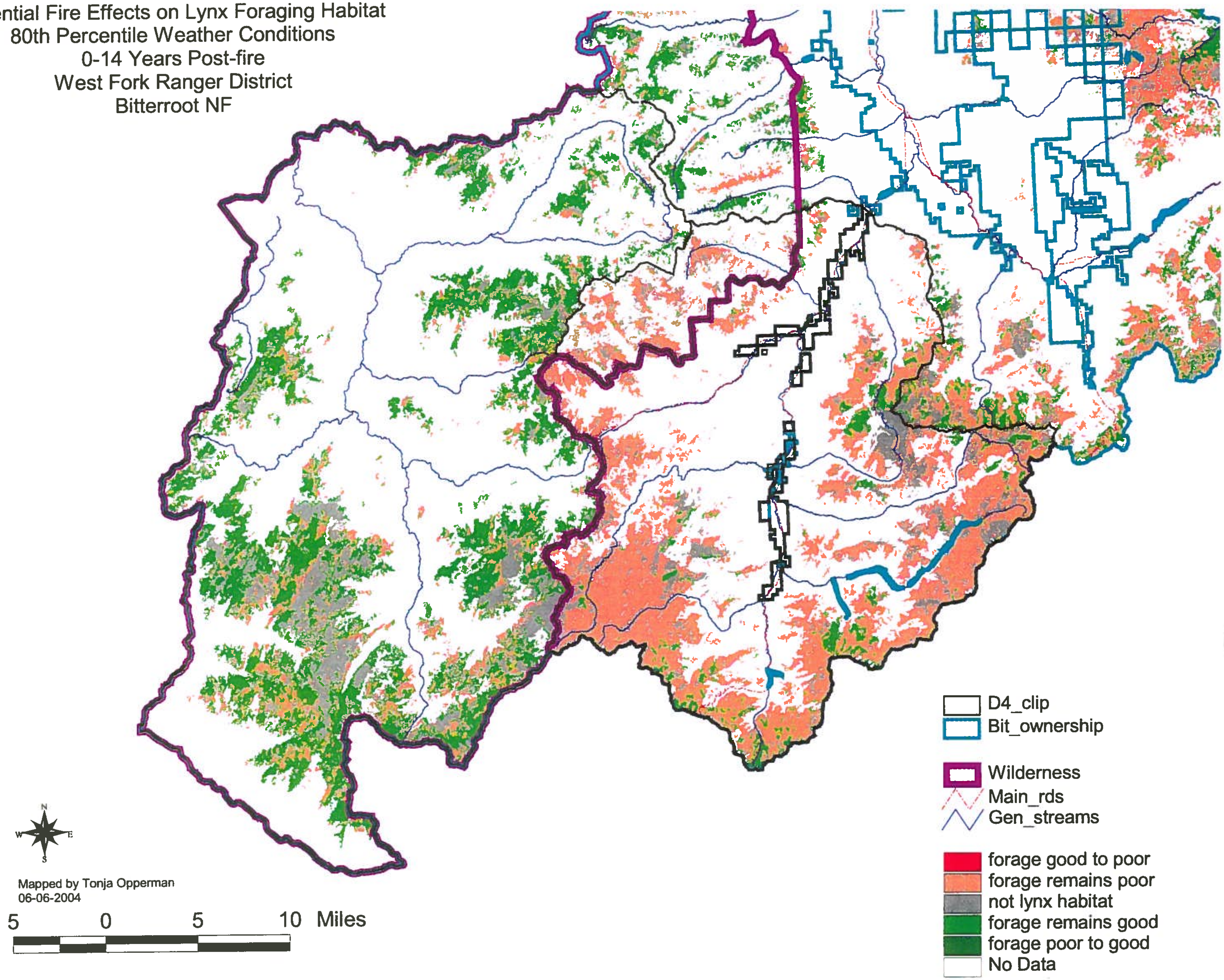
Maps

There are nine maps showing potential fire risks and benefits in lynx foraging habitat; three for each weather condition. Because snowshoe hares prefers a post-fire habitat that is relatively short-lived on the landscape, and because the benefits of this habitat may not be above the winter's snow pack for several years after a fire event, there is a different map for each of three time periods after the fire event. A fire event today may not provide an immediate benefit to lynx, as indicated by the 0-14 years post-fire maps, but a landscape with no fire will surely provide little habitat, as evidenced by the 40+ years post-fire time period maps.

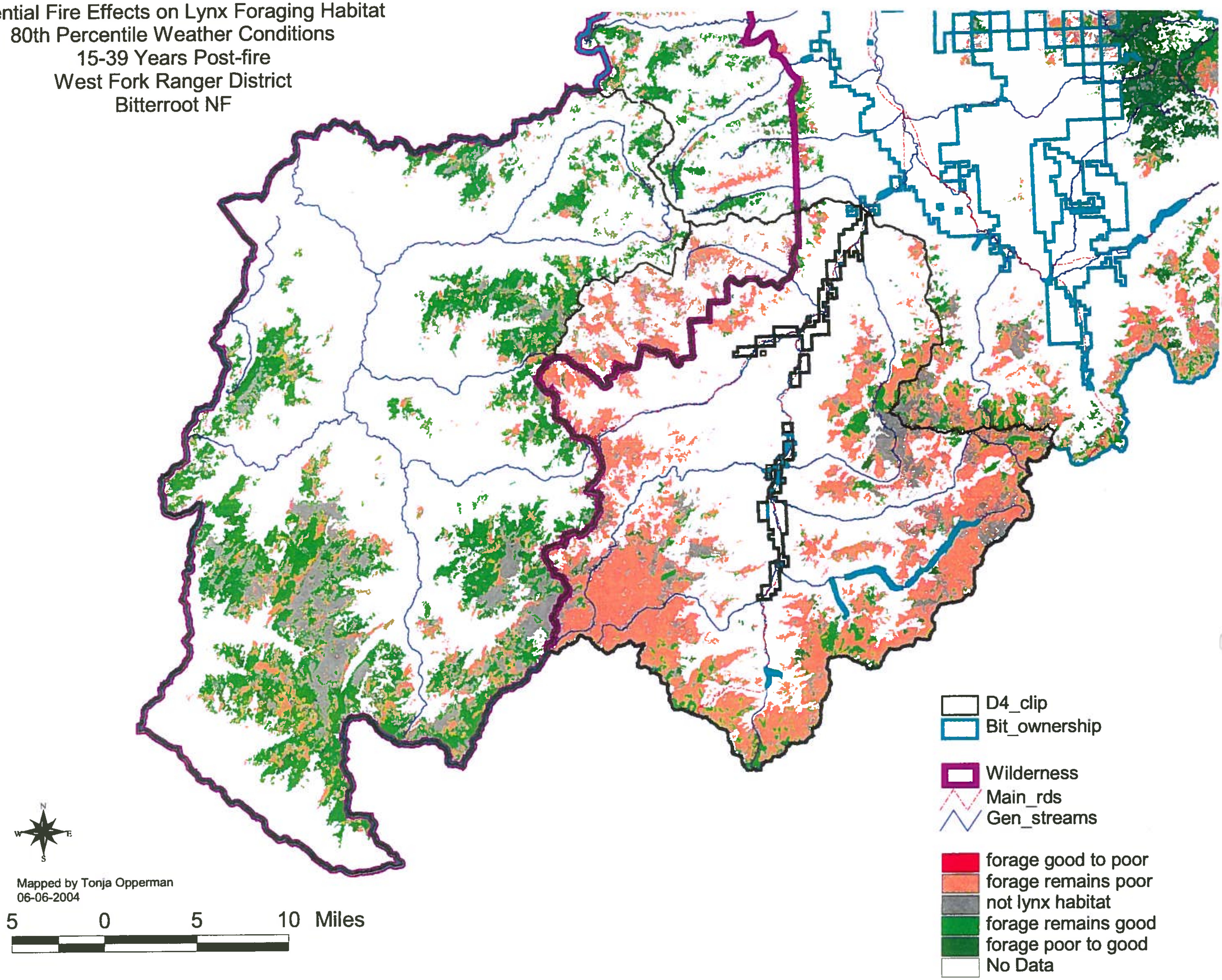
Sources

John Ormiston, Forest Wildlife Biologist, provided valuable information on the ecology and habitat needs of lynx in western Montana. The Region 1 Lynx Conservation Assessment, 2004 and the book "Ecology and Conservation of Lynx in the United States" by L.F. Ruggiero, K.B. Aubry, S.W. Buskirk, G.M. Koehler, C.J. Krebs, K.S. McKelvey, and J.R. Squires, University Press of Colorado, 480p was also referenced.

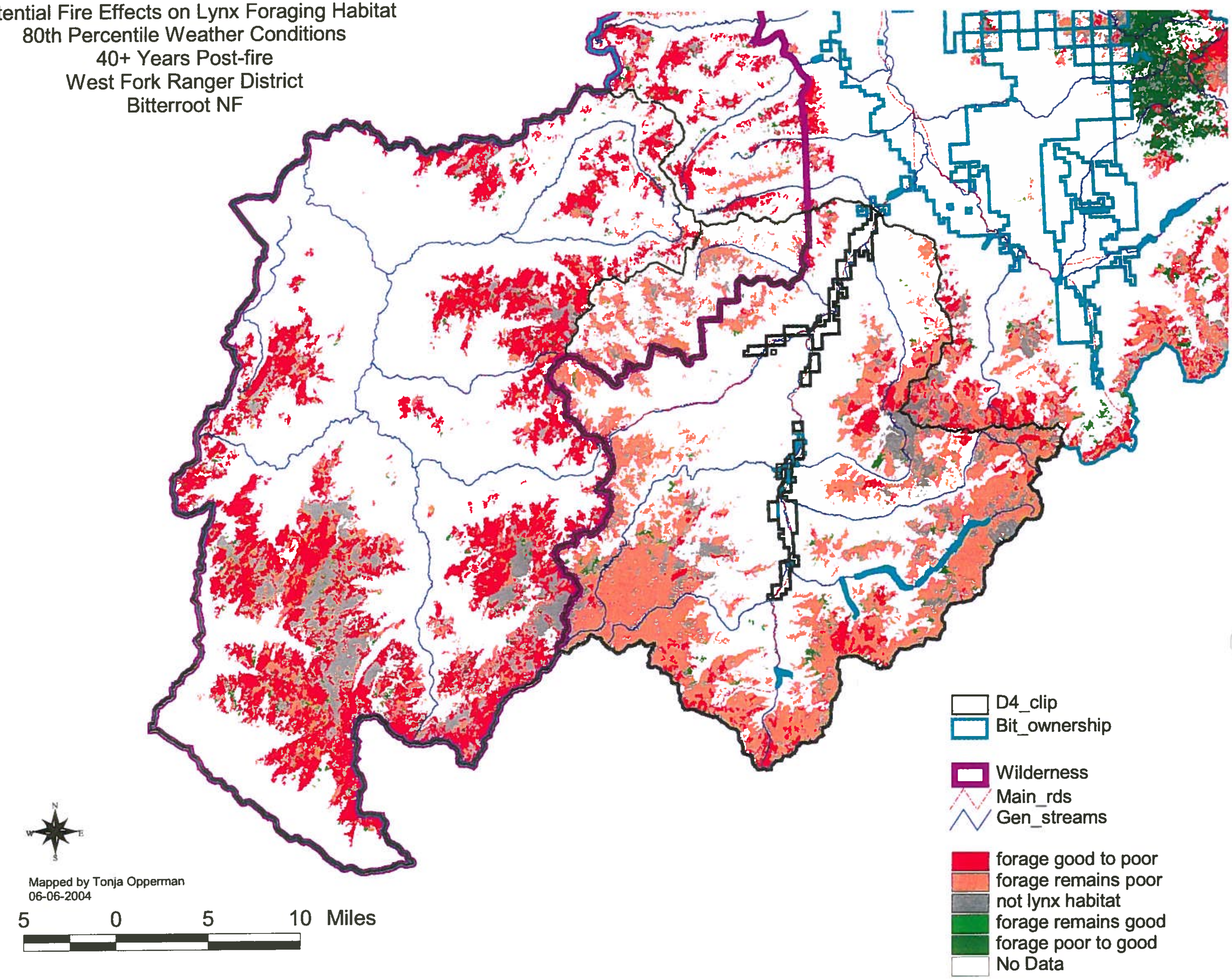
Potential Fire Effects on Lynx Foraging Habitat
80th Percentile Weather Conditions
0-14 Years Post-fire
West Fork Ranger District
Bitterroot NF



Potential Fire Effects on Lynx Foraging Habitat
80th Percentile Weather Conditions
15-39 Years Post-fire
West Fork Ranger District
Bitterroot NF

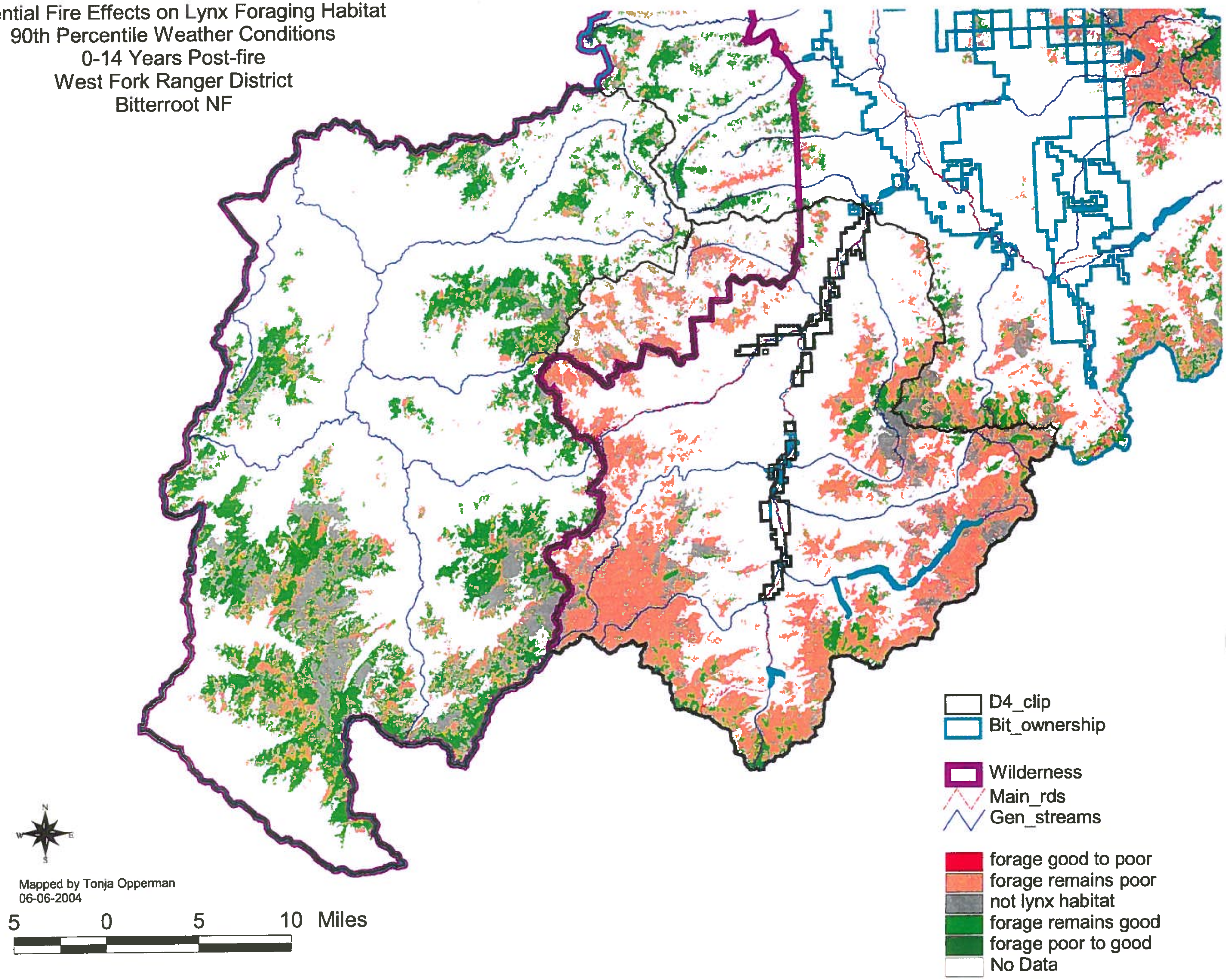


Potential Fire Effects on Lynx Foraging Habitat
80th Percentile Weather Conditions
40+ Years Post-fire
West Fork Ranger District
Bitterroot NF



Mapped by Tonja Opperman
06-06-2004

Potential Fire Effects on Lynx Foraging Habitat
90th Percentile Weather Conditions
0-14 Years Post-fire
West Fork Ranger District
Bitterroot NF



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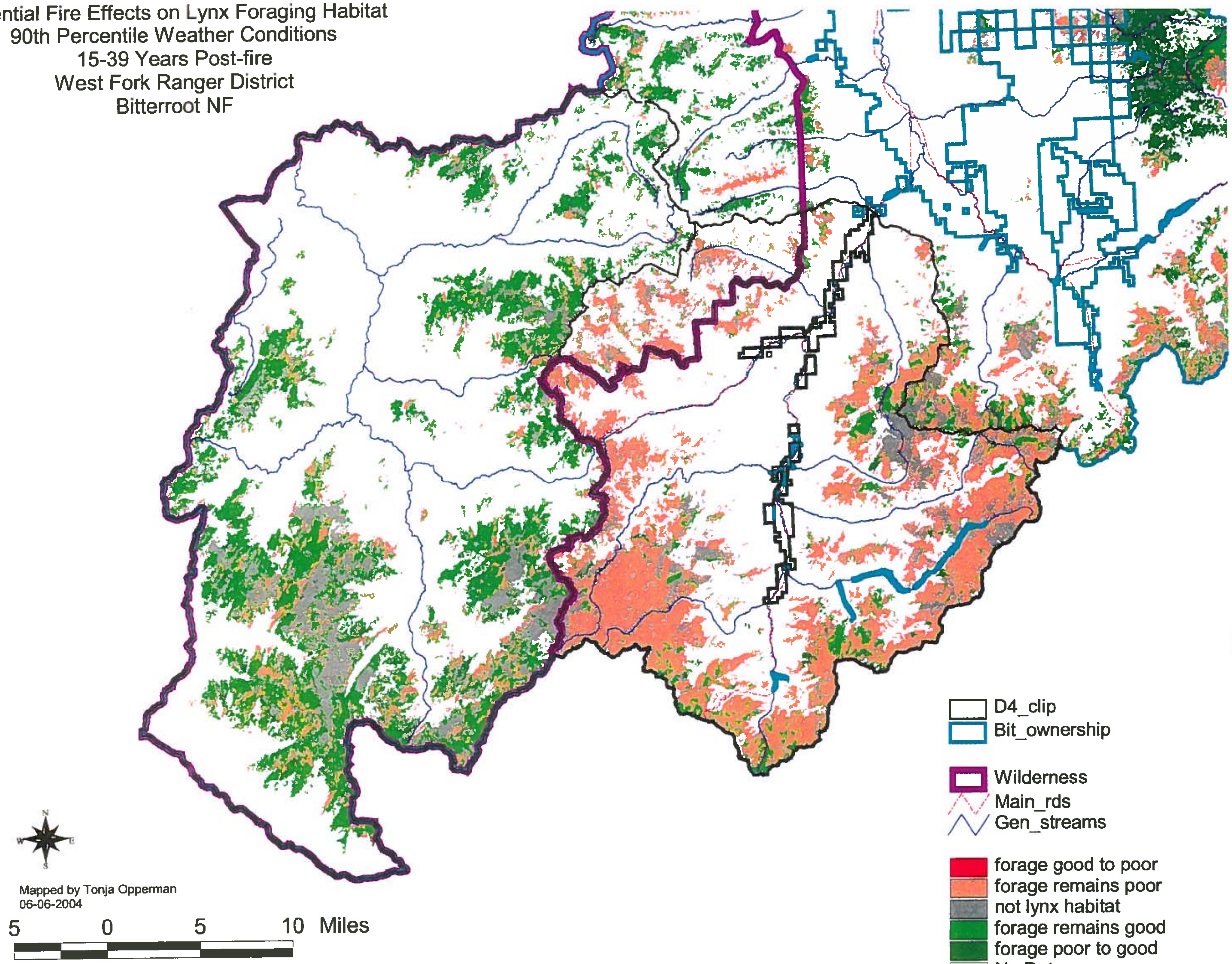
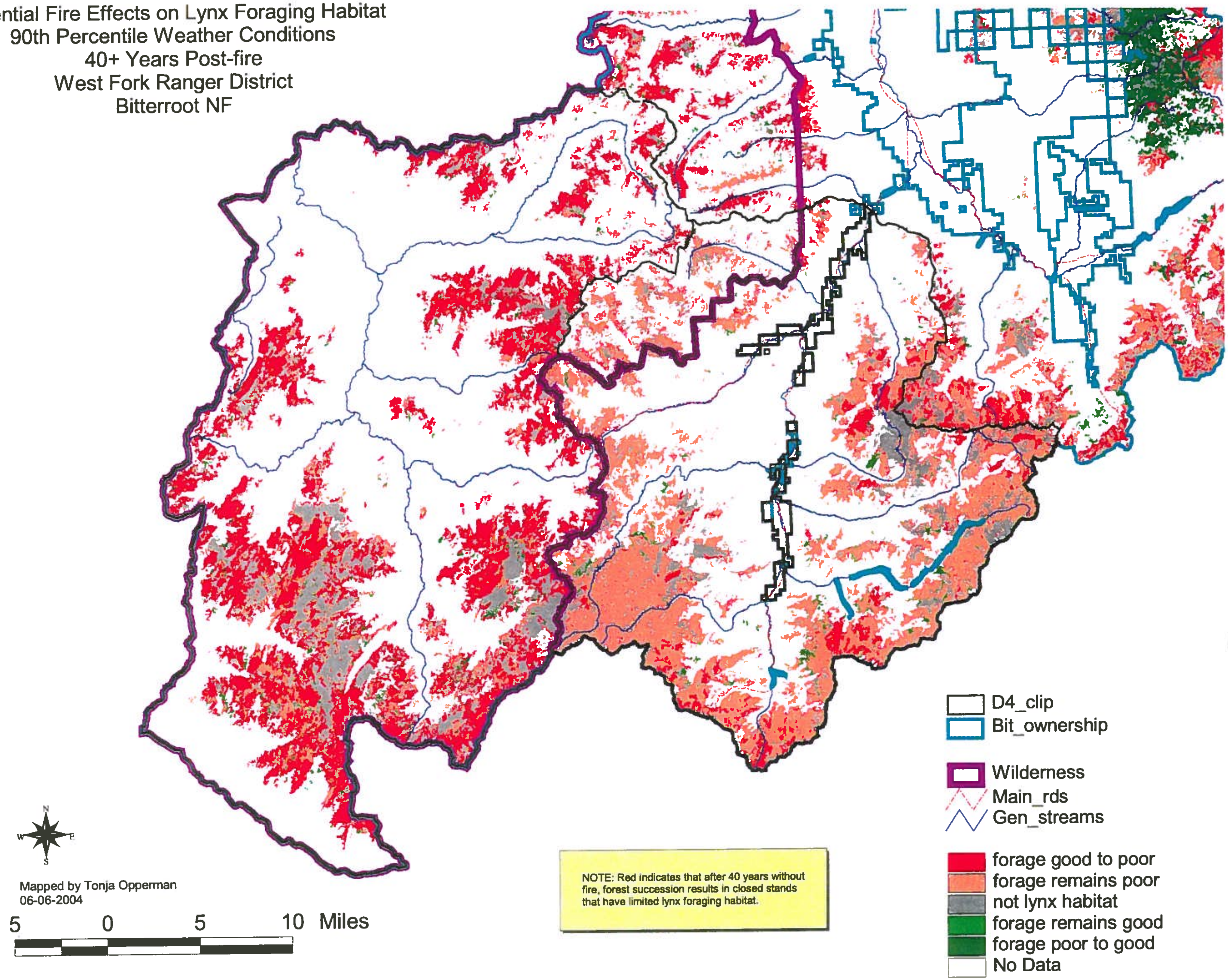
90th Percentile Weather Conditions
15-39 Years Post-fire
West Fork Ranger District
Bitterroot NF

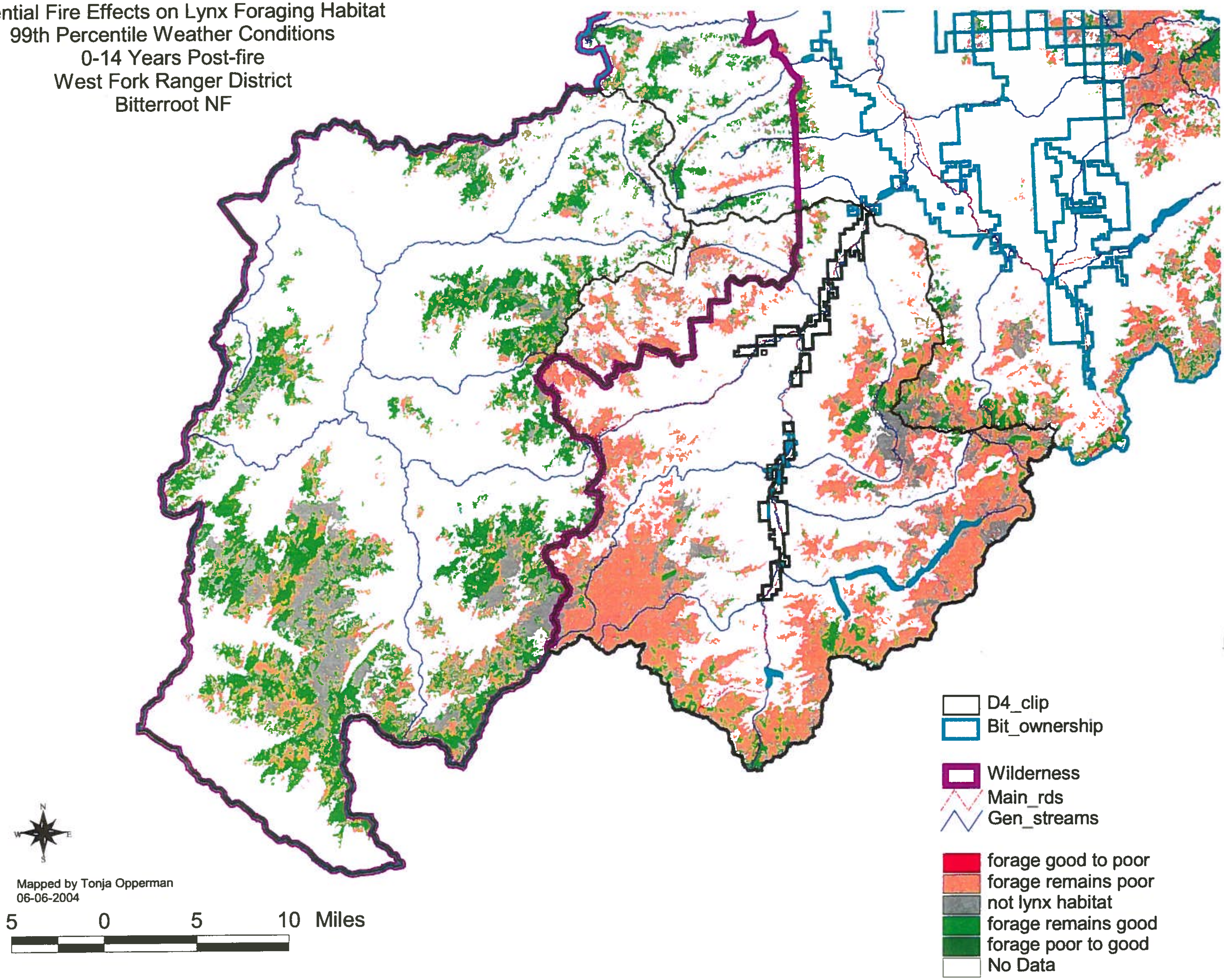


Potential Fire Effects on Lynx Foraging Habitat
90th Percentile Weather Conditions
40+ Years Post-fire
West Fork Ranger District
Bitterroot NF



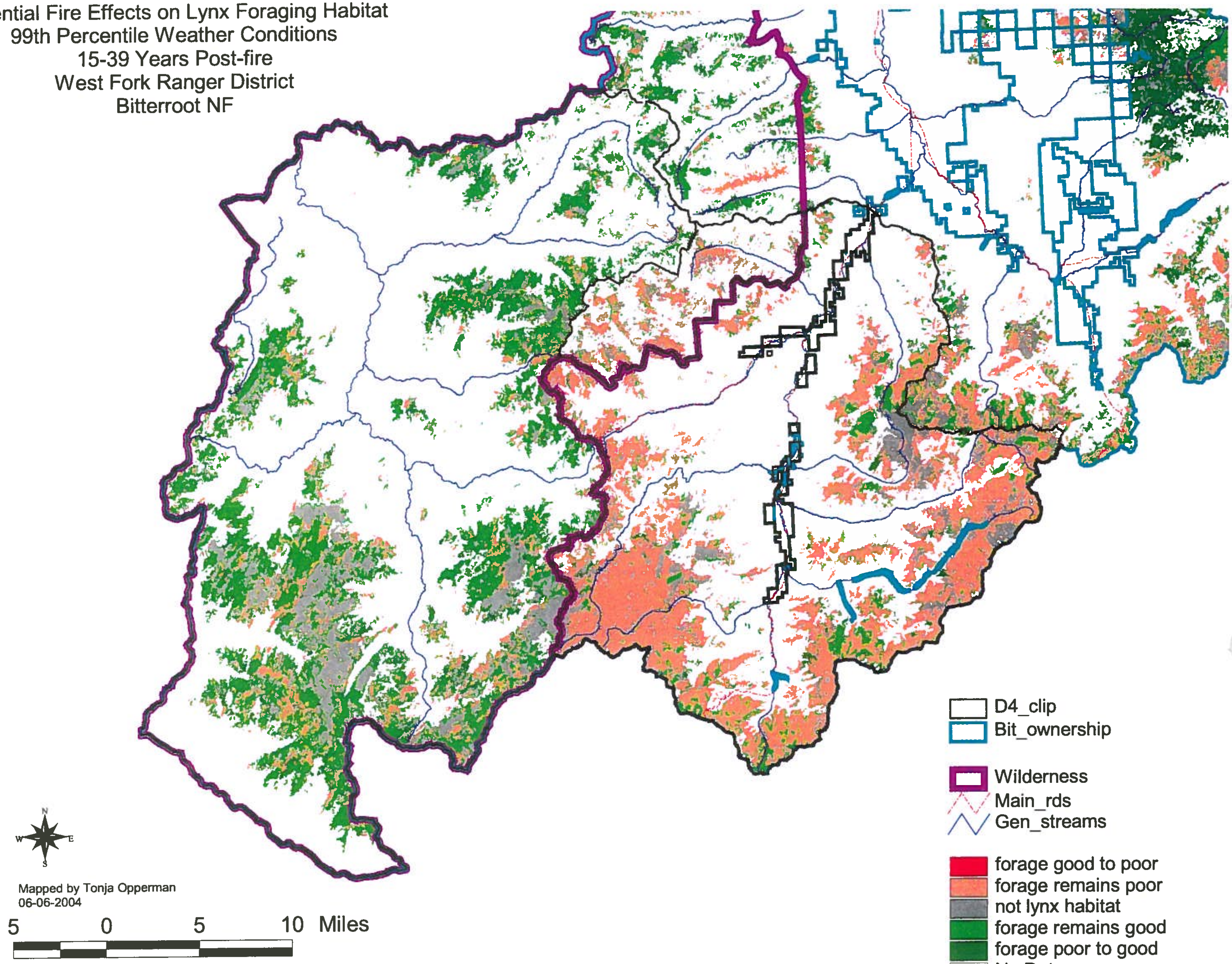
Mapped by Tonja Opperman
06-06-2004

Potential Fire Effects on Lynx Foraging Habitat
99th Percentile Weather Conditions
0-14 Years Post-fire
West Fork Ranger District
Bitterroot NF

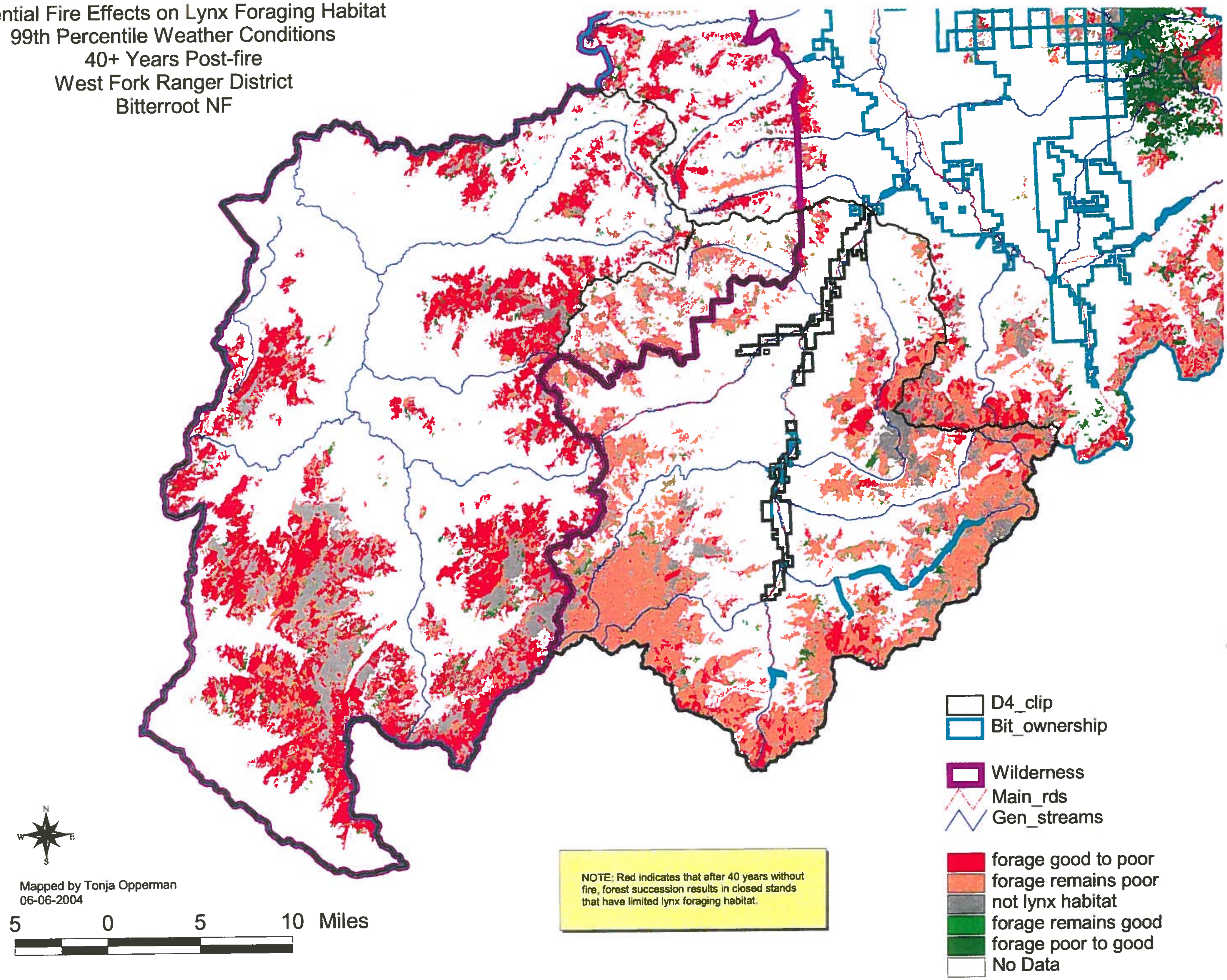


Mapped by Tonja Opperman
06-06-2004

Potential Fire Effects on Lynx Foraging Habitat
99th Percentile Weather Conditions
15-39 Years Post-fire
West Fork Ranger District
Bitterroot NF



Potential Fire Effects on Lynx Foraging Habitat
99th Percentile Weather Conditions
40+ Years Post-fire
West Fork Ranger District
Bitterroot NF



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