Beaverhead-Deerlodge National Forest

FOREST MONITORING AND EVALUATION REPORT

FISCAL YEAR 2000

◆ The Fires of 2000 ◆

INTRODUCTION

Monitoring and evaluation are the primary tools the Beaverhead-Deerlodge National Forest (BDNF) uses to assess whether we are accomplishing the goals set forth in the Forest Plans, and also to determine if the Forest Plans need to be changed. As we prepare to revise our Forest Plan over the next five years, we will use documented information addressing monitoring items laid out by both Forest Plans. Reports prepared for Forest since 1986 and 1987, respectively, identified where implementation of the Forest Plan is or is not achieving the Desired Forest Conditions and help evaluate the effects of management practices.

Since the Beaverhead and Deerlodge Forest Plans were written, new scientific information is available, public demand has changed, and some agency policies changed. We tailored the last three Monitoring and Evaluation Reports (1998, 1999, 2000) toward these new issues not addressed by existing Forest Plan Monitoring items. This new information will help us with the revision of the Beaverhead-Deerlodge National Forest Plan.

Perhaps the most charismatic issue of the last five years is forest health as it is affected by the absence of fire in our landscapes and subsequent discussions of restoring fire to those landscapes. The 1996 Forest Monitoring and Evaluation Report identified effects from the lack of fire, the use of prescribed fire, and protection of homes and property along the forest/private land interface as important emerging issues for revision, (Beaverhead Item 11-3, page 52). Large scale efforts in the Northern Region Overview identified the same issue.

In less than two months, two fires affected 77,073 acres in the 2000 season. The Mussigbrod Fire on Wisdom Ranger District burned most of 59,073 acres. The Middle Fork Fire Complex on the Pintler Ranger District burned most of 18,000 acres. (*Actual burn areas in the 77,073 acres calculated within fire perimeters are closer to 69,000 acres*). This scale of wildfire is unprecedented in the history of the Forest. The 1998 Monitoring Report notes the Beaverhead-Deerlodge National Forest burned about 49,000 acres of vegetation for ecosystem health (for purposes other than timber production) from 1989 to 1999, a ten-year period. More acreage burned from wildfires in two months during the 2000 season than that monitoring period. The wildfires of 2000 affected the Forest's normal workload, budget, and staff available for normal resource management. The fires also affected local communities and most of all, natural resources.

The 2001 Monitoring and Evaluation Report looks first at effects of the fires of 2000 on Forest personnel, staffing, accomplishments, and budget. Second, the Report evaluates the effects the Mussigbrod and Middle Fork fires on individual resources by Forest Plan Monitoring Item.

BACKGROUND ON THE FIRES

MUSSIGBROD COMPLEX

The Mussigbrod Complex (See Figure 3) of fires is located northwest of Wisdom on the Wisdom Ranger District. This fire complex totaled 59,073 acres inside the Beaverhead-Deerlodge National Forest (and another 25,000 acres in the Bitterroot National Forest).

The Mussigbrod Fire started July 31, from a lightning strike near Mussigbrod Lake. By August 2, the fire grew to 300 acres. In mid-August, the Maynard Fire on the Bitterroot, burned over the Continental Divide and became part of the Mussigbrod Complex, which totaled 13,616 acres on August 13.

The Mussigbrod Complex reached peak strength on September 4, when 558 personnel were working on the fire. Ultimately, it involved 84,939 acres on the Beaverhead-Deerlodge and Bitterroot National Forests.

Special concerns during the fire season included Westslope cutthroat trout habitat, threatened and endangered plant species on the Big Hole Battlefield, historical Forest Service structures, the Mussigbrod Campground, as well as ranches and homes near the Forest boundary.

Only three ranches were actually threatened by the fire, and all were protected, though some private property (e.g. fences) was damaged. The only major structure that burned was the Bender Creek Bridge. The Big Hole Battlefield closed for a time, and evacuation was advised in the northwest part of the Big Hole Valley.

The Mussigbrod Fire Complex burned in wilderness, roadless (Figure 5 -Wilderness & Roadless Area Map) and developed lands managed for timber. No other Federal or State (you said agency) lands were involved.

The Mussigbrod Complex is located in the Big Hole watershed. The Big Hole Watershed Committee has been working for several years with agencies on water quality and quantity issues, recreation, and vegetation health. This committee offers an excellent collaboration opportunity for future planning. Inventory of resources for a Landscape Analysis began in 2000, but was curtailed by the fire season. The Big Hole Landscape Analysis is now scheduled for completion in 2002.

MIDDLE FORK COMPLEX

The Middle Fork Complex, (See Figure 4) located southwest of Philipsburg on the Pintler Ranger District, included 11 fires totaling 25,040 acres. About 18,000 acres burned on the Beaverhead-Deerlodge and the remainder burned on the Bitterroot National Forest.

The fires began July 23, when lightning touched off the Cougar Creek Fire in the upper reaches of the Ross Fork of Rock Creek. On July 31, lightning struck again along the Continental Divide, from Lost Trail Pass northeast through the Anaconda Pintler Wilderness. This lightning storm ignited the Falls Fork and Copper Creek fires in the AP Wilderness. By August 2, the Cougar Creek Fire burned over 3,800 acres, and the Falls Fork and Copper Creek Fires combined for about 1,000 acres

Fires around the western part of Montana continued to grow, and by August 10, public lands west of the Divide, were closed to the public.

By the third week in August, the Skalkaho Pass Fire and the Coyote Fire burned into the Forest from the Bitterroot. They became part of the Middle Fork Complex, which by August 13 included eight fires and 15,610 acres.

Over the next few weeks, fire danger remained at “extreme,” no moisture fell, and the fires ground along. The Middle Fork Complex, on September 2, had 886 personnel engaged on nine fires.

Special concerns during the fires included bull trout and Westslope cutthroat trout habitat, the Sapphire Divide Research Natural Area, wildlife habitat, cultural resource sites, the Moose Lake area, ranches, and homes near the Forest boundary.

Evacuation warnings were given at one point to residents in the Moose Lake area. The Skalkaho Highway was closed for most of August, however the fires remained mostly in wilderness and roadless lands. (Figure 5 - Wilderness & Roadless Area Map).

The Middle Fork Complex is located in the Rock Creek watershed. (The creek is considered a "blue ribbon" trout stream of national significance). Fires in the Middle Fork Complex spread across the Middle Fork, Ross Fork, and West Fork drainages in the watershed. All three contain bull trout and Westslope cutthroat trout.

The Rock Creek Subbasin Review, completed in 1998, provides the landscape analysis for these watersheds. Rock Creek was selected to test implementation concepts included in the Interior Columbia Basin Draft Environmental Impact Statement. As a result, there is an abundance of data available in GIS for this area. There is also a list of management recommendations for the watersheds, developed through interagency collaboration. (See Figure #1, Landscape Vicinity)

MONITORING

I. EFFECT OF FIRES ON FOREST OPERATIONS

A. Number and size of fires compared to other years

The Beaverhead-Deerlodge Forest experience a total of 135 fires in 2000, compared to 70 in a normal year (average since 1986).

Table 1. Fires of 2000 compared to the last 10 years

Year	# of Fires	Acres Burned
1990	118	842
1991	91	240
1992	50	103
1993	10	7
1994	108	1,611
1995	36	373
1996	112	3,375
1997	21	7
1998	76	1701
1999	126	4,36
2000	135	69,916

Of those 135 fires, the 106 were lightening caused for a total of 69,741 acres.

Table 2. Cause of Fires in 2000, by size class

Cause of Fires	<.25 acres	<10 acres	<100 acres	<300 acres	<1000 acres	<5000 acres	>5000 acres	Total fires	Total Acres
Lightening	44	42	10	1	3	3	3	106	69,741
Campfires	16	2	0	0	0	0	0	18	0
Equipment	1	0	0	0	0	0	0	1	10
Debris burning	2	2	0	0	0	0	0	4	0
Children	0	0	0	1	0	0	0	1	1
Misc.	1	2	2	0	0	0	0	5	164
Totals	64	48	12	2	3	3	3	135	69,916

The pattern of fire starts had a significant impact on our fire personnel. Several days had multiple fire starts, making it difficult for normal fire manning levels to respond.

Table 3. Fire Starts per Day in 2000

Number of fires starts	Days with that many fire starts
10	1
6	1
5	1
4	7
3	6
2	12

B. Impact on Personnel

Aside from regularly employed fire personnel, a great number of other Forest Service personnel were recruited to combat the wildfires and offer fire support. This ultimately affected other work accomplishments on the Forest (see Section C).

Table 4. Manpower affected by Fires of 2000

Type of Personnel	Number in 2000	Totals
Fire Personnel		179
Regular appointed fire personnel	113	
Seasonal or short-term personnel	66	
Non-Fire Personnel		373
Other FS seasonals	33	
Emergency firefighters	90	
Casuals employed on fires	250	
TOTAL		552

C. Impacts on work accomplishments

(As measured for the Management Attainment Report (MAR)).

The Beaverhead-Deerlodge Forest met our FY 2000 MAR Targets with the following 7 exceptions, five of these were a direct result of shifting personnel to fire duties or fire closures on the Forest (***items in italics in Table 5).***

Table 5. Forest Targets NOT Accomplished in 2000

Indicator	Target	Accomplishment	Reason for shortfall
Road Decommissioning	***35 miles***	***12 miles***	***Lack of available personnel due to support of fire suppression activities***
Inland Fish Stream Restoration	***20 miles***	***7 miles***	***These projects were located on Pintlar and Wisdom districts – priorities shifted to support fire fighting and wildfire rehab efforts***
Recreation and Heritage Sites	***1,030,000 visitor days*** ***2 sites***	***93,000 visitor days*** ***1 site***	***Forest closures due to fire danger kept visitors out, heritage personnel reassigned to fire duties.***
Mineral Operations	***190 operations***	***155 operations***	***Forest closures reduced applications which decreased processing and***

Indicator	Target	Accomplishment	Reason for shortfall
			administration workload
Soil and Water Improvement	***95 acres***	***75 acres***	***Heavy fire activity and personnel reassignment prevented completion.***
Road Reconstruction	20.7 miles	6 miles	Region only funded Centennial Divide project
Trail Construction	18.5 miles	14 miles	Substituted a project with higher unit cost, unable to pay for more miles

Table 6. Forest Targets EXCEEDED because of Fires in 2000

Indicator	Target	Accomplishment	Reason for shortfall
Noxious Weed Treatment	***2000 acres***	***4068 acres***	***Fire activity funded many permanent people, freeing up funds to keep seasonal crews treating weeds later in the year.***
Range Structural Improvements	***75 structures***	***80 structures***	***Fire activity funded many permanent people, freeing up funds for more improvement work.***

II. EFFECT OF FIRES ON NATURAL RESOURCES

For two months after rain and snow extinguished the Mussigbrod and Middle Fork Fires, resource specialists evaluated the immediate effects of the fires on natural resources. They first prepared a Burned Area Emergency Rehabilitation (BAER) Plan. This Plan recommended short-term emergency actions to remove hazards and stabilize soils and watersheds. The team then prepared a Long Term Rehabilitation Plan.

This Plan recommended projects for the next 3-5 years to:

1. Protect long term public health and safety, unique natural and cultural resources and environmentally sensitive areas and investments
2. Contribute to watershed or ecosystem function, water quality improvement and Threatened and Endangered Species habitat restoration or

3. Replace needed infrastructure
4. Minimize uncharacteristic fire/fuel conditions and are
5. Develop cooperatively with communities.

The plan evolved from assessment of the changes created by the Mussigbrod and Middle Fork Fire Complex. The Interdisciplinary Team evaluated changes using their knowledge of previous conditions and resource issues for the area. Geographic Information Systems (GIS) specialists supported the team by providing the analytical framework for mapping and assessing spatial patterns of vegetation and fire behavior. The result is a map of forest fire burn intensity (Figures 3 & 4 – Burn Intensity Maps). Low-level infrared photography provided a method for mapping large areas otherwise inaccessible. GIS specialists in support of resource specialists were able to use existing GIS themes from the Forest database (i.e. timber stand mapping, roadless areas, etc.) with newly acquired data sets to assess resource impacts. The resulting analysis helped assess potential effects and direct mitigation measures.

This section reports findings from the Long Term Rehabilitation Plan as they relate to Forest Plan Monitoring Items. The Mussigbrod Fire evaluation follows Monitoring Items set out in the Beaverhead Forest Plan (1986). The Middle Fork Fire Complex follows Monitoring Items set out in the Deerlodge Forest Plan (1987). A section of recommendations follow with further monitoring of fire effects.

For a complete report on Post-Fire Findings and subsequent Recommendations, See the "Mussigbrod and Middle Fork Fires, Long Term Rehabilitation Plan", USDA, Forest Service, Northern Region, Beaverhead-Deerlodge National Forest, October, 2000.

ANALYSIS OF MONITORING ITEMS AS AFFECTED BY THE FIRES

A. BEAVERHEAD FOREST PLAN

1-1 Elk Population Trend
OBSERVATIONS – MUSSIGBROD FIRE Not an issue, fires will effect security and displacement, not numbers, Item 1-2 and 1-10.
1-2 Elk Winter Forage
OBSERVATIONS – MUSSIGBROD FIRE Elk in this area traditionally winter in the East Fork of the Bitterroot, which also burned. The winter of 2000/2001, elk are expected to move lower in the Big Hole onto private land. Little federal winter game range is involved so there's little the FS can do to alleviate displacement onto private lands except communicate with Fish, Wildlife & Parks and landowners.
1-3 Big Game Population Trend (moose, deer, bighorn sheep)
OBSERVATIONS – MUSSIGBROD FIRE Not evaluated as a concern of the Mussigbrod Fire. Elk, deer and moose were displaced by the fire and suppression activities, some moving down onto private land in the Big Hole Valley. Habitat is not currently a limiting factor for population levels of these species. Bighorn sheep do not summer or winter in this area.
1-4 Winter Range Condition/Trend (moose, deer, bighorn sheep)
OBSERVATIONS – MUSSIGBROD FIRE Not evaluated as a concern for the Mussigbrod Fire. Mule deer that summer in this area winter on the East Fork of the Bitterroot. As reported in the 1996 M&E Report, moose in the Bighole area winter primarily on private land and private haystacks. Bighorn sheep do not summer or winter in the Mussigbrod area.
1-5 Wildlife Habitat Improvements
OBSERVATIONS – MUSSIGBROD FIRE 1020 acres of habitat restoration accomplished elsewhere on the Forest, exceeding Forest Plan monitoring requirement of 250 acres.
1-6 Sagegrouse population numbers
OBSERVATIONS – MUSSIGBROD FIRE Sage grouse are not a species of concern in the Mussigbrod area, see list under 1-8.
1-7 Trumpeter swan nests
OBSERVATIONS – MUSSIGBROD FIRE

Trumpeter swans are not a species of concern in the Mussigbrod area, see list under 1-8.

1-8 Threatened and Endangered Species

OBSERVATIONS – MUSSIGBROD FIRE

Pre-burn TES species of concern are the Canada lynx, Rocky Mountain wolf, northern bog lemming, black-backed woodpecker, and western toad.

- Canada lynx – Lynx is listed as a threatened species, and the animal and its habitat are being managed under the direction of the Canada Lynx Conservation Assessment and Strategy (LCAS January 2000). Lynx were known to occupy the area prior to the fire. Most of the burned area was classified as potential lynx habitat. Past vegetation management affected an average of 6% of the eight LAUs (range 0-17%). Many older clearcuts were becoming suitable lynx foraging habitat. "Old growth" denning habitat was abundant.
- Gray Wolf - Gray wolves are classified as nonessential experimental in the Mussigbrod Complex area. Wolves have been observed in the burned area and adjacent landscape, especially since the 1995 transplantation of wolves into central Idaho. Presently, there is no evidence of "resident" wolves in the burn area.
- Northern Bog Lemming – This species is classified as a Forest Service Sensitive Species. The only known population south of the Continental Divide in Montana is at Maybee Meadows, about one mile south of the fire perimeter. Preferred bog lemming habitat appears to consist of moderately wet sites which support sphagnum moss mats within spruce-fir and lodgepole pine forests (Reichel and Beckstrom 1993, Reichel 1996). Such habitat occurred within the burn area, but very little of it had been surveyed for northern bog lemmings.
- Western Toad - Western toads are classified as a Forest Service Sensitive Species. Little is known about the occurrence of this species within the burned area. Portions of the Mussigbrod Fire Complex area were included in research on amphibians by a graduate student prior to the burn.

FINDINGS

- Lynx - The fires of the Mussigbrod Complex affected eight Lynx Analysis Units (LAUs) (Table 11), five of which contain 15% or greater fire area. Of greatest concern, 74% of the Johnson/Bighole LAU was affected by fire. Fifty-seven percent of the Mussigbrod LAU was affected by fire. Only three LAUs involved were affected less than 10% including the Howell LAU and NF Big Hole LAU, which showed less than 1% change (probably insignificant levels).

  The fire burned mostly in potential denning and traveling habitats. Not much conifer plantation foraging habitat was burned. In the short term following a burn, there is a negative correlation between lynx use and the amount of area burned (Fox 1978). Snowshoe hares recolonize within 5 years; their numbers peak after about two decades, and then they decline over time. Lynx require late succession forests with large downed woody debris for denning.

  The LCAS (2000) speaks favorably toward restoration of natural fire regimes but recognizes these short-term tradeoffs. In the long term, the burn will be highly beneficial

to lynx populations. The result of the fires will be greatly increased conifer reproduction foraging habitat and high quality denning habitat as the fire- killed trees become down woody debris in the maturing conifer reproduction. This, of course, assumes there will be minimal removal of burned trees from the fire areas. While the fire displaced and perhaps killed some individual animals, it was not of a magnitude to threaten the continued existence of the species at the population scale. Wildlife species of the Northern Rockies evolved with, and depend on, these fire regimes to cycle habitats.

Table 7. Lynx Analysis Units Affected by the Mussigbrod Complex

LAU Name	LAU Number	% Affected	'Burned' Acres	'Unburned' Acres	Total Acres
UpperTrail	100200040401	35%	5,942	10,818	16,760
Tie	100200040601	15%	3,009	17,058	20,267
Johnson/Bighole	100200040602	74%	19,463	6,906	26,369
Mussigbrod	100200040603	57%	10,731	7,997	18,728
Plimpton	100200040604	16%	4,383	23,506	27,889
Howell	100200040605	>1%	120	14,870	14,990
NFBigHole	100200040606	>1%	191	29,408	29,599
Pintlar	100200040702	7%	1,503	19,997	21,500
Total		26%	45,342	130,760	176,102

"% Affected" indicates the percentage of the LAU within a fire perimeter and thus potentially affected. "Burned" acres indicate acres within the fire perimeter but not precisely mapped or assessed at this time. "Unburned" acres indicate area unaffected by the fire.

- Gray Wolf - The effects narrative for lynx is appropriate for the gray wolf also, since the LAUs are equal to 6th order HUCs. Table 7 above shows that 26% of eight LAUs were burned over, and three LAUs were extensively burned over (35-74%). No wolves were denning in the burned areas; therefore, fire related impacts would be possible reductions in prey abundance and availability. Elk, deer, and moose were likely displaced by fire and suppression activities to private lands, where wolves following the ungulates would be likely to get in trouble. In late autumn, the elk and deer will depart for winter ranges in the East Fork of the Bitterroot, and wolves staying in the area will be dependent on moose and carrion. Much of the winter range in the East Fork burned also, which could cause serious winter losses to elk and deer that summer in the Mussigbrod Fire area. Short-term effects will be negative for wolves, but long-term effects will be beneficial.
- Northern Bog Lemming - The fire didn't reach the Maybee Meadows bog lemming

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- occupied habitat; however, bog-fens that might have been occupied by bog lemmings were burned over. The concern is that the amount of impact to most of these bog-fens and surrounding forests needs to be determined, so that effects of the fire on bog lemming habitat, and hence on bog lemming population viability, can be evaluated.

Western Toad - The fire burned western toad habitat, and, combined with the drought, may have destroyed the annual reproductive effort, and perhaps the breeding population within portions of the burned area. Data is required to determine the fire impacts to western toads.

1-9 Cavity nesting habitat management

OBSERVATION – MUSSIGBROD FIRE

Post-fire snag assessment in the Big Hole Landscape Analysis (2001) reports:

The Mussigbrod Fire Complex area had not been subject to large fires or beetle outbreaks in the past several decades. Most snags were produced through long-term successional processes. As a result, snags in open settings were limited, while snags in forested stands may have been locally abundant. The density of snags greater than 9 inches DBH on the wildfire impacted area would have averaged 9 per acre for Douglas-fir, 12 per acres for lodgepole pine, 21 per acre for spruce-fir, and 31 per acres for whitebark/limber pine (Harris, 1999).

Pre-burn cavity nesters of specific concern are the black-backed woodpecker, pileated woodpecker and boreal owl.

- Black-backed Woodpecker – These woodpeckers are classified as a Forest Service Sensitive Species. They are primary cavity nesters that excavate nest holes in snags and live trees with heart-rot. Virtually any mature or old growth conifer stand with an abundance of large dead or dying trees will provide adequate nesting sites. However, throughout its geographical range, the black-backed woodpecker is far more abundant in recent burns than in mature coniferous forest and clearly recruits to burns (d 1995, Murphy and Lehnhausen 1998). Black-backed woodpeckers feed primarily on the larvae of wood-boring beetles. Relatively high local population densities may temporarily develop where these larvae are abundant, typically in areas of newly burned, beetle-killed, or partially cutover forest (Bull et al 1986, Murphy and Lehnhausen 1998). Black-backed woodpeckers most likely occupied suitable habitats within the burned area prior to the fire. Surveys document the species near the fire perimeter in the Elk Creek Fire of 1998.
- Pileated Woodpecker - Pileated woodpeckers are important primary excavators of large cavities in Douglas-fir and aspen stands. In the Big Hole, pileated woodpecker nests seem to be in aspen snags, but the birds forage on large Douglas-fir trees. Similar to goshawks, pileated sightings and known nests are at lower elevations and close to the NF boundary. A known pileated woodpecker nest was located in an aspen stand that burned over.
- Boreal Owl - Boreal owls are a former Forest Service Sensitive Species, and are of special interest because of the large number of nest boxes that were installed in the early 1990s that are in the burned area. At least 48 boreal owl boxes were within the

fire perimeter, primarily in Johnson and Tie Creeks. Two of four nest boxes that had been used by boreal owls in 1999 were within the fire area.

FINDINGS

At least 1,000,000 existing snags greater than 9 inches DBH were consumed by the wildfire, or charred severely. However, the wildfire created an estimated 3,000,000 snags of the same size classes (Fischer and Bradley, 1987; Saab and Dudley, 1998). About 50% of the new snags were probably charred so severely they would not be colonized by woodborer larvae, so would no be useable by black-backed woodpeckers. Most likely, the best habitat created by the fire is confined to the periphery of the burn where charring was less extensive.

- Black-backed Woodpecker - The fire created thousands of acres of new suitable habitat for this species. However, much of the potential habitat may be higher than the possible upper elevational limits on black-backed woodpecker occurrence. The lower elevation partially burned fringes of the fire are the best black-backed habitat and also the most likely areas for burned tree removal. The use by black-backed woodpeckers of the burned area, including the high elevation portions, needs to be determined so that the impacts of burned tree removal and firewood cutting on black-backed woodpecker population viability can be evaluated.
- Pileated Woodpecker - The effects narrative for lynx is appropriate for the pileated woodpecker also, since the LAUs are equal to 6th order HUCs. Table 7 above shows that 26% of eight LAUs were burned over, and three LAUs were extensively burned over (35-74%). Pileated woodpecker occupied habitat was destroyed by the fire, including a known nest site in an aspen grove, but the amount of aspen groves and Douglas-fir forests totally consumed and the use of burned areas by pileated woodpeckers need to be determined so that the fire's impact on pileated woodpecker population viability can be evaluated.
- Boreal Owl - The effects narrative for lynx is appropriate for the boreal owl also, since the LAUs are equal to 6th order HUCs. Table 7above shows that 26% of eight LAUs were burned over, and three LAUs were extensively burned over (35-74%). Boreal owl occupied habitat was destroyed by the fire, including known nests in nest boxes that were put up especially for boreal owls. At least 48 of these boxes were within the burned area, but the number of boxes actually burned, the amount of spruce-fir and lodgepole pine forests totally consumed, and the use of burned areas by boreal owls need to be determined so that the fire's impact on boreal owl population viability can be evaluated.

1-10 Habitat effectiveness - security cover/road closures

OBSERVATIONS – MUSSIGBROD

Elk Security - Prior to the fire, hiding cover for elk was reduced in the Johnson-Bender-Tie Creek area by logging and associated road building. Only one Habitat Analysis Unit (HAU), of seven at least partially burned over, was below the Forest Plan Elk Effective Cover (EEC) standard of 70%. That was because of open road density, not loss of hiding cover (see Table 9). However, because of the open road distribution in most of the HAUs, the Hillis Security Area

(Hillis et. al. 1991) standard (30% of the analysis area being elk security habitat) was not satisfied pre-burn.

Table 8. Pre-Fire Elk Habitat Data

HAU	Acres	Hiding Cover %/Acres	Open Road Miles	Open Road Density	EHE	EUP	EEC
Prairie - A	6,202	45.9/ 2,847	5.4	0.56	74	99	73
Elk-Sheep - C	11,845	49.5/ 5,838	5.2	0.28	88	98	86
Upper-Tie - D	6,341	41.1/ 2,609	2.0	0.22	90	100	90
Wooster - E	7,240	46.0/ 3,334	3.7	0.3	84	100	84
Shultz – F	7,433	40.4/ 3,005	8.0	0.69	70	100	70
Bender - G	9,331	45.9/ 4,282	13.2	0.9	64	100	64
Mussigbrod South - H	4,933	42.1/ 2,082	4.9	0.64	72	100	72
Total/Average	53,325	45.0/23,997	42.4	0.51	77	99	76

Displacement of Big Game - Elk and some mule deer that summer in the fire area, winter in the East Fork of the Bitterroot River drainage. The East Fork winter range burned up in the Sula and Valley fire complexes. It is expected that the wintering animals will be forced down to lower elevation private land to find food. Some elk, deer, and moose were forced onto private land in the Big Hole Valley by the fire and suppression activities.

FINDINGS

Elk Security - Hiding cover has been reduced in all of the seven HAUs that were, at least partially, burned over. Now 6 of the 7 HAUs are below the Forest Plan Elk Effective Cover (EEC) standard of 70%, because of open road density and loss of hiding cover. The Shultz and Bender HAUs lost all vegetative hiding cover, and both have high open road densities. All other HAUs, except for Elk-Sheep, lost 50-60% of their hiding cover (see Table 10). Because of the open road distribution in most of the HAUs, the Hillis Security Area (Hillis et. al. 1991) standard (30% of the analysis area being elk security habitat) is not being satisfied post-burn.

Although forage will be abundant in 2-3 years, it probably will take 20-30 years before regrowth of hiding cover. If the proportion of mature bulls, and bull:cow ratios remain important, and if bull harvests aren't controlled by hunting regulations, then road closures or obliterations would be the only way to increase elk security

Table 9. Post-Fire Elk Habitat Data

HAU	Acres	Hiding Cover %/Acres	Open Road Miles	Open Road Density	EHE	EUP	EEC
Prairie - A	6,202	20.2/ 1,253	5.4	0.56	74	36	27
Elk-Sheep - C	11,845	42.9/ 5,075	5.2	0.28	88	100	88
Upper-Tie - D	6,341	24.7/ 1,565	2.0	0.22	90	56	50
Wooster - E	7,240	24.2/ 1,750	3.7	0.3	84	51	43
Shultz - F	7,433	0/0	8.0	0.69	70	0	0
Bender - G	9,331	0/0	13.2	0.9	64	0	0
Mussigbrod South - H	4,933	25.7/ 1,266	4.9	0.64	72	60	43
Total/Average	53,325	20.5/10,913	42.4	0.51	77	36	28

Displacement of big game - There is concern the Forest Service can do little to alleviate displacement other than to communicate with private landowners and the Montana Fish, Wildlife, and Parks.

1-11 Wildlife – Old Growth Habitat

OBSERVATION – MUSSIGBROD FIRE

Pre-burn Management Indicator Species (MIS) of concern for old growth are the pine marten, and northern goshawk.

- Pine Marten - Pine marten are a Beaverhead NF MIS for old growth spruce-fir forests and an important furbearer. Marten were present throughout the burned area in suitable habitat prior to the fire. Research on pine marten in the burn area, before the fire, has been documented in three Master's Theses (Fager 1991, Kujala 1993, Coffin 1994). The information provided for lynx, above, is applicable to marten habitat also.
- Northern Goshawk - Northern goshawks are a Beaverhead NF MIS for old growth Douglas-fir forests and a Forest Service Sensitive Species. Lodgepole pine forests are heavily utilized as well in the Big Hole. At least 12 goshawk nests have been located in the Big Hole Landscape since1990. Most of the known goshawk nests are at lower elevations (< 7,500 feet) within 2 miles of the NF boundary and in either Douglas-fir or lodgepole pine trees. Individual goshawks have been observed within the burned area. The fire perimeter is very near a known nest at Maybee Meadows. No goshawk nests were known to have occurred in the burned area.

FINDINGS

- Pine Marten - The effects narrative for lynx is appropriate for the pine marten also, since the Landscape Analysis Units (LAU) are equal to 6th order watersheds. Table 7 above shows that 26% of eight LAUs were burned over, and three LAUs were extensively burned over (35-74%). Marten occupied habitat was destroyed by the fire, but the amount of spruce-fir and mature-old lodgepole pine forests totally consumed and the use of burned areas by marten need to be determined so that the fire's impact on pine marten population viability can be evaluated. It has been estimated that to maintain a viable population of marten (200-250 individuals) in the Big Hole Landscape, about 74,000 acres of interconnected mature forest must be maintained over time. Prior to the fire, maintenance of 75,000 acres was deemed quite feasible.
- Northern Goshawk - The effects narrative for lynx is appropriate for the northern goshawk also, since the LAUs are equal to 6th order HUCs. Table 11 above shows that 26% of eight LAUs were burned over, and three LAUs were extensively burned over (35-74%). Goshawk occupied habitat was destroyed by the fire, but the amount of Douglas-fir and mature-old lodgepole pine forests totally consumed and the use of burned areas by goshawks need to be determined so that the fire's impact on northern goshawk population viability can be evaluated.

2-1 Fisheries habitat improvement

OBSERVATIONS – MUSSIGBROD FIRE

Grayling

Fluvial arctic grayling in the Big Hole River drainage were petitioned for listing in 1991. The U.S. Fish and Wildlife Service finding in 1996 was "warranted but precluded" based on higher priorities. Based on a memorandum of agreement with the USFWS, failure to maintain minimum numbers of certain year-classes in the Big Hole River, or to accomplish reintroduction objectives in other river drainages, will result in reevaluation of the grayling's status under the Endangered Species Act. Since the USFWS preliminary finding was that listing was "warranted", inability to meet goals and objectives in the recovery plan could result in listing.

The last remaining native population of fluvial (river dwelling) Arctic grayling persists downstream of the fire perimeter in the North Fork Big Hole River and mainstem Big Hole River. These streams receive water from Tie, Shultz, Johnson, Bender, Hell Roaring, and Mussigbrod Creeks. These all have the potential to cause indirect effects on the occupied sections of the river by causing increased sediment or water yields.

Westslope Cutthroat Trout

Westslope cutthroat trout were petitioned for listing throughout their historic range in 1998. The subsequent finding by the USFWS was "not warranted". Regardless, westslope cutthroat trout status in the upper Missouri River drainage is less than ideal. A 1995 viability analysis on all upper Missouri populations indicated most were at a very high risk of extinction. None were considered to have low risk. A large proportion of genetically pure populations are isolated in short headwater stream reaches (often less than 2 miles), reducing their ability to cope with localized disturbance. Natural events or management actions, which threaten the viability of individual populations, also risk genetic diversity within the subspecies.

Westslope cutthroat trout are found in the extreme upper portions of Bender, Hell Roaring, and

Plimpton Creeks (Figure 13). The populations in these streams represent 3 of only 23 genetically pure populations remaining in the Big Hole sub-basin. All 23 of these populations are limited to short sections of stream, frequently less than 2 miles. Because of the small sizes of these populations and the lack of connectivity between them, all are considered to be at extreme risk of extinction.

Several of the affected watersheds contain important recreational brook trout fisheries: Tie, Johnson, Bender, Trail, and Elk Creeks. Prior to the fire, these streams contained some of the highest densities of brook trout found in the Big Hole sub-basin (Figure 14). All had densities that ranked in the top 15% of 300 sampled (and occupied) stream reaches on the National Forest. In fact, one reach of Bender Creek ranked in the top 2% with 110 brook trout/100 meters of stream length.

Mussigbrod Lake supports important brook trout, grayling, and burbot recreational fisheries.

This is one of few lakes that has a campground and road access. All of these populations are relatively strong, but the lake depth is relatively shallow and therefore more susceptible to a winte fish kill (Richard Oswald, MFWP, personal communication.).

FINDINGS

Fire affects fish habitat mostly by changing vegetation cover. When any disturbance results in less than 10% of the ground surface covered with plants and litter, surface runoff can increase over 70%, and erosion can increase by orders of magnitude (Robichaud et al. 2000). Impacts include loss of channel stability, sediment and ash delivery to stream courses from erosion, and changes in the ability of the stream to moderate temperature extremes. Increased stream flow is expected where most or all vegetation is killed, because interception and evapo-transpiration are reduced (Swanson 1981).

Effects of wildfire on fish habitat have been found to be natural without persistent effects. Rainbow trout in Beaver Creek, a tributary to the Missouri River in Montana, rebounded strongly within 2-3 years after the North Hills Fire significantly reduced the population (Novak and White 1989). Rieman and Clayton (1997) found species such as bull trout and steelhead, well adapted to pulsed disturbances like those created by fire. Burns (2000) indicated that Chinook salmon, steelhead, bull trout, and cutthroat in the Middle Fork of the Salmon River tributaries and main Salmon River tributaries were not expected to be adversely affected by any disturbances to habitat from wildfire.

For the purposes of this analysis, risk and potential extent of impacts to individual fisheries resources were considered to largely depend on:

- Extent of vegetative change in individual watersheds (area burned and burn intensity).
- Whether riparian vegetation was eliminated adjacent to extensive areas of high burn intensity.
- Burn severity plus soil types and change in the capacity of soils to allow adequate infiltration during rain and snow melt events.
- Drainage basin (watershed) characteristics.
- Proximity of fish populations to disturbed areas.
- Size of the stream.

- Occupied stream length and status and health of populations.

- Availability of segments where fish can avoid critical impacts of the fire and its aftermath.
- Values at risk and extent of loss if untimely, intense precipitation or run-off events occur.

Johnson, Schultz, Bender, Hell Roaring, and Mussigbrod Creeks are the primary areas of focus. Timber harvest in the Johnson and Schultz drainages during the 1960s resulted in increased peak flows, degraded channel stability, and reduced the quality of pool habitats (Bender-Retie FEIS, 1991; page III-41). Recent surveys have not been conducted to determine the extent of stream channel and fish habitat recovery. If this has not fully occurred, effects from the fire may be amplified.

In the drainages listed above, high intensity burn areas consumed riparian vegetation over relatively long, continuous lengths of stream, with large areas of stand replacement burns on adjacent side slopes. Burn severities were generally moderate on the slopes, with limited areas of high severity more common in the drainage bottoms, where fuel accumulations were high. Risk to fisheries in these areas is significantly increased due to nearly complete vegetative removal from side slopes, causing a reduction in the ability of riparian areas to mitigate changes in run-off or sediment recruitment from upslope areas.

Areas of elevated risk occur in three places in upper Johnson Creek, constituting a total of 1,950 acres and 3.5 miles of stream. Also within upper Johnson Creek drainage, an additional 555 acres with similar characteristics are present along 1.0 mile of Schultz Creek. In total, these represent 33% of the drainage area and 65 -70% of the perennial stream length in Johnson Creek drainage above FS Road #1203. Past management has impacted these drainages. Where full recovery has not occurred from timber harvest and grazing, the potential for problems is more likely.

In Bender Creek, 1,012 acres are as described above along 3 miles of stream. This represents about 12% of the drainage area and 63% of the stream length above the FS boundary, and possibly as much as 15-20% of the habitat occupied by cutthroat (extent of distribution has not been accurately defined). In Hell Roaring Creek, 680 acres along 1.6 miles of stream, representing 45% or more of the stream length occupied by cutthroat (extent of distribution has not been accurately defined).

Conditions described above occur over 1,732 acres and 2.1 miles of stream in the Mussigbrod Creek drainage above the mouth of Hell Roaring Creek. These acreages in Hell Roaring and upper Mussigbrod Creek represent 30% of the drainage area and 45% of the perennial stream length above Mussigbrod Lake. Additional areas in these drainages suffered high burn intensity, but they were less expansive and appeared to have adequate vegetation between them and the streams to largely mitigate sediment introduction.

Models of the 10-year storm events comparing pre- to post-fire conditions indicate a 30 to 32% increase in discharges in the Johnson, Bender (at FS road 1203), and Mussigbrod drainages (at Mussigbrod Dam). This may have limited consequences from a drainage perspective, but could be detrimental to fish in important stream segments. This is especially true where the stream's potential to buffer stochastic events has been significantly handicapped. Based on these conditions, these drainages have relatively high potential for streams to receive large amounts

of sediment from slopes; increased storm and run-off discharges; and increased channel instability.

Westslope cutthroat fisheries in Bender and Hell Roaring Creeks have notable portions of occupied habitat at risk from post-fire impacts. Similarly, the combination of impacts in all drainages affected by the Mussigbrod Complex Fire present some likelihood of transmitting impacts to fluvial arctic grayling in localized areas on the Forest. Significant habitat alterations could reduce the amount of suitable over-winter habitat (sediment can fill deep pools and interstitial spaces in the stream bed) and negatively impact recruitment (sediment embeds in spawning gravel), thus magnifying risks to the long-term viability of these populations.

Mussigbrod Lake is relatively shallow (personal communication). Richard Oswald, MFWP) and is therefore at increased risk of oxygen depletion in winter. Increased phosphate from ash flowing into the lake will likely lead to large algal blooms and therefore increases the risk of a winter fish kill from oxygen depletion. Mitigation might include plowing snow off the surface of the ice in winter to allow sunlight to penetrate into the depths of the lake. This allows algae to continue to photosynthesize and produce oxygen.

RECOMMENDATIONS

- Reduce non-natural sources of sediment by obliterating roads and improving water management on the majority of remaining roads in the affected watersheds.

Reduce the probability of new impacts to streams by cattle by changing season or duration of grazing as well as fencing riparian areas along Johnson Creek as needed.

2-2.5 Habitat & population response to improved conditions

Included in discussion for 2-1.

2-3 Riparian Area Function

OBSERVATIONS – MUSSIGBROD FIRE

There are two concerns for how the wildfire affected riparian function. The first is how vegetation removal changes stream channel stability and stream flow regimes. This is addressed in item 3-1. This section will focus on the impacts of the fires on willow/shrub and aspen stands and that result on riparian habitat.

Riparian areas in the Big Hole Valley range from narrow steep, entrenched channels (channel type A) with conifer overstory to wide, flat valley bottoms with broad floodplains (channel types E and C) and willow and sedge cover. Most of the steep valleys are inaccessible and relatively undisturbed by direct human management, while most flat valley bottoms have a long history of use, predominately roads and grazing. The existing condition of most of the flatter valley bottoms range from functional-at-risk to non-functional most often because of bank trampling or overuse of vegetation by wildlife or livestock. Currently, browse on woody riparian species including willow or aspen is at an intense level across southwest Montana (Keigley and Frisina, personal communication) and has been so since 1987, according to surveys by the Beaverhead National Forest; University of Montana, Missoula; and Montana Fish, Wildlife, and Parks.

The effect of numerous consecutive years of intense browsing ranges from loss of younger age classes from willow and aspen stands to total loss of stands. Historically, it is likely the

proportion of willow and aspen dominated riparian stands has never been this low (Wendel Hann, personal communication). The added grazing pressure from livestock and the rising numbers of moose and elk to prehistoric population highs exacerbates the problem of disturbance and stress occurring in the remaining willow/aspen dominated riparian areas.

FINDINGS

The Mussigbrod Fires burned conifers and a few willow stands in parts of some valley bottoms. Approximately one hundred acres of willow/sedge stands burned intensely in the Johnson Creek drainage. Several hundred acres of large spruce, fir, and the lodgepole pine burned intensely (moderate to high severity) in the Hellroaring and Mussigbrod drainages.

These burned areas offer the possibility of rejuvenated alder, willow, or aspen stands in these valley bottoms. However, because of the relatively small area burned compared to the existing situation in the overall riparian landscape, these areas are expected to draw unnaturally large numbers of livestock and wildlife to them to graze/browse on the regenerating and remnant riparian woody shrub stands. Under the current situation, the expected long-term result of the burn and the browsing disturbance regime is the loss of willow/aspen stands in these drainages.

RECOMMENDATIONS

Fence select stands from moose and elk. Monitor recovery of willow/shrub and aspen stands within the fire perimeter.

3-1 Watershed – impacts of management activities on sediment

OBSERVATIONS – MUSSIGBROD FIRE

The intent of this watershed monitoring item is to assess the impact of management activities on sediment. Instead, this discussion will assess the effect of a natural event (wildfire) on sediment and stream function.

Issues addressed will include:

- Increases in erosion, sedimentation, and nutrients with possible effects on stream channel stability and beneficial uses like municipal water supply and irrigation.
- Changes in stream flow regime, including short-term increases in peak flow. Potential effects include changes in stream channel stability and ability of culverts and bridges to pass peak flows. Peak flow analysis considers watersheds above the point where important infrastructure is first encountered.
- Changes in large woody debris (LWD) recruitment and its effect on stream channel stability.
- Reduction in streambank stability where vegetation plays a significant role in bank integrity.

This assessment considers watersheds affected by fire within the Big Hole River basin. Watersheds considered include Trail Creek, Prairie Creek, Tie Creek, Johnson Creek, Bender Creek, Mussigbrod Creek, Plimpton Creek, and Pintler Creek. All watersheds drain into the Big Hole River, a large order stream within the Missouri River basin.

Watershed function integrates the soil and hydrologic function over a watershed, telling us how well a basin infiltrates, stores, and releases water. Landforms and geologic parent material

exhibit a strong influence on watershed function. Plutonic rock types, such as granite, dominate this part of the Big Hole Landscape. Landforms derived from glacial activity dominate the area, with exceptions in the Trail and Prairie Creek watersheds. Glacial till (moraine), a matrix of rock and soil debris, provides a thick mantle over much of the area. Glacial till typically absorbs and retains water very well, providing a slow release of water throughout the year. Because surface runoff is rare, surface erosion is very limited as well. Drainage densities within areas of glacial till are typically low, further enhancing a slow release of water during storm events and snowmelt. Low relief, stream-dissected landforms are found within the Trail and Prairie Creek watersheds. These landforms route water and sediment more effectively than watersheds dominated by glacial till. However, the low relief nature of these basins moderates the runoff efficiency to a substantial degree.

Elevations range from about 6,200 to 8,400 feet. Coniferous forests dominate vegetation types, w inclusions of wet meadows and rock outcrop. Annual precipitation varies from 16 inches at the lowest elevations to 50 inches at the Continental Divide, most of it falling as snow during winter and rain during late spring storms. While summer thunderstorms do occur in July and August, mo do not produce significant peak flow events. Peak flows generally occur in late May or early June derived from snowmelt or snowmelt in conjunction with rainfall.

Past management actions considered include timber harvest and roads within Trail, Prairie, Tie, a Johnson Creek basins. Livestock grazing within the analysis area does not appear to play a widespread role in affecting water resources, although localized effects were occasionally noted.

The Mussigbrod and Bender watersheds are largely unroaded and have little to no timber harvest within their boundaries. In these areas, it is expected that the effects of fire will be within the natural range of variability, and recovery will not need to be supplemented with further efforts.

The Johnson and Trail Creek watersheds have been roaded and harvested. Field surveys in the late 1980's identified a number of areas where water yield and sediment increases from these activities were having an adverse effect on aquatic resources (Trail Creek EIS, 1990; Bender-Retie EIS, 1991). Consequently, the existing condition of these watersheds may be such that they are more likely to be affected by a change in water yield and sediment regimes than Mussigbrod and Bender. In the early 1990's, extensive efforts were made to reduce sediment inputs to streams from the roads in Johnson and Trail Creeks.

FINDINGS

Watershed analysis was completed using aerial and on-the-ground field reconnaissance. All burned areas were viewed and videoed by helicopter flights. On-the-ground review provided a validation of effects viewed by aerial reconnaissance. Both efforts were used to characterize burn severity. Mapping burn severity provides an important component in determining changes in peak flows. Watershed delineation for peak flow analysis occurred above important infrastructure items such as a bridges or culverts. Predicted post-fire peak flows (NRCS Peak Discharge Analysis) are rated in terms of a flood recurrence interval (USGS Water Resources Investigations Report 92-4048). This information can be used to determine the risk to infrastructure. Because snowmelt runoff regimes occur in more gradual fashion than runoff generated from intense rainfall, peak flow analysis may be a substantial overestimate of actual runoff conditions. Table 4 components used in computing peak discharges by watershed.

Table 10. Peak Flow Increases in Mussigbrod Watersheds

Watershed Name	Watershed Acres	Moderate Burn Intensity (%)	Peak Flow Increase (%)
Trail Creek at FR 106	2,656	11	23
Prairie Creek at FR 106	2,226	0	0
Tie Creek at FR 1203	11,289	12	13
Johnson Creek at mouth	15,370	48	33
Johnson Creek at FR 1203	11,656	41	24
Johnson Creek at FR 1137	4,370	57	33
Bender Creek at FR 1202	3,210	35	24
Bender Creek at mouth	8,800	24	13
Mussigbrod Creek at dam	9,330	32	24
Mussigbrod Creek at USFS	12,320	25	23
Plimpton Creek at USFS	6,280	8	7
Pintler Creek at lake	13,100	5	7

On-the-ground analysis helped determine effects on water quality, LWD recruitment, and changes in stream bank stability. A sampling of various situations provides the framework for determining effects. The ultimate determination is the resilience and recovery of watersheds disturbed by fire.

The total area within the burned perimeter represents about 5% of the Big Hole River watershed (municipal watershed) at the intake for the Butte water supply near Divide. This represents a significant dilution effect on ash and other suspended material when it reaches the filtration plant intake, which serves the city of Butte. The dilution effect might be averted if a significant rainfall event occurred over the burn area before recovery, but not the rest of the Big Hole watershed.

Trail and Prairie Creeks - These two basins have similar basin characteristics and burn effects, though Prairie Creek experienced a greater burn area. As discussed in the landscape setting, these watersheds route sediment and water more effectively than basins dominated by glacial till. However, the low relief nature of the topography results in watersheds that are moderately sensitive to disturbance. Sapling stands resulting from past regeneration harvests (10-30 years) and subsequent fuels treatment created conditions that tended to lower fire intensities. Many

streams are typically low-gradient E type channels, often found within meadows that experienced only light burn intensities. Streams appear in Proper Functioning Condition (PFC), with little change expected. LWD does not play a large role in stream stability, with little change expected.

Tie and Elk Creeks - Only a small portion of the watershed experienced fire, mostly occurring along ridgetops in the northern part of each basin. No detectable changes in peak flow, sediment, and stream stability is expected.

Johnson Creek - Stand replacing fire occurred throughout much of the basin, except where regeneration treatments in the upper basin (including Schultz Creek) provided an ameliorative effect on fire behavior. Changes in snow accumulation and melt are expected due to loss of overstory canopy, with commensurable increases in water yield. However, the dominating presence of glacial till and high surface rock content creates a relatively resilient situation where large increases of sediment and peak flow are not expected.

Wide and flat valleybottoms occur in the lower drainage, becoming somewhat narrower in the upper basin. This provides a buffering capability for any sediment moving down slopes, making sediment bulking of Johnson Creek unlikely. Light burn or no burn occurred in the riparian area above FR 1245 crossing. Below this, much of the riparian area burned down to the lower bridge on FR 1203.

Large woody debris and rock play an important role in stream stability, except in meadow areas. Short-term increases in large woody debris are expected as weakened snags topple. The longevity of this LWD should increase somewhat, as charred wood is more resilient to rot and decay. A long term shortage of LWD may occur before the next generation of riparian trees become mature. Short term stream bank erosion may occur where fire has disturbed stream banks that depend on shrubs, forbs, and grasses for stability.

Bender Creek - Stand replacing fire occurred over the lower three-fourths of the basin, burning throughout the riparian area. Valley bottom widths are narrower than Johnson Creek; otherwise watershed characteristics and fire effects are similar to those described for Johnson Creek. Bender has very limited past management actions. The observed section of trail appears very stable. This means limited effects of fire-induced watershed responses on roads, bridges, and culverts. The bridge that burned on FR 1203 has wood abutments consumed by fire. The fill behind the burned abutments is at high risk for failure during the next runoff event.

Mussigbrod Creek - Most of the stand replacing fire occurred in the portion of the basin above Mussigbrod Lake. Significant reaches of riparian areas burned on Hell Roaring Creek and Mussigbrod Creek above the confluence with Hell Roaring. Trails in the valley bottoms above The lake constitute the only management disturbance in this area. Watershed characteristics and fire effects are similar to those described in Johnson and Bender Creek, with some exceptions. Areas with less rock and more exposed soil appear more frequently, creating a higher potential for short term erosion. The trail up Mussigbrod Creek has sections, which contribute small amounts of sediment. Poor location and maintenance contribute to much of this, with further problems caused by the fire consuming abutment logs.

Mussigbrod Lake provides a buffering capacity for runoff, sediment, and nutrients. Drawdown during the fall is about 8-10 feet, providing about 800 acre feet of storage for attenuating a flood peak. Under undisturbed conditions, a 10-year flood peak (146 cfs) would refill the lake in about 3 days. Observance of the upper end of the lake during low water shows that the present level of sedimentation is relatively low. If a runoff event occurred which transported sediment,

ash, and LWD into the lake, it is likely that only a portion of the suspended sediment and ash and a small portion of the LWD would make it below the dam.

Emergency needs described in the BAER report have already been implemented to reduce the immediate risk to property and many aquatic resources. The need for long term rehabilitation treatments is most likely to be associated with roads.

RECOMMENDATIONS

- Ensure that livestock grazing does not impede recovery potential of vegetation and watershed function. Livestock grazing within burned areas should involve input from resource specialists.
- Obliterate and recontour about 11 miles of road within the fire perimeter. Water yield increases that occur as a result of the fire can be partially ameliorated by storing water on the slopes as long as possible. Road systems often act as additional drainage systems, facilitating movement of water to stream channels and leading to increased peak flows. By recontouring road prisms, this drainage system is removed, and water will move downslope at a slower rate. Additionally, water is often stored in the unconsolidated material that fills the road prism.
- Perform timely maintenance on the remainder of roads within the fire perimeter to ensure that existing drainage structures are operating efficiently.
- Monitor stream channel, peak flow, and precipitation monitoring on Johnson, Bender and Mussigbrod Creeks. First, determine the existing condition of watersheds within the fire perimeter, especially Johnson and Trail Creeks. If today's conditions have not improved from those in the late 1980's, these watersheds may still be more susceptible to changes due to fire. To accomplish this, stream survey sites should be established on Schultz, Upper Johnson, Main Johnson, Hellroaring, and Upper Mussigbrod Creeks. In the summer of 2000, sites were established on Prairie, Hogan, and Upper Trail Creeks. Lower Mussigbrod has had sites established since 1999. Additional monitoring should determine the effectiveness of the road treatments of the 1990's.

3-2 Watershed – impact of harvest on watershed standards

This monitoring item reports on acres of timber harvest scheduled and whether standards for timber harvest are met. It is not relevant to the effects of wildfire. See item 3-1.

3-3 Watershed /Soils – effectiveness of Best Management Practices

This item is not relevant to the effects of wildfire. It reports timber harvest projects and whether BMPs for timber harvest are implemented. See item 3-1.

4-1 Soils – effects of activities on soil displacement and organic residue

OBSERVATIONS – MUSSIGBROD FIRE

A wildfire of this size has the potential to reduce soil productivity over both the short and long run. Some of the concerns are:

- Soil surfaces are exposed to erosion due to removal of plant canopies and duff layers.

- Soil erosion and runoff are intensified due to water repellency below soil surfaces.
- Soil organisms are affected due to soil heating and loss of living vegetation.
- Roads within burned watersheds can produce more erosion and sediment during runoff, especially on low standard and poorly maintained roads.

Soils in the Mussigbrod fires have developed in decomposed granitic bedrock, granitic glacial deposits, and alluvium. Dominant soil classifications are Typic and Lithic Cryochrepts. Cryorthents, Cryoboralfs, and Cryoborolls also occur.

Landforms consist of low relief stream dissected mountain slopes in the western third of the fire and moderate relief glaciated mountain slopes in the eastern two-thirds.

Dominant habitat types are subalpine fir/grouse whortleberry, dwarf huckleberry, twinflower and Douglas fir/pinegrass and twinflower. A variety of riparian habitat types occur in stream bottoms. Sagebrush and bunchgrass habitat types occupy small areas within the fire perimeter.

Soils are shallow where glacial erosion is dominant, generally in the upper basins and on the slopes of glaciated valleys. Deep soils occur on glacial deposits and alluvium. Moderately deep soils are found on frost affected ridges and stream dissected mountain slopes.

FINDINGS

The fires were evaluated to determine if emergency or long-term rehabilitation measures were necessary to prevent damage to soil productivity. This was equated to soil loss due to erosion from soil no longer protected by a duff layer and canopy of vegetation.

Burn intensity was classified based on the size of fuel consumed by the fire:

- Low - 1 hour fuels not consumed
- Moderate - 1 hour fuels consumed, 100 hour fuels partially to completely consumed, 1000 hour fuels not consumed
- High - 1hour, 100 hour, and most 1000 hour fuels consumed

Burn severity was classified based on the condition of the duff layer and the soil under it:

- Low - duff surface charred but not consumed
- Moderate - duff charred black, no fire induced water repellency, no soil discoloration, roots flexible
- High - duff burned to white ash, areas of fire induced water repellency, soil discolored, roots brittle

Spot checks indicate that most areas with the canopy consumed classified as moderate burn intensity. Those with brown needles classified as low burn intensity. Spot checks of burn severity indicated that areas of moderate burn intensity had a burn severity distribution of 5% high severity, 30% moderate severity, and 65% low severity. Areas of low burn intensity were classified as 100%. Low severity and preliminary area estimates of burn intensity and burn severity are listed below.

Table 11. Estimated Burn Intensity Acres

Fire	Fire	

Complex	Intensity	Acres
Mussigbrod	High	0
	Moderate	12,572
	Low	28,742

Table 12. Estimated Burn Severity Acres

Fire Complex	Fire Intensity	Acres
Mussigbrod	High	629
	Moderate	3,771
	Low	37,738

RECOMMENDATIONS

The combination of expected runoff events, habitat types, soils, landforms, and burn severity leads to the conclusion no feasible emergency or long term rehabilitation is needed to prevent extensive soil damage from erosion. Some localized erosion will occur. Rationale for this statement is discussed below.

Spring runoff is the design storm for this evaluation. Between now and then only light rain is expected, followed by the normal snows that accumulate until spring. Soils should receive water slowly enough to permit infiltration. The mat of charred duff has protected the areas with moderate burn severity during the recent rains and will do so in the spring.

Some plants have begun growth this fall and, with light rain and warm weather, others are likely to appear before growth ceases for the year. Plants such as pinegrass, grouse whortleberry, beargrass, buffalo berry, currant, and other species will likely show up next spring. Lodgepole pine and some of the other conifers have dropped seed that will germinate in the spring. Existing plant roots are available to help bind the soil as well.

Most of the soils have rock content of 35% or higher with a fair component of surface rock. An erosion pavement will quickly develop if runoff becomes concentrated enough to cause erosion.

The most serious impacts from the fire have occurred on glacial landforms. These landforms generally do not concentrate overland flow as efficiently as stream dissected landforms do. Glacial deposits usually have the opposite effect, namely collecting water in depressions.

Finally, high burn severity occupies a small portion of the area and occurs in a mosaic pattern within the less severely affected areas.

Mitigation of long term fire effects will require we

- Maintain existing roads within watersheds that burned, as needed, to control surface runoff on road surfaces and on natural surfaces that have burned. Obliteration may be

necessary for some low standard roads if runoff cannot be controlled.

- Monitor rates of vegetative and soil water repellency recovery of burned areas.
- Monitor changes in carbon sequestering and fire effects on mycorrhiza within burned areas are other information needs.

5-1 Recreation – levels of dispersed/developed/wilderness use

OBSERVATIONS – MUSSIGBROD FIRE

To address this monitoring item, the report looks at fire impacts to recreation, trail and wilderness resources within the burned area, rather than changes in use. Potential impacts to recreation facilities and use include:

- Direct and indirect fire damage, including suppression effects to trails and recreation facilities.
- Impacts to recreational users such as hiking, hunting, fishing, picnicking, horseback riding, and dispersed camping.
- Potential for increased special use permit applications from mushroom pickers. Will there be conflict with other users? How to handle the additional special uses workload?
- Spread of noxious weeds in areas that have been virtually weed free.
- OHV (off-highway vehicle) and snowmobile use levels and patterns may change.

The Mussigbrod fire had a significant impact on the recreation resources and opportunities in Beaverhead County and the Wisdom Ranger District. All of the burned area was closed to public access during the period of significant fire activity and will remain closed until the fire is controlled. Closures in the burned area also impacted the bow season and extended into the rifle-hunting season.

Primary recreation resource impacts are resulting from continued area closures, fallen trees and rocks blocking trails, burned trail signs and markers, outfitters displaced, and degradation of trail conditions. Additional recreation resource impacts will result from severely decreased tree canopy offering less shelter from sun and wind, reduced aesthetic appeal to visitors who do not appreciate a scorched and charred landscape, and additional damage resulting from floods as a result of the changed watersheds. Some trails were subject to high erosion rates before the fire. Erosion is expected to increase over the next few years if overland flow from heavy rain events exceeds pre-fire conditions and until soil and slopes are stabilized and revegetated.

<u>Background</u>

The Beaverhead-Deerlodge National Forest is rich in recreation opportunities. Popular recreational activities include hiking, OHV use, fishing, picnicking, camping, hunting, horseback riding, skiing, wildlife and scenery viewing, and driving for pleasure.

Within the Mussigbrod fire area there are three historic guard stations, one that is on the cabin rental program and two used for administrative purposes only. Mystic Lake cabin sits within the Anaconda-Pintler (A-P) Wilderness. Mussigbrod campground and trailhead is a popular destination point for visitors wanting to access the A-P and the many trails and high alpine lakes within the wilderness. The A-P Wilderness has approximately 280 miles of trail including a 45-mile section of the Continental Divide National Scenic Trail (CDNST).

The Placer, Bender, Johnson, and Trail Creek areas are popular for dispersed camping, fishing, and hunting. Snowmobilers and cross-country skiers use the area extensively during winter. Both the Nez Perce and the Lewis and Clark National Historic Trails run the length of the Trail Creek drainage. Chief Joseph Pass, known for its excellent, consistent snow, has over 5,000 skiers annually at the groomed cross-country ski system there. A new warming hut is presently being constructed at the site.

FINDINGS

Developed Recreation - While most recreation opportunities in the burned area are undeveloped, there are a few developed facilities such as Chief Joseph Trailhead, Hogan Guard Station, Bender Cabin, Mussigbrod Campground, and Mystic Lake Cabin in the perimeter of the burned area. The fire burned all around these facilities and came very close to a few, but the facilities were left intact.

On the other hand, many dispersed sites, used historically by visitors, were burned. These sites need to be inventoried for hazard trees and other safety concerns. Hazard trees will be removed, signing will be done at some sites we are rehabbing, and there may be some possible closures.

A post-fire evaluation was done on the earth embankment dam at Mussigbrod Lake. The Mussigbrod dam is classified as a low hazard, Class B dam. This evaluation concluded there should be no adverse hydrologic impacts to Mussigbrod dam from burning the watershed.

One outfitter was displaced from one of his spike camps for this season due to the fire. Discussions will be necessary to see if a temporary or new location will need to be established.

The Anaconda-Pintler Wilderness is almost entirely free from noxious weeds. Efforts will need to continue and intensify through visitor contacts with Wilderness Rangers, and ongoing education efforts on weed identification and methods for preventing the spread of weed seeds.

One post-fire concern new to this Forest has been the issuing of special use permits for mushroom gathering. In some cases this has created a tremendous workload for districts after large complex fires. Additional funding will be necessary for the district to handle the permit administration, public involvement, NEPA, and education for mushroom-pickers

Wilderness Trails - About 10 miles of the CDNST, 2 miles of the Mussigbrod trail, and 1 mile of the Plimpton Creek trail within the A-P Wilderness were burned over with a moderate intensity or higher fire.

Non-Wilderness Trails - About 34 miles of non-Wilderness trails were burned over with a moderate intensity or higher fire.

In both categories of trails, waterbars, tread lateral log supports, puncheon, and bridges were incinerated or damaged. Downfall has increased dramatically. Numerous new hazard trees line all the trails that experienced burnover. Natural barriers to OHVs on trails that have travel restrictions have been lost in a number of cases.

Travel Management - The opportunity for unrestricted cross-country travel by snowmobiles increased greatly with the consumption of smaller trees, large tree lateral branches, and stacked downfall by the fire. Visibility on slopes in several drainages is improved tremendously. For the most part, these improved winter recreation conditions will have a neutral effect except for two concerns. The first is the spread of noxious weeds by increased snowmobile traffic from the heavily infested Bitterroot Valley into the watersheds above the Big Hole Valley. The second concern is the temptation for increased snowmobile incursions into the A-P Wilderness because

of improved visibility and maneuverability.

The loss of downed woody material on some riparian and upland sites laced by old logging roads between Schultz Creek and Johnson Creek will increase the likelihood of OHV travel and rutting. Similarly, natural downfall barriers to OHVs on the non-Wilderness trail system have been burned out, increasing accessibility for OHVs on both trails and cross-country off the trail system

RECOMMENDATIONS

- Identify hazard trees within 150 feet of National Forest roads and within 1-2 tree lengths of trails and dispersed campsites. Flag for removal to minimize health and safety hazards to people entering the burned area.
- Eradicate all new populations of noxious weeds promptly.
- Replace all trail signs and markers that were burned by the fire.
- Discuss how the potential special use permit administration workload will be dealt with.
- Increase trail maintenance funding for the next three to five years on Wilderness and non-Wilderness trails within the fire perimeter to keep up with the increased trail clearing and drainage workload expected from burned and diseased tree blowdown and higher runoff peak impacts on trail tread.
- Increase Wilderness perimeter signing and patrols to prevent inadvertent and deliberate snowmobile incursions resulting from greater accessibility.
- Monitor effectiveness of emergency rehabilitation efforts on trails within burned area.
- Monitor for any increase of snowmobile incursions into the AP Wilderness because of the improved visibility and maneuverability along the Continental Divide and in the Mussigbrod and Hellroaring drainages. Monitor changes in the use levels and patterns of OHVs on and off the trail and road systems.
- Monitor sites with soils disturbed as a result of fire suppression activity for newly established populations of noxious weeds.

5-2 Recreation – Wilderness use compliance with management direction

This item is intended to report on use compliance in the Anaconda Pintler and Lee Metcalf Wildernesses. This year, it addresses only the Anaconda Pintler Wilderness.

OBSERVATIONS AND FINDINGS – MUSSIGBROD FIRE

Facilities - Mystic Lake cabin sits within the Anaconda-Pintler (A-P) Wilderness. Mussigbrod campground and trailhead, which sits right on the edge of the Wilderness, both burned.

Wilderness Trails - The A-P Wilderness has approximately 280 miles of trail including a 45-mile section of the Continental Divide National Scenic Trail (CDNST). About 10 miles of the CDNST, 2 miles of the Mussigbrod trail, and 1 mile of the Plimpton Creek trail within the A-P Wilderness were burned over with a moderate intensity or higher fire. Waterbars, tread lateral log supports, puncheon, and bridges were incinerated or damaged. Downfall has increased dramatically. Numerous new hazard trees line all the trails that were burned over.

Noxious Weeds The Anaconda-Pintler Wilderness is almost entirely free from noxious weeds. Efforts will need to continue and intensify through visitor contacts with Wilderness Rangers,

and ongoing education efforts on weed identification and methods for preventing the spread of weed seeds.

Snowmobile Use in Wilderness Opportunities for unrestricted cross-country travel by snowmobiles increased greatly with the consumption of smaller trees, large tree lateral branches, and stacked downfall by the fire. Visibility on slopes in several drainages improved tremendously. These improved winter recreation conditions will have a neutral effect except for the temptation for increased snowmobile incursions into the A-P Wilderness because of improved visibility and maneuverability. Monitoring of illegal incursions into the wilderness will be important.

5-3 Roadless character – changes in roadless acres

OBSERVATIONS – MUSSIGBROD FIRE

The Mussigbrod fire burned in the North Big Hole Roadless Area, (portions identified as A1-001 and B1-001 in the Beaverhead Forest Plan, Appendix C, page C-5). These two subunits are over 30,000 acres total in size. Developments around Mussigbrod campground nearly divide area A1-001 in half. Most of the roadless area borders the Anaconda-Pintler Wilderness along the upper elevations.

FINDINGS

Firelines in this roadless area were primarily constructed by hand or Fire Line Explosives. These lines were rehabilitated immediately following fire suppression and are very difficult to distinguish a year later. Less than 2 miles of dozer line were constructed along the fires eastern boundary between Mussigbrod Lake and Plimpton Creek. These dozer lines were rehabilitated immediately following fire suppression, but they will remain identifiable for some years. Soils were disturbed, water bars constructed and debris piled over the roadway to protect soils and prevent use. These rehabilitated fire lines impact the roadless character in a very localized way, but do not change the size of the roadless area, nor do they affect the overall quality of the roadless area.

5-4 Recreation – facilities for people with disabilities

(Not applicable to post fire monitoring)

5-5 Heritage Resources – Historic Preservation Act

OBSERVATIONS – MUSSIGBROD FIRE

This monitoring item reports on whether activities (or in this case the natural event of wildfire and activities related to fire suppression) are in compliance with Section 106 of the National Historic preservation Act.

Issues related to fire effects on historic resources are:

- Lack of pre-burn survey information hinders knowledge of fire impacts.

- Changed conditions necessitate re-evaluation of known sites' eligibility.
- Potential effects of rehab work on cultural sites.
- Sites discovered resulting from the fire and fire suppression activity need to be documented and protected.
- Sacred/traditional use sites may see an increase in use with heightened site awareness during fire-suppression activity.

Very little cultural resource survey work had been conducted prior to the fire. Those inventories tended to be project-specific and did not give a broad representation of the history or cultural use of the area.

The Mussigbrod Fire impacted approximately 45,363 acres on the Beaverhead-Deerlodge National Forest. Cultural resource specialists have examined 944 acres, or 2 percent of the Forest System lands within the fire's perimeter since 1979. Of that total, approximately 320 acres has been done as part of the fireline rehabilitation work.

FINDINGS

Of the known sites within the fire's perimeter, one site was affected. Site 24BE945, a historic Forest Service guard station, had the remains of two buildings and part of a jackleg fence burn. The fire did not affect any of the other known sites within the fire's perimeter.

During fire suppression activity, three possible prehistoric sites and one historic site were identified. If the three possible sites are in fact cultural sites, the fire may have affected the integrity of the sites, depending on the factors that could make the sites eligible.

The majority of the burned area has yet to be surveyed for cultural resource sites. For prehistoric sites, the change in workmanship, materials, setting, and feeling would be the fire's greatest potential effect. Prehistoric resources that could exist in the fire's perimeter include pictographs, stone circles, lithics, culturally modified (scarred) trees, campsites, trails, and spiritual sites.

Table 13. Fire Effects on Known Sites in the Mussigbrod Fire

Smithsonian Number	Site Name	National Register Status	Fire Effects
24BE1707	Portable Sawmill	Unresolved	None
24BE945	Schultz Creek Guard Station	Unevaluated	Partially burned
24BE1522	Bender Creek Station	Eligible	Wrapped, unburned
24BE236	Rifle/Ambush pits	Unevaluated	Unknown
To be assigned	Scofield Cabin	Unevaluated	None

Fire could damage historic resources. Log and frame buildings, agricultural, and mining structures would all be susceptible to fire. Workmanship, materials, setting, feeling, and

association could be lost at historic sites. Undiscovered sites in the fire's perimeter could include mines and mining camps; irrigation ditches, dams, and structures; communication lines, fences, trails, roads, administrative sites, trapper and range rider cabins, and homesteads.

The potential exists to discover sites associated with the Lewis & Clark Expedition and the Nez Perce War, both of which took place in the vicinity of the fire.

Survey Strategy

With the low level of inventory conducted within the fire area of potential effect prior to the burn, an aggressive cultural resource survey strategy needs to be implemented. The survey will continue through 2002. Reports on new sites and fire impacts will be part of the Big Hole Landscape Analysis. The Forest's Site Inventory Strategy (SIS), coordinated with the east side forests, State Historic Preservation Office, and the Advisory Council on Historic Preservation, stratifies the fire area into high, moderate, and low cultural site probability layers.

Intensive inventory coverage is required for those areas defined as high site probability areas (less than 20% slope, springs, stream confluences, major ridge systems, passes, saddles, open high altitude basins, dominant geologic features, travel routes, and areas historically or ethnographically known for special values). Moderate probability areas (20-40% slope) deserve reconnaissance-level and spot check surveys, totaling at least 30% coverage. Examples of sites that could be found in these areas include plant harvesting/gathering sites, mining and quarrying, and scarred trees.

Low probability areas (>40% slope) do not demand coverage, but should be sampled to confirm the applicability of the survey strategy. Site types that could be located in these areas include rock art, rock shelters and caves, historic mining, vision quests, and isolated kill sites. Travel routes, especially trails, could be located in any of the probability areas. See the attached map for the areas defined as high, moderate, and low probability.

For this assessment, the September 4 acre totals and perimeter delineation will be used. Acres within the fire's perimeter total 45,363 acres. Of this total, 24,627 acres (54.3%) are high probability, 16,679 acres (36.8%) are moderate probability, and 4,056 acres (8.9%) are low probability. The methodology has been simplified due to time constraints; actual acres in high and moderate probability areas could be slightly higher if spring locations, petrological/geological concerns, and areas with "special values" were identified on the map.

Table 14. Site Probability by Fire within the Mussigbrod Complex (Acres)

Fire Name	High Probability (<20% slope)	Moderate Probability (20-40% slope)	Low Probability (>40% slope)
Maynard	13,392.72	8,637.61	1,628.90
Mussigbrod	11,234.37	8,041.66	2,427.88
TOTAL ACRES	24,627.09	16,679.27	4,056.78

CONSULTATION

The Forest's Heritage Program will consult with the Montana State Historic Preservation

Officer as we assess effects to sites within the fire's APE, and as we determine the effectiveness of the survey strategy. Additionally, consultation will occur with the Salish-Kootenai and Lemhi Shoshone cultural resource specialists when resources of interest to them are discovered or affected. Because of the fire's proximity to the Big Hole National Battlefield, the Nez Perce Tribe may be involved as well.

RECOMMENDATIONS

- Site and structure protection should be implemented within the fire area to minimize the ignition potential of known National Register-eligible sites.
- Signs should be posted at trailheads and campgrounds reminding Forest users of laws protecting heritage sites.
- Section 106 requirements need to be implemented for all proposed rehabilitation work.

6-1 Range Forage Utilization – number of AUM's

On a forestwide basis, we conducted monitoring and evaluation on 112,000 acres, 160% above the funded level of 70,000 acres. One hundred eighty five allotments were monitored, compared to the 115 we were funded to monitor. Actual grazing use in 2000 was measured at 141,208 Animal Unit Months. This compares to 190,000 AUM's projected as the capacity by the Beaverhead Forest Plan in 1986.

This analysis will look at the impacts of the Mussigbrod Fire to livestock operations and use levels in 2000, and effects in years to come on the Big Hole allotments.

OBSERVATIONS – MUSSIGBROD FIRE

Four grazing allotments are located within the Mussigbrod Fire perimeter: Clam Valley, Mussigbrod, Tie-Johnson, and Trail Creek. The Clam Valley and Tie-Johnson Allotments were operating under late model management plans at the time of the Mussigbrod Fire. The uplands and riparian zones on these allotments, based on annual observations, appeared to be on an improving trend. The Mussigbrod Allotment had been operating under trial reductions in numbers and season through the annual operating plans to meet Forest Plan riparian standards. The Trail Creek Allotment was operating under an approved allotment management plan that included a rest-rotation system

FINDINGS

The Mussigbrod Complex Fire burned with moderate to high intensity over primary/secondary rangeland sites in key portions of all four grazing allotments within the fire perimeter. Primary and secondary riparian rangeland sites on the Trail Creek, Tie-Johnson, and Mussigbrod Allotments experienced appreciable willow stand consumption, loss of livestock barriers, and exposure of streambanks to hoof action. Some sedge sites burned in the east forks of Plimpton Creek on the Clam Valley Allotment, making those first order stream channels more vulnerable to trampling.

Scattered but appreciable primary/secondary upland (sage-grass) range sites on the Tie-Johnson, Mussigbrod, and Clam Valley Allotments experienced complete consumption of sagebrush stands and probable measurable mortality within the understory of key forage graminoids such as june grass, Idaho fescue, and bluebunch wheatgrass.

Thousands of timber habitat type acres burned thoroughly enough to provide potential new

transitory forage for livestock for a five to twenty year period depending on variables such as accessibility, blowdown over the next few years, habitat type, rate of graminoid recovery, etc. The Continental Divide between Schultz Saddle and Lost Trail Pass experienced extensive burning that has removed timber overstory and downfall barriers to livestock drift between the Bitterroot Valley and the Big Hole Valley.

In conclusion**:**

- Natural timber and downfall barriers to livestock drift have burned. Livestock will be more difficult to control within pastures and between allotments.
- Adjustments are needed in the timing, duration, and numbers of livestock. These changes will differ from the routine annual operating plans or the long-term management plans on three of the four allotments affected.
- Forage species and streambanks in some riparian zones within all of the grazing allotments may experience unacceptable levels of defoliation, trampling, and soil destabilization.
- New transitory forage will offer an opportunity to improve livestock distribution, lessen grazing impacts, and (possibly) temporarily increase red meat production.
- Traditional livestock trails may be heavily logged in with blowdown, which would drastically restrict livestock distribution.

RECOMMENDATIONS

- Allow additional grazing administration time for District staff to insure that livestock do not drift into vulnerable riparian and upland sites in rested or deferred pastures during the term of re-establishment and vigor recovery of woody and graminoid forage plants.
- Log out useful traditional cattle trails and create new cattle trails on improved locations where it is cost-effective to improve or maintain good livestock distribution.

6-2 Range Improvement construction

The Beaverhead-Deerlodge National Forest exceeded the funded target of 75 range improvement structures because fire activity resulted in funding for improvement work later in the year, see Table 6. The rest of this discussion focuses on impacts to range improvements from the Mussigbrod Fire.

OBSERVATIONS – MUSSIGBROD

Boundary and interior fences on the four allotments varied from good to very poor condition. Water developments were in good condition.

The Mussigbrod Complex Fire damaged or destroyed about three miles of pasture, exclosure, allotment, and boundary fence. Two water developments were damaged.

The effectiveness was reduced of natural timber/downfall barriers to cattle movement between pastures and allotments on the Trail Creek, Mussigbrod, and Tie-Johnson Allotments. The Continental Divide between Schultz Saddle and Lost Trail Pass experienced extensive burning that removed timber overstory and downfall barriers to livestock drift between the Bitterroot Valley and the Big Hole Valley.

In conclusion**:**

- Natural timber and downfall barriers to livestock drift have burned. Livestock will be more difficult to control within pastures and between allotments without fencing.
- Boundary fences between private land/National Forest, interior allotment fences, and a few water developments were damaged or destroyed.
- Traditional livestock trails may be heavily logged in with blowdown, which would drastically restrict livestock distribution.

RECOMMENDATIONS

- Extend existing interior fencing on all four allotments to tie into new effective termini that will block livestock drift through former natural barriers.
- Reconstruct and repair interior allotment fences, pasture fences, and water developments
- Log out useful traditional cattle trails and create new cattle trails on improved locations where it is cost-effective to improve or maintain good livestock distribution.

6-3 Noxious Weed Infestations and Control

The Beaverhead-Deerlodge Forest exceeded the funded target of 2000 acres for noxious weed control in FY2000 because fire activity freed up funding to keep weed crews on later in the year, see Table 6. The Forest also initiated a Forestwide Noxious Weed Environmental Impact Statement with proposals to be implemented in 2001. The rest of this discussion focuses on noxious weed infestations related to the Mussigbrod Fire.

OBSERVATIONS – MUSSIGBROD FIRE

Noxious weeds have mainly been a problem of shrub/grasslands and disturbed sites (harvest sites, roads, and developed recreation areas) in the Big Hole Landscape. Overall, weed infestations are not yet epidemic in this area, but in adjacent counties, they are. Beaverhead County, in general, has had good success in controlling the rapid infestation of weeds that adjacent counties have experienced. Most of the area's known weed populations have been kept in check with pro-active monitoring and control programs. Shade from forest cover tends to inhibit establishment, development, and growth of most noxious weeds. About 94% of the land within the Mussigbrod Fire burn perimeter was forested prior to burning. This heavy domination by forest cover allowed for current weed monitoring and control measures to be effective along roadways. Nearly continuous forest cover along the Continental Divide provided a natural barrier to weeds migrating from the heavily infested Bitterroot Valley.

FINDINGS

Most noxious and invasive weed plants in Montana are intolerant of shade and develop best on sites with disturbed surface cover. The Mussigbrod and adjacent fires disturbed large areas of surface vegetation and removed tree canopy shading. Large areas of continuous disturbance have been created that provide an unchecked dispersal corridor with the extreme weed infestations of the Bitterroot Valley. Miles of fire control line disturbed additional ground. Additionally, vehicles and machinery from many parts of the country visited the area, bringing in unknown quantities and species of weed seed. This will dramatically increase the potential for establishment and growth of noxious and invasive weeds.

Burn intensities within the fire perimeter were high enough to totally damage all effective forest

cover on about 26% of lands within the burn perimeter. Destruction of this ground vegetation has now provided ideal disturbance for seeding in of weeds. Over half of this "weed-friendly" disturbance occurred along the Continental Divide. The protective forest barrier separating weed infestations on the Bitterroot has been breached over a large area. High probability weed infestation sites are:

- About 2,800 acres along the Continental Divide have a high risk to knapweed introduction, establishment, and growth from destruction of forest cover and disturbance to ground cover. This condition covers an area from Gibbon's Pass to the end of Forest Road 73548 above Trail Creek, and the Continental Divide National Scenic Trail (CDNST) junction on Forest Road 73548, north through Tie Creek to the head of Hell-roaring Creek.
- Eleven miles of non-wilderness trails burned over, resulting in a moderate risk of increased weed expansion.
- Twelve miles of the CDNST and Mussigbrod Trails burned over, resulting in a moderate risk of increased weed expansion. The remoteness of these trails makes them difficult to monitor and treat.
- Existing weed infestations (knapweed, musk thistle, and St. Johnswort) along 15 miles of the Johnson, Bender, and Mussigbrod road systems have greatly increased risk of weed expansion from forest cover destruction.
- Two existing backcountry knapweed infestations in Plimpton Creek have a greatly increased risk of expansion due to forest and ground cover destruction. This area amounts to 800 acres.
- Eight miles of dozer fire line on National Forest (Figure 6) passing through cut areas, grass/shrub sites, and open timber stands has increased potential for knapweed establishment because of disturbance such as staging areas, helispots, and safety zones.
- Forty miles of system roads have had considerable out-of-county vehicle and machinery traffic due to fire control efforts (Johnson, Tie, Bender, Prairie, Trail, Placer, and Mussigbrod roads).

RECOMMENDATIONS

Additional weed control needs beyond the capability of the existing district weed control program and equipment have been identified. Post-fire rehabilitation funding included:

- Procuring a five-year weed control, spraying contract to treat 2,876 acres of high potential weed establishment sites. This control program includes monitoring, mapping, data entry, and treatments. Each mile of road and trail represent two acres of treatment needs.
- Increased funding, staffing, and equipment for the Wisdom District Force Account weed control program, for five years, to meet additional weed control needs caused by wildfire and control efforts. This control program includes monitoring, mapping, data entry, and treatments on 896 acres additional to the current program.
- Monitoring and surveying of all 3,772 acres annually during the growing season. Mapping known and discovered infestation sites using GPS technology, and record conditions to the Forest Weed database. Treated sites will be monitored more frequently,

and effectiveness of treatment assessed.

- These treatment needs are incorporated in the Forest-wide Weed Control EIS.

6-4 Allotment Management Plan Updates

The Beaverhead-Deerlodge Forest met its funded target of completing nine new or updated allotment plans. None of these were in the area affected by the Mussigbrod Fire.

No immediate changes in Allotment Management Plans will be made as a result of the Mussigbrod Fire. Post-fire analysis determined that the changes are transitory and can be dealt with through adjustments in the Annual Operating Plans for the next 2 years. Clam Valley and Tie-Johnson AMPs were completed fairly recently. Mussigbrod AMP is scheduled for revision in 3 years.

7-1 Timber – Volume of timber offered (actual vs. projected)

(Not applicable to post-fire monitoring)

7-2 Timber – Volume and area harvest by method and management area

(Not applicable to post-fire monitoring)

7-3 Timber – Change in suitable base from ground truthing

(Not applicable to post-fire monitoring)

7-4 Timber – Cultural Treatments

(Not applicable to post-fire monitoring)

7-5 Timber - Accomplishment of Regeneration

This monitoring item is assessed as it relates to the concern about re-establishing trees on severely burned forest.

OBSERVATIONS – MUSSIGBROD FIRE

Large areas were de-forested by wildfire. For the most part, the forest communities affected are adapted to regenerate following fire. However, severely burned areas may have situations (such as soil changes, long distance from seed sources, and destruction of soil seed) that may not lead to adequate or timely regeneration to desirable species. A small percentage of sites in the Mussigbrod/Maynard fire may require artificial regeneration to meet resource goals and Forest Plan objectives.

Prior to the Mussigbrod and Maynard wildfire, over 99% of the stockable forestland within the fire perimeter was adequately stocked with forest trees. Affected management areas include wilderness (5,354 acres), other, non-timber allocations (17,060 acres), and suitable timberlands (22,192 acres). About 114 acres of private land lies within the fire perimeter.

The 1976 National Forest Management Act states it is the policy of the Congress that all forested lands in the National Forest System be maintained in appropriate forest cover with

species of trees, degrees of stocking, rate of growth, and conditions of stand designed to secure the maximum benefits of multiple use sustained yield management in accordance with land management plans. The Forest Service Manual (FSM 2407.02) defines reforestation objectives of maintaining appropriate forest cover, and to achieve it in a timely and cost-efficient manner.

FINDINGS

About 26% of the area is now unstocked due to high intensity burning. Observations following the fire show, for the most part, that cones opened and shed seed within a week of the burn. Cone serotiny in lodgepole pine ranges between 20-35%, and seed should be abundant following wildfire on all but a few sites. Natural regeneration success has been good in this area, and desired stocking levels are normally achieved by standard practices.

In about 5% of the intensely burned sites (about 600 acres), burning was severe enough to destroy cones and seed. Heavy fuel loadings allowed heating of the soil, destroying the seed bank there. These sites occur on suitable timberlands and do not meet stocking objectives. Additionally, loss of hiding cover over large areas dictates a desire to restock these sites promptly to meet wildlife objectives. Natural regeneration will be substantially delayed on these sites, with suitable stocking not predicted for over two decades.

RECOMMENDATIONS

Because natural reforestation problems are predicted on only about 1% of the area within the burn perimeter, no large-scale seeding program of forest trees is recommended. Hand planting of about 600 acres is recommended to assure timber and wildlife cover management goals are achieved in a timely manner. The recommended specifications of this management action are:

- Hand plant in the spring or summer of 2002 or 2003
- Use containerized stock of seed adapted to the site conditions
- Use a species mix of 70% LP, 30% S, and minimum 600 TPA on subalpine fir habitat series (except previous whitebark pine stands)
- Use a species mix of 70% WBP, 30% S, and minimum 400 TPA on previous whitebark pine stands
- Use a species mix of 70% DF, 30% LP, and minimum 300 TPA on Douglas-fir habitat series

7-6 Timber – Assessing Silvicultural assumptions and practices

The 1986 Forest Plan makes the assumption that lodgepole pine is at greatest risk for an outbreak of insects or disease. Because of that, the timber management program focuses on lodgepole pine stands in recognition of their susceptibility to mountain pine beetle infestations. The plan states that in addition to creating more diverse aged stands of lodgepole, silvicultural prescriptions will address other insect and disease concerns, including spruce budworm. The large areas of tree mortality caused by the Mussigbrod wildfire have created brood habitat conducive to localized and short term bark beetle epidemics, one of those beetles being the mountain pine beetle. Those concerns are addressed under item 9-1 (Forest Health Protection). Additional forest health concerns addressed in this section include re-establishing trees on severely burned forest (Item 7-5) , protecting regenerating aspen from browsing, and protecting sensitive plants. ***For lack of a more appropriate monitoring item to address ecological health***

concerns, aspen and sensitive plants are addressed here.

OBSERVATIONS – MUSSIGBROD FIRE

Protecting Regenerating Aspen

Aspen stands and patches form important habitat for wildlife and are key to the area's autumn visual quality. The amount of aspen habitat has been declining on this landscape for decades. The effects of the wildfire will likely increase regeneration and cover of this habitat. Without controls the large populations of big game animals in the area may over-browse young aspen suckers, prevent their desired development to mature stands, and nullify any benefit from the wildfire.

Numerous aspen patches and stringers occurred throughout the area before the fire. Most of these patches were associated with moist sites or were scattered within larger conifer stands. No aspen acreage estimates are available for this specific area, but past assessments on the Forest found current aspen cover at 5% of that which occurred in the 1860"s)Pioneer Landscape Assessment, 1998).

Aspen sites are typically the first species to respond to fire with suckering of new stems from mature root systems and growth of abundant and succulent foliage. This ability to quickly regenerate from roots, rather than waiting for seed to germinate and roots to develop, would normally give aspen an advantage in dominating the site. Aspen dominance would persist for many decades until conifers could finally pass aspen in height and begin to shade them out. Persistent top browsing of the young aspen removes this natural advantage, allowing conifers to dominate the site many decades earlier. This could act to eliminate the patch entirely, long before another wildfire can again remove the conifers.

Heavy browsing damage to the tops of young aspen by moose, elk, and cattle is common in this area, often at such levels as to prevent a patch from developing into mature trees. Once an individual tree reaches 12-15 feet in height, it tends to be free from top browsing. Fencing has been found to be the most effective method in allowing a regenerating aspen patch to develop to mature conditions.

FINDINGS

The Mussigbrod/Maynard Wildfire Complex burned over about 42,000 acres of National Forest. Scattered within this conifer-dominated landscape were hundreds of acres of aspen patches. These patches were small, ranging from a few decadent trees to stands of five acres. The majority of the patches were two acres and less. Many aspen sites burned during the fire, top-killing the mature aspen and overtopping conifers.

Blackened litter and open ground will increase solar heating, providing ideal conditions for sucker stimulation. Significant aspen suckering is anticipated on these sites, and the potential for them to dominate the site for 4-5 decades is high. Dozens of sites in each of Trail, Tie, Plimpton, Mussigbrod, Bender, Johnson, and other drainages have burned. Because of its ability to sucker from an extensive root system, aspen are the first to produce abundant browse early following fire.

As other vegetation will be slower to develop following the fire, young aspen suckers become prime targets for big game. These sites become very susceptible to severe overbrowsing of their tops, arresting development to mature stands of aspen. This susceptibility lasts until they can grow above browse height. The more open conditions created by the fire may also make it easier for cattle to access and browse these sites.

RECOMMENDATIONS

Protect regenerating aspen clumps in Trail, Tie, Johnson, Bender, Plimpton, and Mussigbrod drainages by constructing about 50 miles of 8 strand, high-tensile wildlife fence. An average two-acre patch of aspen requires about one-fourth mile of fence. This will allow fencing of about 200 acres of aspen. Fence would be maintained and monitored for up to ten years, or until aspen grows above browse height (12 feet).

- Protecting Sensitive Plants

Candystick (*Allotropa virgata)*, a sensitive plant species, is very common in the Mussigbrod burned area. Some rehabilitation projects may disturb ground vegetation and could adversely affect candystick plants.

Candystick is common the northeast end of the fire and may occur in potential habitat throughout. Little is known about the response of candystick to fire disturbance; however, we know it needs live, mature lodgepole pine roots to exist. There is a conservation strategy to control activity in candystick habitat. No other sensitive plants are known to occur within the wildfire perimeter.

FINDINGS

Numerous candystick populations have been mapped in the area. Many of these occur within burned areas where rehabilitation activities will be proposed. From the numerous findings, it is anticipated many more populations occur in the area. Most of the occurrences are in the Mussigbrod Lake area and the Anaconda-Pintler Wilderness.

RECOMMENDATIONS

The district sensitive plant coordinator will participate in project development and prepare mitigation measures for all proposed, ground-disturbing, fire rehabilitation projects. These measures will be consistent with applicable conservation strategies for sensitive plants.

8-1 Facilities, Forest Road Construction

Not applicable to post-fire monitoring, this item refers to road construction directly associated with timber offered for sale)

8-2 Facilities, Road Management

OBSERVATIONS – MUSSIGBROD FIRE

The majority of the transportation system in the Mussigbrod area was planned and developed prior to the Forest Plan and was constructed to provide access for management activities. The majority of the transportation system was built prior to formal development of Best Management Practices and does not meet current standards.

Road management strategies have for the most part been implemented to minimize impacts to big game. Very little consideration was given to providing for fish passage in drainage structure design and construction in the original design.

FINDINGS

There is a potential within the burned areas for increases in runoff, which could result in increased sediment delivery from road surfaces and ditches. Increases in subsurface water flow

can be expected because the trees that once functioned as “wicks” in removing the flows no longer perform that function.

There is potential that existing drainage features both within the burned areas and downstream from them may not be adequate to accommodate increased peak flows.

Within the burned areas, a significant public safety risk is present due to the probability that fire-killed or damaged trees will fall into the roadway. A significant amount of work can also be expected to remove fallen trees from the roadway throughout the use period.

The fire destroyed the treated timber bridge over Bender Creek. The bridge must be replaced for public safety and resource protection. The Johnson Creek bridge on Forest Road 1203 has deteriorated and is signed for a 13-ton limit. Replacement with a highway load standard bearing bridge is critical for heavy equipment necessary to perform needed fire rehabilitation work.

RECOMMENDATIONS

Bring roads for short and long term access, up to standards for Best Management Practices to reduce sediment. Upgrade drainage structures to meet fish passage and peak flow standards. Implement critical maintenance measures for resource protection and safety on the existing transportation facilities, particularly or the short term in those areas impacted by the fires that were not identified in BAER. And prepare and implement a comprehensive access and travel management plan.

8-3 Facilities Trail management

OBSERVATIONS – MUSSIGBROD FIRE

The Mussigbrod area includes historic guard stations, rental cabins, campground and trailheads, the Continental Divide National Scenic Trail (CDNST), Chief Joseph Pass, Nez Perce and the Lewis and Clark National Historic Trails, and the Anaconda Pintler Wilderness.

The Mussigbrod fire had a significant impact on the recreation resources and opportunities in Beaverhead County and the Wisdom Ranger District. All of the burned area was closed to public access during the fire and until the fire was controlled. Primary impacts included fallen trees and rocks blocking trails, burned trail signs and markers, and degradation of trail conditions. Secondary recreation resource impacts resulted from severely decreased tree canopy offering less shelter from sun and wind, reduced aesthetic appeal of the charred landscape, changes in the watersheds from water movement.

FINDINGS

Wilderness Trails - About 10 miles of the CDNST, 2 miles of the Mussigbrod trail, and 1 mile of the Plimpton Creek trail in the Anaconda Pintler Wilderness burned over with moderate intensity or higher.

Non-Wilderness Trails - About 34 miles of non-Wilderness trails were burned over with a moderate intensity or higher fire.

Regardless of trail status, waterbars, tread lateral log supports, puncheon, and bridges were incinerated or damaged. Downfall increased dramatically. Numerous new hazard trees line all the trails that burned over. Natural barriers to OHVs on trails with travel restrictions have been lost in a number of cases.

Opportunities for unrestricted cross-country travel by snowmobiles increased greatly with the

consumption of smaller trees, large tree lateral branches, and stacked downfall by the fire. Visibility on slopes in several drainages also improved. These improved winter recreation conditions will have neutral effect except for two concerns. The first is spread of noxious weeds by increased snowmobile traffic from the heavily infested Bitterroot Valley into the watersheds above the Big Hole Valley. The second concern is the temptation for increased snowmobile incursions into the Anaconda Pintler Wilderness because of improved visibility and maneuverability.

RECOMMENDATIONS

Remove hazard trees within 150 feet of National Forest roads and within 1-2 tree lengths of trails and dispersed campsites to minimize health and safety hazards to people entering the burned area. Replace all trial signs and markers that were burned by the fire. Increase trail maintenance funding for the next three to five years for trails within the fire perimeter to keep up with the increased trail clearing and drainage workload expected from burned and diseased tree blowdown and higher runoff peak impacts on trail tread. Increase Wilderness perimeter signing and patrols to prevent inadvertent and deliberate snowmobile incursions resulting from greater accessibility.

8-4 Facilities, Road Maintenance

(See 8-2)

9-1 Protection from Insect and Disease

OBSERVATIONS - MUSSIGBROD AND MIDDLEFORK FIRES

The Forest updated information gathered in 2000 during the summer of 2001 with the help of entomologists from the Research Branch of the Regional Office. The table below represents more refined data gathered for both fires.

Bark Beetle existing conditions and typical fire effects on those conditions

All conifers in the fire area may host one or more bark beetle species and woodborers.

Tree Species and some of the bark beetles they host

Tree Species	Primary Bark Beetle Which This Tree Species Hosts	Secondary Bark Beetle Which This Species Hosts
Lodgepole Pine	Mountain Pine Beetle (Dendroctonus ponderosae)	Pine Engraver (Ips pini) plus several others
Whitebark Pine	Mountain Pine Beetle (Dendroctonus ponderosae)	Several Ips species
Douglas-fir	Douglas-fir Beetle (Dendroctonus pseudotsugae)	Several others
Engelmann spruce	Spruce Beetle (Dendroctonus rufipennis)	Ips tridens
Subalpine fir	Western Balsam Bark Beetle (Dryocetes confuses)	--

Subalpine fir	Western Balsam Bark Beetle (Dryocetes confuses)	--

All of these beetle species were present on the forest prior to the fires. Ground surveys confirmed that several areas in or near the fire perimeter had contained endemic spruce beetle populations prior to the fires of 2000. These include Bender Creek and North Fork of Rock Creek near Skalkaho Pass. These populations had been killing a few trees in these drainages each year, but hadn't expanded greatly. Douglas-fir beetle population was similarly low in population within the fire perimeter. Douglas-fir beetle has been active on the Bitterroot National Forest adjacent to our fires.

What is the historical range of beetle populations and how do they interact in the ecosystem?

Bark beetles and woodborers are native to the ecosystem, often in boom and bust cycles. They have been described as "change agents" which induce tree death; changes to forest stand densities, in course woody debris, in forest floor litter, and in amounts of sunlight reaching the forest floor. Indirectly, they influence timing, scale, and intensity of fire, water quality and quantity, wildlife use, trees species composition, age and size of remaining trees, and commodity or amenity values.

Bark beetles respond to climate and tree characteristics. Woodborers interact with bark beetles, feeding on their larvae and competing for food under tree bark. The last significant tree kill from bark beetles in or near the areas where the fires of 2000 burned the project area was from a mountain pine beetle increase in the 1920's and 1930's

Western Balsam Bark Beetle has been increasing across the region. This isn't considered an epidemic, but the beetle is becoming a noticeable presence in the subalpine fir timber type, and is present in the Forest.

Mountain pine beetle is an aggressive primary beetle, attacking large, live, healthy lodgepole and whitebark pine. It is considered to be the most important native bark beetle pest of mature pines in the Western United States. Populations can build fast and kill millions of trees. A population outbreak is often followed by fire within 15 years. We have no conclusive evidence that fire-stressed lodgepole is attractive to mountain pine beetle. There is some indication that fire damaged whitebark pine is susceptible to mountain pine beetle.

Ips pini beetle (pine engraver) nearly always plays the role of a secondary beetle. This refers to its propensity to attack trees weakened through other means (drought, fire injury, wind throw). It may kill some otherwise healthy trees, but the probability of large-scale tree mortality is low. Low precipitation in spring and early summer predisposes lodgepole to attack. Outbreaks are normally 2 or 3 years long

Douglas-fir beetle can act in either primary or secondary roles. In endemic levels they infest scattered trees, including windfalls and fire-scorched or otherwise damaged trees. They can become an aggressive mortality factor if triggering events such as drought, fire, or wind throw strike areas that has sufficient beetles to respond. In those cases they can spread to adjacent green trees

Spruce beetles are typically present in low (endemic) population levels and as such facilitate regeneration of spruce by creating small disturbances in the overstory tree canopy. But their population can escalate rapidly. These large die-offs and subsequent fire may have kept some

willow bottoms stocked with willow rather than spruce.

Woodborers respond to mortality from other sources (such as fire or bark beetles).

FINDINGS AFTER THE FIRES OF 2000

How did the fire affect bark beetle habitat?

The fires varied in severity, producing a mosaic of habitat conditions for bark beetles. We classified beetle habitat within the fire perimeter into the following categories:

Classification of bark beetle habitat

Category of beetle habitat	Approximate % area within the burn
None or very little beetle habitat (water, rocks, fire-killed trees with no live cambium). Not susceptible to beetle mortality. We expect this type to produce few beetles and we expect few trees of this category to die due to beetles.	58% of area within fire perimeter
Beetle habitat – mixes of fire damaged and undamaged trees throughout burn. (Present condition is 50% live trees and 50% dead) We expect beetles to produce successful broods in this category, and we expect beetles to kill trees and to increase population numbers in this zone.	42 % of area within fire perimeter

Of particular concern are conditions in which Douglas-fir beetle or spruce beetle would thrive. We sampled the area with walking transects during summer of 2001. In late fall of 2001 a Forest Service entomologist did intensive transects for beetles. She surveyed 85 spruce trees and 100 Douglas-fir trees, finding substantial numbers of both species As of fall 2001, one year after the fires, we have found an increase in Ips, mountain pine beetle, spruce beetle and Douglas-fir beetle.

Noticeable mountain pine beetle increase is confined to fire-killed whitebark pine. It is not evident on lodgepole pine. Spruce bark beetle, Douglas-fir beetle, and ips have broods in both downed dead and standing dead trees. Downed logs with succulent bark are where most of the brood is now, although some standing dead trees and a few live trees contain beetles. Spruce trees burned so severely that they have no live foliage or cambium do not contain beetles. In contrast to spruce, dead Douglas-fir with all foliage gone and severely burned bark sometimes did contain beetles. We found this condition in both Mussigbrod and Bender drainages for Douglas-fir. We documented no tree death due to bark.

Our data indicates an increasing population of beetles for four out of five beetle species described, relative to pre-fire conditions. The full extent of beetle build-up will be unknown for a few years. We need more data to specify changes in western balsam bark beetle populations.

What is the susceptibility of trees inside the fire perimeter to bark beetles?

The fire killed most of the trees in ½ of its area. Trees killed are no longer susceptible to bark

beetle mortality. The fires of 2000 produced three elements necessary to place those trees inside their perimeters into a highly susceptible category. Those elements are: stressed trees from long drought and age, fire and presence of beetles that we have found in the fire perimeter.

Spruce beetle, Douglas-fir beetle, ips, and to a certain extent mountain pine beetle have already capitalized on these conditions. However, direct fire injury will probably account for more mortality than will bark beetles

What is the susceptibility of trees outside the fire perimeter to bark beetles?

Trees outside the fire perimeter do not have direct fire damage and so their vigor is unaffected by fire. But their proximity to the building population of beetles in the fire will mean their defenses against beetle will likely be tested in the next several years.

All of the bark beetle species discussed are natives of this ecosystem. Every tree in the area has at least one bark beetle that it hosts. Local endemic populations of beetles are a normal component of the ecosystem. To that extent, all the trees are susceptible to attack and mortality due to bark beetles. This interaction is a part of normal ecosystem function. We expect that normal background mortality to continue, regardless of fire effects.

Even large populations of bark beetles and resulting tree mortality can be part of normal ecosystem function. Fires, wind throw, and drought are typical triggering events for such buildups. But this type of buildup is of concern to forest management since it may impact special components of forest cover vegetation types (spruce and Douglas-fir in this area).

The following discussion describes how fires affected each beetle species and how the host trees near the fire perimeter are set up to respond.

1. Douglas-fir bark beetle in Douglas-fir outside fire perimeter:

Stand conditions conducive to beetle depredation are:

- Stands in which Douglas-fir is the dominant species and on sites where it is commonly found. Douglas-fir habitat types on south slopes and drier ridges sustain more beetle-caused mortality than others.
- Age of Douglas-fir. Greater than 100 years is highly susceptible. Older than 120 years is extreme.
- Size of the Douglas-fir. Trees less than 14 inches in diameter are less likely to be attacked successfully.
- Stand density. When basal area exceeds 150 square feet per acre, susceptibility increases.

The 10,533 unburned acres of Douglas-fir that are within 5 miles of the burn all meet these 4 criteria. They can be considered at risk to Douglas-fir beetle. Approximately 2,000 acres of those unburned Douglas-fir are very susceptible to the beetle.

2. Spruce beetle in Engelmann spruce outside the fire perimeter:

Spruce stands are highly susceptible if they grow on well-drained sites in creek bottoms, have an average diameter breast high of 16 inches or larger, have a basal area greater than 150 square feet per acre, and have more than 65 percent spruce trees in the canopy.

36,169 acres of unburned spruce outside the fire perimeter but within 5 miles that meet this criterion. These stands of spruce can be considered susceptible to mortality from spruce beetle.

7,200 of these acres are in narrow riparian strips in which spruce forms a large portion of the tree biomass. These contain the largest spruce trees and best fit the description of "highly susceptible" to spruce beetle.

3. Mountain pine beetle in lodgepole pine and whitebark pine outside the fire perimeter:

Lodgepole pine outside the fire line is quite susceptible to attack by mountain pine beetle as judged by diameter, age and local environment , but the fires of 2000 did not exacerbate their susceptibility. These conditions existed prior to the fires of 2000 and continue now. The beetle has been building rapidly for two to four years in forest areas within 50 air miles (near Butte, Montana). We have seen small pockets near the north end of the burn complex for several years. Neither research literature nor our field surveys give strong indication that mountain pine beetle is attracted to fire-stressed lodgepole pine. That does not exclude the possibility that such interaction may occur.

Whitebark pine may be susceptible to mountain pine beetle after fires. We found the beetle attacking fire-killed whitebark pine during summer of 2001), but not live trees

4. Pine Engraver (Ips) in lodgepole and whitebark pine outside the fire perimeter:

Ips is a secondary beetle; usually killing a few trees to a few hundred Trees outside the fire perimeter have experienced drought stress for several years. The fire provided habitat for ips beetle population increase. So lodgepole near the fire perimeter are at increased susceptibility. But we do not expect ips beetle to kill a significant number of trees outside the fire perimeter.

5. Western balsam bark beetle and subalpine fir:

Subalpine fir across our forest and regionally has experienced several years of dying-off (aerial insect and disease detection surveys, years 1999, 2000). Causes are not well understood. This may be natural succession, root rots, western balsam bark beetle, or other unknown causes. We have not detected an increase in population after fires of 2000. We have no conclusive evidence suggesting that the fires have increased susceptibility of subalpine fir to beetles. Nor do we know that the fires will increase the population of beetles, thus increasing pressure on the nearby subalpine fir trees.

SUMMARY - Ips, Douglas-fir beetle, spruce beetle, and mountain pine beetle show increased populations within the fire perimeter. We do not have strong evidence that the fires increased susceptibility for trees outside the fire for ips or mountain pine beetle. We do have adequate evidence that Douglas-fir and spruce trees outside the fire are at increased risk to mortality from beetle.

RECOMMENDATIONS

Analyze the feasibility of using harvest, trap trees, and/or pheromones to reduce Douglas-fir and spruce tree mortality outside fire perimeter.

Monitor bark beetle population within and near to the fires of 2000.

Monitor tree death due to direct (delayed) fire effects and bark beetles.

10-1 Economics, predicted cost vs. experienced costs for timber sales.

(Not applicable to post-fire monitoring)

10-2 Economics, predicted values for timber

This item is intended to validate models used to predict values for timber and is not applicable to post-fire monitoring.

10-3 Economics, program budget vs. actual dollars received

(Not applicable to post-fire monitoring)

11-1 Adjacent Lands, Resources, Communities

The Fire Season of 2000 raised issues about how management of the National Forest affects the local economy, resource values, local uses and lifestyles. In particular, the Forest was concerned about how we did at:

- Communicating with the public about the actual effects of the fires of 2000, the rehab need we have, and what we're doing to meet the need.
- Maintaining good relations developed during the fire season.
- Building support for long-term community-based actions to improve fire readiness.
- Increasing public understanding of the role of fire in our forests.

OBSERVATIONS – BEFORE THE MUSSIGBROD FIRE

Relationships - We enjoyed good relationships with news reporters before the fires, but had never had those relationships tested by a large-scale emergency. Reporters have been sympathetic to our push for "firewise" rural homeowners but needed newsworthy events or "hooks" to proceed with coverage, and we were finding those harder to develop.

We enjoyed good working relationships with county commissioners in both Granite and Beaverhead counties, in spite of differences that sometimes developed over policy.

Communities - Relationships with Granite County residents and with Big Hole residents were fair to good. Granite County had enacted a "Catron County" style ordinance some years ago, but never had been aggressive about enforcing it or negative toward the Forest Service.

Beaverhead County has allowed a citizen's group called the Beaverhead Resource Use Committee to develop a plan for managing federal and state lands, but so far the plan is just in the proposal stage, with public support for it uncertain.

Anaconda, in Deer Lodge County, was only occasionally engaged in Forest Service issues, focusing more on local issues in Anaconda.

Some Big Hole residents were not pleased with the Rainbow Family Gathering that occurred in June and July. They felt the agency should have stopped the gathering altogether. Others elsewhere in Beaverhead County felt the response was too heavy handed, that agencies overreacted.

Public Safety - About five years, the Butte Ranger District began working to increase awareness among homeowners in Silver Bow County subdivisions of the need to become "firewise." The campaign began with a proclamation from the county chief executive, a full-page newspaper graphic, radio announcements, and a week of tips on TV weather segments of the nightly news.

Since then, the Butte Fire Protection Association (BFPA) organized to bring local, state, and federal fire fighting and emergency agencies together. The group held tabletop exercises and looked for opportunities each summer to spark and continue interest. For three years, a public service announcement ran on KXLF-TV, co-produced by the public affairs office for the BFPA. The association also supplies firewise publications for distribution at-risk areas.

Homeowner education was occasionally a theme at county fairs around the forest in the late 1990s.

Education - The forest has not interpreted fires or their effects in any roadside signing. There was some environmental education work done with fire as a topic at the Birch Creek Center. There, one of the trails runs through a 1987 burn, and a 1998 prescribed burn is visible from campus. But, fire was not a major emphasis.

FINDINGS – AFTER THE MUSSIGBROD FIRE

Relationships - Good work by incident teams gave communities much needed personal contact that will be much harder for regular Forest staff to accomplish.

News reporters were pleased by the job the Forest and two major incidents did keeping information flowing to them about the fires. Reporters' attention can be drawn back to the fires if we offer newsworthy events to cover, such as reseeding, announcing the results of our assessments, and so on.

Interest in rehab plans is less than it is in actual rehab work and the photo opportunity that presents.

Service and other clubs in the Forest's area sponsored talks about the fires, which gives us an opportunity to explain our rehab assessment and plans. We are developed a power-point program that went into use shortly after the fires were out. This allowed us to contact new audiences.

Communities - As we completed each phase of the post-fire recovery, we held community meetings in Wisdom to let the local populace know what the fires meant in terms of resource effects, how we plan to work with them, and what the next step is. We will also use these meetings to suggest steps the people themselves should consider taking, perhaps facilitated by county commissions. We should plan to continue these meetings over the next year, until interest has obviously waned.

A residual bad feeling remains about the Rainbows and federal policies in general. Most of those critical of the fire fighting strategy were able to see the scale of the fires through several tours of the Mussigbrod fires.

As memory of the fires fades, we can expect people to return to their pre-fire positions on timber harvest, forest health, and the role of the Forest Service. Making homes near forests safe may be the only "neutral" ground we'll find to operate in. As we advocate for more prescribed burning or other management actions, we can expect to see groups choose sides on this issue, and we can expect the fire organization to be in the unaccustomed position of being "bad guys" in the view of some.

As fire prevention and fire use become a greater proportion of Forest Service work and budget, we can expect criticism from many quarters: some longing for more commodity production, others critical of management they feel is too intrusive.

RECOMMENDATIONS - LONG-TERM FIRE REHABILITATION & RESTORATION

Install interpretive signing along major roads and highways (Highway 43, Chief Joseph and Lost Trail passes, Highway 38), and forest roads. Construct an accessible interpretive trail, possibly at Mussigbrod Campground. Continue community meetings to provide information on post-fire assessments. Encourage communities to organize for future fires. (Districts, ongoing)

RECOMMENDATIONS - HAZARDOUS FUEL REDUCTION & COMMUNITY ASSISTANC

At the Regional Level

- Update existing fire education materials and consider providing all schools in Montana with a unit on the 2000 fires, with video, CD-ROM, activities, and tied to an interactive website. This could provide an opportunity to further market the "Living with Fire" CD and video, the Fireworks trunk, and other information. Make sure the website is placed on the major search engines.
- Consider holding a national level scientific meeting, perhaps at the University of Montana, to review the effects of the fires, and include papers presented at another website, aimed at college level audiences and linked to important fire information/education websites.

At the Forest Level - Embark on a concerted, five-year campaign to make rural homes in our area "firewise."

- Use a professional agency to develop a plan
- Produce materials called for in the plan, such as TV ads, radio ads, and printed material
- Establish 1-2 fire education specialist positions for the forest. These positions would work with homeowners, community groups, and schools and help carry out the firewise campaign. They would have lead responsibility for coordinating our presence at county fairs, sports shows, and other events where the firewise message would find a suitable audience. They would work with the Forest Public Affairs Officer on news opportunities to keep the firewise message before the public. They would organize community events to further strengthen the firewise message. If there were two positions, each would cover about half of the forest, with support from the forest public affairs and fire staff officers.
- Repackage and distribute elementary and secondary fire education materials (including Firewise and Smokey materials) to area schools and at fairs, sports shows, and other events.
- Develop "firewise" exhibit panels for use at fairs, sports shows, and other events. Produce a scaled down tabletop version for agency office reception areas.
- Use images in the exhibit for an interactive website program and a power point program presented at area service clubs.
- Post power point and other interactive information at the forest website.
- Work with local communities, providing facilitation, educational materials, and assistance to develop local "firewise" plans and homeowner education efforts.
- Look for fire recovery events and invite reporters to cover them (PAO, Fire Education Specialists, ongoing)
- Visit service and other clubs to report on the fires' aftermaths, assessments, and to

deliver the "firewise" message.
11-2 Adjacent Lands, effect of other agencies and private on Forest mgt
(See 11-1 above)
11-3 Emerging issues and changing social values
Effects of the lack of past fire on the way wildfires burn today, the use of prescribed fire, and protection of homes and property along the forest/private land interface all combine to make fire management an increasingly controversial subject. This has been the case since before the 1996 Forest Monitoring and Evaluation Report identified "Fire" as an emerging issue 5 years ago. The National Fire Plan (Final Report 1995 and Protecting People and Sustaining Resources in Fire Adapted Ecosystems – A Cohesive Strategy, October 2000) has effectively replaced many of the priorities for vegetation management laid out in our current Forest Plan. The discussion in Item 11-1 briefly touches on the need to bring private landowners and agencies together to manage for wildfire. This will need to be addressed as an issue in the upcoming Forest Plan Revision.
12-1 Allocations, Management Area Changes
(Not applicable to post fire monitoring)
12-8 Data base, Compartment Exams
Following the fires of 2000, the Beaverhead-Deerlodge Forest remapped and updated the Timber Stand Measurement and Record System (TSMRS) to reflect changes in the vegetation on all acres affected by fire. Most of this information was interpreted from low level infrared photography taken in the month after the fire. Stand polygons are on record in a Geographic Information System.