

# SPRUCE AND DOUGLAS-FIR BARK BEETLES

## Introduction

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Many insects and pathogens capitalize on the changed forest conditions after fires. In the West Side Reservoir Fires, spruce and Douglas-fir and bark beetles are of primary concern to land managers because of their potential to develop large populations within the fire area, spread into live trees within and outside the fire area, and produce adverse effects on other resource values.

Disturbances such as insects, disease, and fire, are a natural part of the ecosystem. Wildlife, vegetation, and other components of the ecosystem have evolved and responded to the influence of these processes for thousands of years. Bark beetle populations are “endemic” in the forest, with typically low annual tree mortality. However, periods of high beetle population levels occur periodically, usually in response to disturbances that stress and weaken host trees (such as drought, fire, blowdown). These insects have evolved to take advantage of disturbances, such as the West Side Reservoir Fires, where thousands of fire-killed and stressed trees provide suitable brood-producing habitat for bark beetles. A bark beetle outbreak in and around the fire area would be normal and natural from an ecological context; however, high tree mortality in much of this area (both on national forest and private lands) may conflict with management objectives and create undesirable consequences.

Several conditions must exist for bark beetles to take advantage of fire-damaged hosts (FHP 2000b, FHP 2003). These include the following:

*First*, the fire area must have sufficient numbers of host trees, and those must have an adequate supply of undamaged inner bark (phloem) in which beetles feed and lay eggs. Stand-replacing fires, or fires in thin-barked tree species, may render the inner bark unusable to beetles. However, within the West Side Reservoir Fires, many of the older and large-diameter (>16”) Douglas-fir and many large spruce in the burned areas were found to still have viable, moist inner bark. The larger trees are still capable of attracting and supporting bark beetles for up to one year, before the inner bark dries out. Fewer beetles would be produced in these than if they were alive or less charred.

*Second*, fires must occur at a time when beetles are able to capitalize on the new feeding and breeding habitat. Fires in late summer or early fall may occur after adult beetles have flown, and a burned tree’s inner bark may become too dry, or in some cases “sour”, before the next year’s flight season. The West Side Reservoir Fires occurred after the beetle flight season in 2003. The fire killed many spruce and Douglas-fir trees, though the inner bark on many is still moist and able to support a new generation of beetles (Exhibit Pb-8). Many other trees not directly killed by the fire have experienced crown scorch and are highly stressed. These trees are the most susceptible to beetle infestation and able to produce high numbers of new adult beetles in subsequent years.

*Third*, there must be a population of beetles within a reasonable distance to take advantage of weakened trees that become available. High Douglas-fir beetle populations currently exist throughout northwestern Montana, including on the Flathead National Forest near the fires. This is likely to continue for at least 2-3 more years (Gibson 2003, Exhibit Pb-8). Spruce beetles are currently at endemic population levels in Northwest Montana, but expected to be capable of exploiting the new, highly desirable feeding and breeding sites in the West Side Reservoir Fires' area.

Historically, there have been, and continue to be, bark beetle outbreaks on the Flathead National Forest. Within the past 20 years there have been substantial outbreaks of mountain pine beetle in lodgepole pine stands (McGregor *et al.* 1983) and spruce beetle outbreaks in stands of Engelmann spruce (Gibson 1984). Currently an epidemic exists in Douglas-fir stands in parts of the Big and Coal Creek drainages on Glacier View Ranger District and in Logan and Good Creeks on the Tally Lake Ranger District, and surrounding lands (Gibson 2002a, Exhibit Pb-8). Small, Douglas-fir beetle outbreaks are scattered throughout mature Douglas-fir stands on Hungry Horse and Spotted Bear Ranger Districts (ref 2003 FHP annual report). In addition, past bark beetle outbreaks in the Northern Region precipitated by fire-damaged stands are well documented (Amman & Ryan 1991; FHP 1999b; Gibson & Oakes 1993, 1994).

Predicting bark beetle infestations is not an exact science. "Impact" models are useful in predicting beetle-caused mortality in stands of certain characteristics (Cole and McGregor 1983; Negron *et al.* 1999). Our best efforts are directed towards risk and hazard reduction – recognizing when "outbreak conditions" are present, considering potential effects on various resources should an outbreak be realized, and implementing strategies to prevent or lessen the effects of an outbreak if management objectives deem that a prudent course of action. That is the strategy of this analysis.

The greatest benefits in dealing with actual or potential Douglas-fir or spruce beetle infestations are derived from efforts aimed at preventing outbreaks rather than suppressing them (Schmitz and Gibson, 1996). This involves modifying live susceptible stands to the extent possible to make them less vulnerable before some type of stand disturbance which may trigger an outbreak. Actions may include altering tree densities and species compositions. Once disturbances occur (common ones being blowdown, fire and drought), removal of bark beetle susceptible trees before they are infested is the most effective course of action to prevent an outbreak or influence beetle populations. Removing as many infested trees as feasible before the adult beetles emerge and spread to live trees in the vicinity can reduce the risk of a large-scale bark beetle infestation (USDA 1995, 1999d, Gibson 2001, Exhibit Pb-8). Alternatives include use of pheromones to either trap or repel beetles, burning or peeling infested logs to destroy brood, and using trap trees to attract beetles then removing the attacked trees. All these methods have utility and are applicable in specific situations (Exhibit Pb-9). The West Side Reservoir Fires action alternatives employ a variety of methods to deal with a potential bark beetle outbreak.

## Information Sources

Bark beetle life history and outbreak assumptions are based on literature cited in the text and personal communications with entomologists and silviculturists. Stand conditions, susceptibility, and potential effects are based on information from stand exams, photo interpretation, field observations, satellite imagery, and various GIS data filed in the Flathead National Forest and West Side Reservoir EIS electronic libraries.

## Analysis Area

The area affected directly by spruce and Douglas-fir bark beetles is the National Forest System Lands within the West Side Fire perimeters (refer to Figure 1-1). For evaluating indirect and cumulative impacts of bark beetles, the area affected includes all lands within a 5-mile radius of the West Side Fire perimeters (Figure 3-11 and 3-12). This distance is based on our knowledge that bark beetles will only fly as far as necessary to find a suitable host. Flight tests indicate few beetles can fly more than 7 miles nonstop (Chansler 1960, in Schmid and Frye 1977). Therefore, it is reasonable to assume beetles produced in the fire area might fly up to five miles from where they developed.

Table 3-12 below displays the different land ownerships and acreages within the 5-mile zone, including the fire areas, which may be directly or indirectly affected by bark beetle activity. Most of this area (93%) is National Forest System Lands.

**Table 3-12: Acres by land ownership within five miles of the West Side Reservoir fire areas**

Ownership	Acres	Percent of Total Area
National Forest	297,760	93
Small Private	19,003	6
State of Montana	3740	1
Anaconda Aluminum	251	0.08
<b>TOTAL</b>	<b>320,754<sup>(1)</sup></b>	

1) 289,157 acres outside the fire areas

## Affected Environment

### *Spruce Beetle*

#### Description, Life History, and Host Interactions

The spruce beetle (*Dendroctonus rufipennis* [Kirby]) is the major natural mortality agent of mature spruce in this area. At endemic population levels, spruce beetles usually live in wind-thrown trees, scattered individual trees, and groups of low-vigor trees. Outbreaks normally

occur after a stand disturbance event, such as a windstorm, that result in an abundance of feeding and breeding habitat for the beetle. Beetle populations can increase dramatically in these situations and spread into susceptible, larger-diameter, standing live spruce in surrounding regions, causing extensive mortality of these trees. Outbreaks during the last decade in Alaska and Utah spread over more than 2.3 million acres and 122,000 acres respectively, killing tens of millions of trees (FHP 1999a).

The normal life-cycle for spruce beetle is two years. Adult beetles fly and attack host trees mostly in early summer. The female finds a suitable breeding site, emits a pheromone (or chemical substance) that attracts male beetles. Males then attract both male and female beetles; initiating a mass attack on the tree. A thousand or more beetles may infest a single tree and in turn produce two to five times that number of beetles in the next generation. Once mated, the female constructs an egg gallery in the inner bark of the tree and lays her eggs. Eggs hatch the same summer laid. Larvae tunnel at right angles to the egg gallery and feed, eventually killing the tree by girdling.

Most of the time spruce beetles overwinter as larvae and pupate by late the following summer. These new adults would overwinter again in the same tree, with the majority emerging from their original pupal sites, moving to the base of the same tree, and boring back into the bark near the litter line. This may be an adaptation to reduce predation by woodpeckers and reduce winter mortality from extreme cold. The spring and summer of their second year, the adult beetles emerge from the tree to seek mates and new breeding sites. Beetles developing in downed logs remain in place after maturity, until emerging the following spring.

Spruce beetles are able to fly several miles in search of suitable breeding sites, and being non-aggressive in nature would favor wind thrown, weakened trees to attack. If these trees are not available, they would attack live, healthier trees, though they may or may not be successful. Larger-diameter trees (>18" DBH) are usually attacked first, but with high and persisting populations, smaller-diameter trees may be attacked as well.

Natural enemies of the beetle include birds, insect predators and parasites. When beetles are at lower populations, these organisms can effectively keep population levels in check. During outbreaks, their influence is much less effective.

### **Past and present spruce beetle activity in and around the project area**

Spruce is and has historically been a very common species throughout the west side of the South Fork drainage. Spruce beetle activity undoubtedly fluctuated through time and was probably always a common cause of mortality in larger-diameter spruce. Periodic epidemics occurred in response to events such as fire or windstorms, depending upon the condition of the stands.

A major spruce beetle epidemic occurred in northwest Montana and northern Idaho following a severe windstorm of hurricane force in 1949. Hundreds of thousands of acres of blowdown resulted, thousands of which were in drainages of the South Fork Flathead River. This was followed by millions of spruce trees infested and killed by spruce beetles through the 1950s. Harvesting throughout the South Fork (in the 1950s and 60s) was conducted to slow down the

epidemic and salvage the value of the many dead and highly susceptible spruce trees. This blowdown event and subsequent salvage effort converted many of these stands to early seral seedling and sapling. As a result, the vulnerability of the South Fork landscape to spruce beetle was reduced from the pre-1950 condition.

Spruce beetle activity has been at endemic levels in and around the project area for the past 40 years, causing scattered mortality nearly every year. Aerial surveys have detected scattered spruce beetle-caused mortality across a total of about 8300 acres within 5 miles of the West Side fires since 1968 (the first year of aerial surveys). The highest activity levels occurred in the early 1980s and the lowest in the 1970's (Exhibit Pb-7).

### **Current spruce beetle conditions within the fire perimeter**

Shortly after the West Side Reservoir Fires, all stands within the fire areas (about 31,545 acres) were evaluated for susceptibility or “hazard” of spruce beetle infestation. Hazard was estimated using a well-established rating system developed over 20 years ago (Schmid & Frye 1976). Criteria for the rating system includes average diameter of spruce over 10” DBH; proportion of spruce in the canopy; basal area (density) of the stand; and physiographic location (i.e. creek bottoms vs. lower productivity sites). Rather than applying the detailed ratings for the post-fire stands, information from past and immediately post-fire field inventories, photo interpretation, and satellite imagery was used to determine if large diameter (>10 inches) spruce was a major stand component. Stands containing large spruce were then integrated with the fire severity and its effect on the susceptible spruce trees. Refer also to Section P in the Project Record for data and maps related to spruce beetle hazard.

Over 9700 acres or 31% of the fire area was identified at some level of spruce beetle susceptibility. Most of these acres are in moist, productive riparian zones or in mid to high elevation stand dominated by spruce and sub-alpine fir, where the fire stayed on the ground and burned through the vegetation on the forest floor, damaging the spruce trees in the process. These sites have the highest number of larger-diameter, fire-affected spruce, many over 20” DBH, and many already wind thrown, creating even more desirable beetle habitat.

The Table 3-13 displays the estimated acres of spruce stands within the fire areas that are susceptible to spruce beetle (Exhibits Pb-3 and Pb-4).

**Table 3-13: Estimated Acres of stands susceptible to spruce beetle within West Side Reservoir Fires**

<b>FIRE</b>	<b>ACRES SUSCEPTIBLE TO SPRUCE BEETLE</b>	<b>% OF EACH FIRE'S ACRES</b>	<b>DISTRIBUTION</b>
Beta	2400	45%	All elevations
Blackfoot/Doe	6365	35%	Mostly in riparian areas and higher elevations
Ball	965	12%	Mostly in riparian areas and higher elevations
<b>TOTAL</b>	<b>9730</b>	<b>31%</b>	

Spruce has thin bark. A moderate or high severity fire that chars the bole along most of its length kills the inner bark, rendering the trees useless to spruce beetles as habitat. Low severity underburns char only the lowest part of the bole or the root crowns and the foliage is usually still green, creating ideal beetle habitat. The inner bark has been damaged in the charred regions of the bole, highly stressing the trees. In most cases, these trees have been killed by the girdling effect of the fire itself (they are “dead but don’t know it yet”). They still contain abundant moist inner bark in which beetles may successfully develop.

### **Current Spruce Beetle Habitat Conditions Outside the Fire Perimeter**

Using information from past field inventories, photo interpretation, satellite imagery, and field knowledge, spruce beetle stand hazard ratings were determined for the forest lands outside the fire perimeters, within five miles from the boundary (as described above under Analysis Area and Information Sources). Criteria used to determine hazard include average diameter of spruce over 10” DBH; proportion of spruce in the canopy; basal area (density) of the stand; and physiographic location (i.e. creek bottoms vs. lower productivity sites). (Schmid & Frye 1976). Refer to Exhibit Pb-1 for description of the hazard rating analysis.

The hazard rating measures a stand’s ability to support a population of beetles. Hazard ratings do not predict when or if the beetle would be active or cause mortality in a certain stand nor do they predict actual stand losses from beetles. What they do is identify stands with conditions that would support a beetle outbreak, and stands that could experience considerable mortality once an outbreak occurs.

High hazard stands are those in which large amounts of beetle mortality might be expected once a disturbance (such as fire) occurs, allowing an increase of beetle populations. Moderate and low hazard stands may experience less beetle-caused mortality, but large, old trees might still be killed in these stands (Randall and Tensmeyer 1999). In addition, low hazard stands become more vulnerable when high hazard stands nearby are infested.

### **National Forest System Lands:**

Table 3-14 and Figure 3-11 display the estimated acres of spruce stands on National Forest System Lands outside the fire area and their hazard ratings for spruce beetle (Exhibits Pb-3 and Pb-4).

Relatively few stands fall in a low hazard category. Low hazard stands are typically those where larger (>16” DBH) spruce are present, but at low numbers or the spruce are relatively small (<12” DBH). Individual trees may be infested and killed by spruce beetle, but the stand as a whole does not provide abundant beetle habitat.

The overwhelming proportion (over 85%) of the susceptible spruce stands within five miles of the fire boundary are rated medium to high hazard to spruce beetle infestation. This is consistent with the cool, moist habitats and lack of stand replacing fire for over 150 years in most of the west side of the reservoir, especially at the higher elevations. Shade tolerant forests of spruce and subalpine fir are the dominant forest cover in these areas.

**Table 3-14: Estimated Acres and spruce beetle hazard rating for stands on Flathead National Forest System Lands outside of fire areas and within five miles of West Side Reservoir Fires**

<b>SPRUCE BEETLE HAZARD RATING</b>	<b>ACRES</b>	<b>% OF TOTAL SUSCEPTIBLE ACRES</b>
Low	17,875	13%
Medium	89,906	66%
High	28,064	21%
<b>TOTAL</b>	<b>135,845 acres 51% of National Forest System Lands</b>	

Medium hazard stands are typically well-stocked stands on productive sites, composed of medium to large diameter (>12" DBH) trees, where spruce comprises less than 60 percent of the overstory stand stocking. Spruce beetle has the capability of causing high mortality to the larger diameter (>16" DBH) trees in these stands, but net losses would be lower than the high hazard stands, because there are fewer of these susceptible trees.

The high-hazard stands generally are of similar character as medium hazard, but have higher proportions of larger diameter (>16" DBH) spruce in the canopy, often over 65 percent of the stocking. Given high beetle populations, these stands would experience the greatest net losses and would be able to support and contribute substantially to high beetle population buildup.

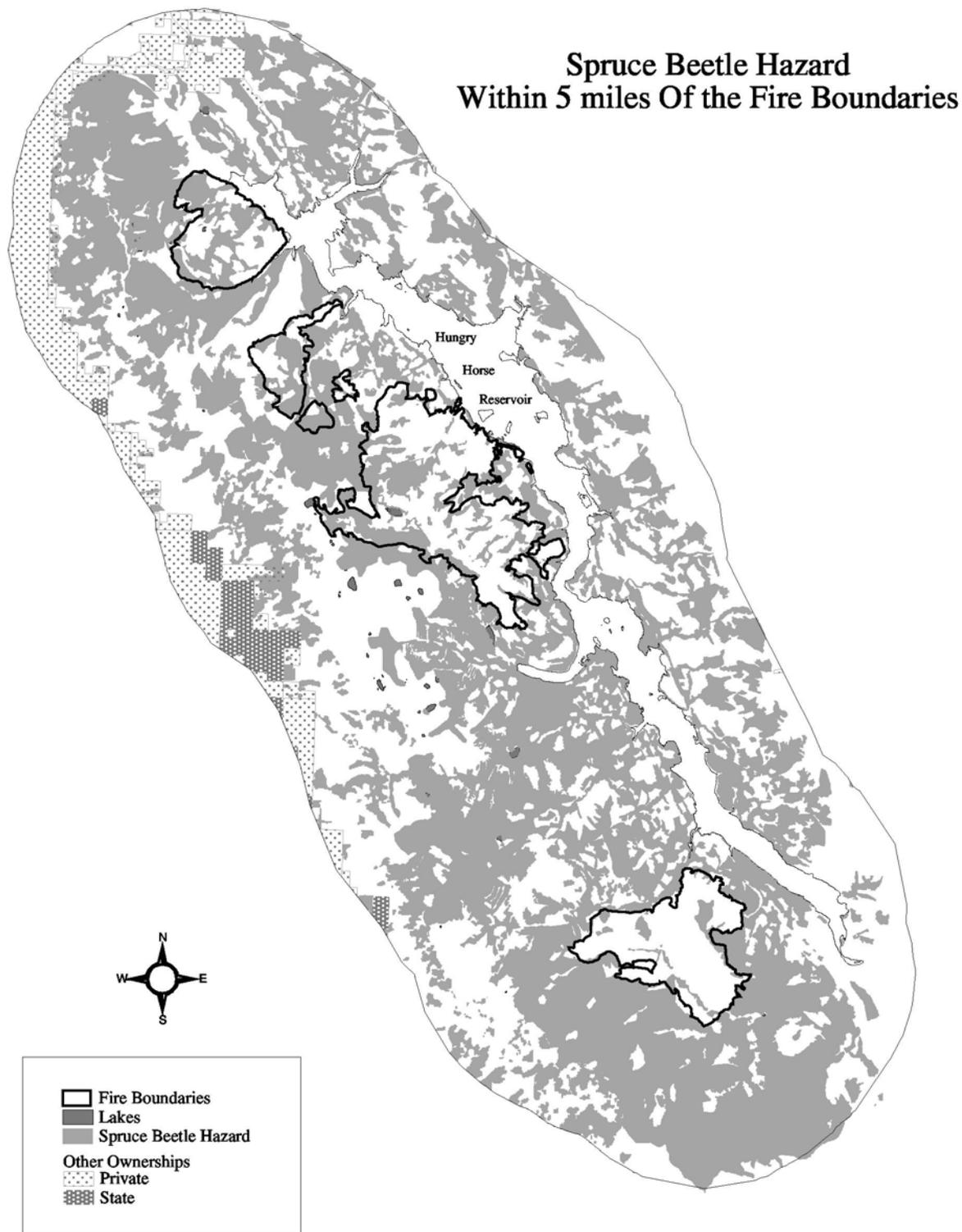
#### **Private Forest Lands:**

The 19,000 acres of private lands in the 5-mile zone outside the fire area are small private holdings in the Hungry Horse and Martin City area north of the fires and on the lower west slope of the Swan Range west of the fires. Approximately half of these lands are cleared forest, now supporting pasture and residential areas. Much of the forested area in the north end of the analysis area is pole-sized lodgepole pine originating from the 1929 Halfmoon Fire. There are no large areas of spruce dominated forest, although small patches of susceptible spruce trees exist along the base of the Swan Range, primarily along streams. These stands are estimated to total about 1200 acres. It is not known exactly what hazard level these stands may be; it depends on how many larger diameter (>16" DBH) spruce trees exist. Based on conditions in adjacent National Forest lands and photo interpretation of some of the private lands, large spruce are likely to be a component in these stands, and these trees would be vulnerable to spruce beetle infestation and mortality if an epidemic occurs because of beetle infestation in West Side Reservoir fire.

#### **State Forest Lands:**

The State Forest lands within 5 miles of the West Side Reservoir fires are at lower elevations along the west side of the Swan range. Although the hazard was not rated for these 3,700 acres, they are adjacent and similar to National Forest Lands with a mix of Medium and no hazard. These are mostly mix species stands with higher percentage of grand fir and Douglas-fir and less spruce than the in the adjacent National Forest stands. Therefore, a reasonable estimate is less than 1000 acres with some hazard.

Figure 3-11. Spruce Beetle Hazard Within West Side Reservoir Fires and Within 5 Miles of Fire Boundary, National Forest Lands.



## ***Douglas-fir Bark Beetle***

### **Description, Life History and Host Interactions**

The Douglas-fir beetle (*Dendroctonus pseudotsugae* Hopkins) infests and kills Douglas-fir throughout most of its range in western North America. Normally, at endemic population levels, beetles infest scattered trees, especially those weakened by such factors as defoliation, root disease, fire-scorch or windfall. When and where such susceptible trees become abundant, beetle populations can build rapidly and spread to adjacent green, standing trees. During outbreaks, they commonly kill groups of 100 trees or more. Outbreaks frequently last from two to four years, with those of longest duration coinciding with periods of drought.

The Douglas-fir beetle has a one-year life cycle. In this area, adult beetle flight season lasts from mid-April through June. Adult beetles are strong fliers, capable of flying for several miles in search of mates and breeding sites. Once the female beetle finds a suitable host tree, she emits a pheromone attracting male beetles that attract beetles of both sexes. A thousand or so beetles can be attracted to one tree, initiating a mass attack. Once mated, the females bore into the moist inner bark layer and lay eggs. The larvae that hatch bore outward from the egg galleries, feed on the inner bark, and kill the tree by girdling. Later in the year, the larvae pupate and develop into adults, which then overwinter in the tree. The following spring, this new generation of adults emerges to begin the cycle again.

Beetles usually only attack trees over about 8” in diameter, because of the need for sufficient thickness of the inner bark to support the brood. They preferentially attack stressed and weakened trees, such as those recently damaged or killed by fire, drought, other insects or diseases. If dead or stressed trees are not available, they attack live, more healthy trees, even stands normally considered to be low hazard (such as those with trees of smaller diameter or low numbers of larger diameter Douglas-fir). Beetle brood success in these types of stands will depend on tree vigor and number of attacking beetles.

As many as 1200 to 1500 male and female beetles may attack a typical 20” diameter tree and produce about 7,500 beetles, assuming a 5 percent brood survival rate. Generally, at high population levels, one infested tree can produce enough beetles to kill an additional 5 trees (Gibson 2004 personal communication).

Natural enemies of the beetle include an array of bird species (woodpeckers and other insect-eating birds), insect predators, and parasites. These organisms can have an impact on beetle populations and brood success when beetles are at lower population levels. During outbreak conditions, their effect is much reduced, simply because of the very large numbers of beetles.

### **Past and present Douglas-fir beetle activity in and around the project area**

Historically, Douglas-fir dominated forests were probably never widespread within the cool, moist west side of the lower South Fork Flathead watershed. They were mainly limited to the drier south and westerly aspects in the upper part of the drainage and in the valley bottom that

is now under Hungry Horse Reservoir. Douglas-fir beetles would have had periodic influence on these Douglas-fir forests, particularly after a triggering event such as blowdown or fire, with effects ranging from small to large, depending upon stand conditions at the time.

Douglas-fir beetle activity has occurred within five miles of the fires nearly every year, except during the late 1970's, since at least 1968 (the first year of aerial surveys). It has affected an overall area of about 7800 acres, with almost half of that over the last 3 years. Douglas-fir beetle and associated agents (mainly root disease and drought) have killed small patches of mature and older Douglas-fir stands throughout the analysis area. The largest patches are 100 to 150 acres in size; most are less than 5 acres. Most of the activity has been on the drier south and west aspects on the east side of the South Fork drainage, in and south of Coram Experimental Forest, and on west slopes of the Swan Range (FHP 2004, Exhibit Pb-7 and Pb-14).

Within the fire areas, Douglas-fir beetles caused mortality on only about 60 acres in 2003, before the fires began (Exhibit Pb-7).

Western Montana is currently experiencing a Douglas-fir beetle outbreak, although it is beginning to decline, except in areas affected by wildfires in recent years. Aerial surveys showed the highest amount of Douglas-fir beetle activity in 2001 with about 78,000 acres infested in western Montana. In 2003, 70,000 total acres were infested; with the Lolo and Bitterroot National Forest experiencing sharp increases after the fires in 2000 and declines in other areas (FHP 2004). Outbreaks are usually short-lived, lasting anywhere from 2-6 years, depending on the weather. Continuing drought and mild winters, combined with an abundance of host material, has favored the beetle and prolonged the current outbreak.

### **Current Douglas-fir bark beetle conditions within the fire perimeter**

#### **National Forest System Lands**

The West Side Reservoir fires affected about 31,545 acres of National Forest System Lands. After the fires, stand hazard for Douglas-fir beetle was determined for all these acres, primarily using field surveys (pre and post-fire) and photo interpretation. This analysis is described in the Exhibit Pb-2. About 6955 total acres within the fires were identified as susceptible to Douglas-fir bark beetle.

Table 3-15 displays the estimated acres of stands within the fire areas that are susceptible to Douglas-fir beetle (Exhibit Pb-5, Pb-6).

Criteria for the rating include stand density and the size, age, and proportion of Douglas-fir in the stand (Weatherby & Thier 1993; Negron *et al.* 1999, Randall & Tensmeyer 1999). This rating was integrated with the fire severity and its effects on the larger diameter (14"+) Douglas-fir trees within the stand. Douglas-fir trees severely affected by the fire, but perhaps not directly killed (i.e. scorched crowns, charred boles, charred root crowns or large, surface roots) were considered more vulnerable to beetle attack and mortality than they were before the fire. Stands where average tree size was smaller, where Douglas-fir was a more minor stand component, and/or fire severity was particularly high, damaging the cambium layers of

the tree, were rated lower hazard. Maps and tables displaying the beetle hazard analysis and potential for population buildup are found in Exhibits Pb-5 and Pb-6.

**Table 3-15: Estimated Acres of stands susceptible to Douglas-fir beetle within West Side Reservoir Fires**

<b>FIRE</b>	<b>TOTAL ACRES SUSCEPTIBLE TO DOUGLAS-FIR BEETLE</b>	<b>% OF EACH FIRE'S ACRES</b>	<b>DISTRIBUTION</b>
Beta	371	7%	Scattered at low and mid elevations
Blackfoot/Doe	2351	13%	Mostly on south and west aspects at mid elevations
Ball	4233	52%	Mature stands throughout fire
<b>TOTAL</b>	<b>6955</b>	<b>22%</b>	

### **Current Douglas-fir bark beetle habitat conditions outside the fire perimeter**

Using the same information sources as described earlier under the spruce beetle, Douglas-fir bark beetle hazard was determined for the forested lands within five miles of the West Side Reservoir Fires. Criteria used to determine Douglas-fir beetle hazard include tree size, age, stand density and proportion of Douglas-fir in the stand (Randall & Tensmeyer 1999; Weatherby & Thier 1993; Steele *et al.* 1996). Refer to Exhibit Pb-2 in the project record for a discussion of the hazard rating analysis. As explained under the spruce beetle section, the hazard rating identifies stands with conditions that would support a population of beetles, and the level of beetle-caused mortality that may be experienced.

### **National Forest System Lands**

Table 3-16 and Figure 3-12 display the acres susceptible to Douglas-fir beetle on National Forest System Lands outside the fire area. Refer also to Exhibits Pb-5 and Pb-6.

Although nearly 44,000 acres are susceptible to Douglas-fir beetle, about half of the stands are rated as very low to low/moderate hazard. This is in large part due to the low proportion of larger, older Douglas-fir within these stands. Most of these stands are mixed species, where Douglas-fir comprises a relatively small proportion of the total overstory stocking. In other low hazard stands, Douglas-fir may be a dominant species, but the stand is relatively young and not yet at the size and age that makes it highly susceptible to Douglas-fir beetle. However, even these stands may experience beetle mortality during an epidemic situation.

About 23,000 acres within the 5-mile zone are considered moderate to high hazard (or unknown level) to Douglas-fir beetle. These are stands where larger diameter, older Douglas-fir comprise a large portion of the stand stocking, providing beetles with more abundant breeding material given a disturbance such as fire and subsequent beetle population buildup.

**Table 3-16: Estimated acres and Douglas-fir beetle hazard rating for stands on Flathead National Forest System Lands within five miles of West Side Reservoir Fires**

Douglas-fir Beetle Hazard Rating	ACRES	% OF TOTAL SUSCEPTIBLE AC
1 - 2 = Very low	13,294	30%
3 - 4 = Low	2750	6%
5 = Low/Moderate	4700	11%
6 - 8 = Moderate	12,480	29%
9 - 10 = High	4895	11%
11 = Very high	211	<1%
Unknown level - No exam	5457	12
<b>TOTAL</b>	<b>43,787 acres</b> (16% of National Forest System Lands)	

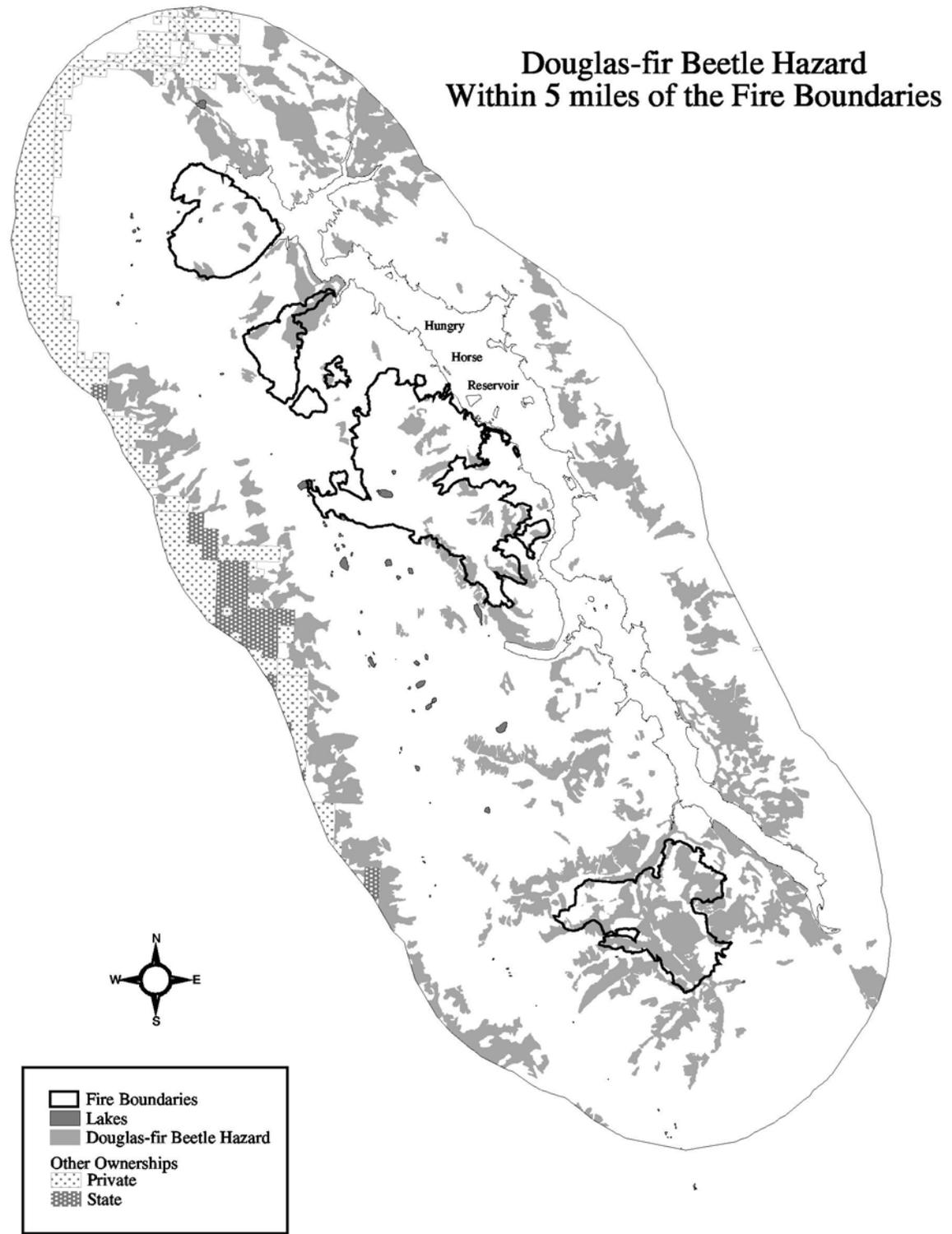
**Private Forest Lands:**

As stated under the section on spruce beetle, the 19,000 acres of private lands in the 5-mile zone outside the fire area are small private holdings in the Hungry Horse and Martin City area north of the fires and on the lower west slope of the Swan Range west of the fires. Most of these lands are cleared forest/pasture, residential areas, or pole-sized lodgepole pine originating from the 1910 fire. There are no large areas of Douglas-fir dominated forest, although small stands of susceptible trees exist along the base of the Swan Range. These stands are estimated to total about 2500 acres. It is not known exactly what hazard level these stands may be; it depends on how many larger diameter (>14" DBH) Douglas-fir trees exist. Based on conditions in adjacent National Forest lands and photo interpretation, large Douglas-fir are present in these stands and these trees would be vulnerable to beetle caused mortality if an epidemic occurs because of beetle infestation in West Side Reservoir fires.

**State Forest Lands:**

The State Forest lands within 5 miles of the West Side Reservoir fires are at low elevations along the west side of the Swan range. Although the hazard was not rated for these 3700 acres, they are adjacent and similar to National Forest Lands with a mix of moderate to very low and no hazard. The State lands have immature trees from previous timber harvest and natural openings in about half the stands. The other half are mostly mixed species stands with scattered Douglas-fir. Only a few have large diameter Douglas-fir. A reasonable estimate is approximately 1200 to 1500 acres with some level of hazard.

Figure 3-12: Douglas-fir Beetle Hazard Within West Side Reservoir Fires and Within 5 Miles of Fire Boundary, National Forest Lands



## Environmental Consequences

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Bark beetle activity in forest stands and its resulting consequences are a normal and natural part of the ecosystem that has been occurring for thousands of years. Beetle outbreaks after disturbance events, such as fire, are not a certainty, but neither are they unheard of. As described under “Affected Environment”, there may be situations where the consequences of beetle activity may conflict with management objectives for a variety of resources, potentially affecting wildlife habitat, old forest, riparian and stream stability, timber productivity, private property, or other values. The purpose of this section of the EIS is to disclose the possible effects from a beetle outbreak on these resource values. This information allows the decision maker to make a fully informed decision, integrating the beetle assessment with the other considerations and purposes of the proposed activities.

Potential beetle activity and the possible course of an outbreak will be described in this. Numeric predictions are best used as a relative comparison of potential hazards and effects between alternatives.

No significant issues related to bark beetles were identified (refer to Chapter 2). The following Effects Indicators were used to focus the beetle analysis and disclose relevant environmental effects:

- Salvage treatments and other methods in areas susceptible to spruce beetle (acres)
- Salvage treatments and other methods in areas susceptible to Douglas-fir beetle

### *Outbreak characteristics and analysis assumptions*

Our best means of assessing outbreak effects is a review of past and ongoing epidemics (Gibson 2002b, Exhibit Pb-15). When we refer to an acre being infested with bark beetles, it does not necessarily mean that every tree, or even most of the trees, have been attacked and thus killed by beetles. Trees killed per acre can vary widely. Current Douglas-fir beetle outbreaks in the region averaged about 1.5 trees per acre killed in 2001 (an estimated 351,500 trees on 200,500 acres); however, ground-collected data from the past few years have shown that up to 50 trees per acre killed in heavily infested stands is not uncommon. Data collected in the early 1970s in northern Idaho showed in one Douglas-fir beetle-infested stand, 90 of 152 Douglas-fir were killed in one year (Furniss et al. 1979). Data collected in 2001 on the areas affected by the 2000 fires on the Bitterroot show new Douglas-fir beetle attacks averaged 23 trees per acre for 12 plot areas, but one was as high as 46 trees per acre (Gibson 2002b, Exhibit Pb-15). These examples illustrate the extent that extreme levels of bark beetle populations may affect stands.

Surveys conducted a year after the 2001 Moose Fire area found the average spruce beetle infestation was 1.7 trees per acre (0.2 to 11). Douglas-fir beetle infestation was 0.9 trees per acre (0.1 to 5.7). Infestation levels greater than 1 tree per acre are generally considered

outbreak conditions (Moose EIS, pages 3-49 to 3-57). Surveys and observations in 2003 (Gibson 2003a) showed a substantial decline in the numbers of spruce beetles. Although the weather conditions had been favorable for their development, few of the previously infested trees contained adult beetles. Many spruce trees had dried to extent beetle larvae did not survive and wood-boring beetles had apparently consumed some of the larvae. However, Douglas-fir beetles had thrived and many more fire-affected trees had been infested in 2003. Plots installed after the fire showed 2.5% of the Douglas-fir were attacked in 2002 and 30% of the remaining trees were attacked in 2003. After the second year (2003), about 70% of the Douglas-fir greater than 14 inches DBH that survived the fire were still alive and susceptible to future Douglas-fir beetle attack (Bentz 2004).

It is helpful to understand the typical pattern of infestation and mortality, especially with Douglas-fir beetles. It frequently begins with beetles attacking small groups of trees scattered across a stand, from a few to a dozen or so trees killed in each spot. Emerging adult beetles then spread to neighboring susceptible trees, and these relatively small pockets of infestation would grow year by year, depending upon individual stand conditions and other factors, such as favorable weather. Beetle populations and associated tree mortality can grow exponentially, and these infestation “cells” can eventually join one another, creating larger areas of infestation.

Based on many years of observation and data collection, we can assume that in a “typical” Douglas-fir or spruce beetle outbreak, before an outbreak subsides in 2-6 years, 60-80% mortality of the trees over 14-16 inches DBH should be anticipated (Gibson 2002b, Exhibit Pb-15). In an epidemic, one could also reasonably assume that a 3:1 increase in area infested by bark beetles could be experienced on a year-by-year basis. Under very high population levels, beetles may attack and kill many trees that would normally not be susceptible, such as younger trees or those in smaller diameter classes.

## ***Direct and Indirect Effects***

### **Alternative 1 (No Action)**

No treatment of fire-affected forest (salvage or non-salvage methods) that might influence beetle populations would occur under this alternative.

### **Effects of Spruce Beetle Activity**

*On National Forest system lands within the West Side Reservoir Fires:*

Using the information described above, a reasonable expectation is that adult spruce beetles would attack trees across an estimated 4800 acres (50%) of susceptible stands within the West Side Reservoir Fire areas in the spring/summer of 2004. These are spruce stands where a low severity ground-fire occurred, severely damaging and killing the spruce by girdling them at the root collar or lower bole, but leaving their crowns unscathed and large portions of their bole undamaged. This is ideal spruce beetle habitat. In addition, many of the spruce have

blown down, improving habitat conditions for beetles even more. Additional trees that survived the fire in unburned and low severity fire areas would be attacked in 2005.

The beetles would complete their two-year life cycle in these trees, with a new generation of adults emerging in the spring/summers of 2006 and 2007. There would be very few live spruce left within the fire area for these adults to infest because few actually survived the fire. The adult beetles would instead spread outside the fire area in search of breeding habitat.

### **Effects of Douglas-fir Beetle Activity**

#### *On National Forest system lands within the West Side Reservoir Fires:*

Using the information described in the Outbreak Characteristics section above and field observations that confirm Douglas-fir beetles have been active in the fire areas in 2004, beetles could be expected to infest Douglas-fir trees across at least 3500 acres (50% of the susceptible stands) within the fire areas in the spring and summer of 2004. These trees are likely to be those most severely stressed by the fire. Even with no threat of beetle attack, these trees would very likely die directly from the fire damage. The beetles would complete their one-year life cycle within these trees, and adults emerging in the spring of 2005 could feasibly infest up to 10,000 acres. Many, if not most, of these acres would “overlap” with those infested in the previous year, with emerging beetles attacking live trees that are scattered throughout the fire area. In succeeding years, assuming favorable beetle conditions, we might see up to 30,000 acres infested with Douglas-fir beetle. Again, many of these acres would be the same as those in previous years, but most would be outside the fire areas within a few miles of the fire boundary. Not all trees on these acres would be attacked and killed, with anywhere from two to dozens of trees infested per acre. Ball Fire has the most acres of susceptible stands within the fire area and the greatest continuity to Douglas-fir stands outside the fire, compared with Beta, Blackfoot and Doe fires. Therefore, the greatest impacts from Douglas-fir beetle are expected in the south end of the analysis area.

Live overstory Douglas-fir trees exist across an estimated 2500 acres of the fire area, where the fire burned at lower severities. Loss of high numbers of these Douglas-fir trees that survived the fire would reduce the future forest structural diversity of this area, possibly affect future old forest and wildlife habitat values, and decrease potential seed sources for tree regeneration. Remaining thermal cover within the fire area would be reduced with mortality of the live Douglas-fir. The trees that die would contribute to the large diameter snag component, which, though also important and a valuable wildlife habitat and forest structural component, already exists in relative abundance across this landscape compared to live overstory tree components.

As the more desirable feeding and breeding habitat declines, under high populations beetles may attack trees that in endemic situations would not be susceptible, such as younger more vigorous trees or trees of smaller diameter. Substantial loss of these smaller and/or more vigorous trees can occur under continuing high beetle populations.

## ***Direct and Indirect Effects***

### **Common to All Action Alternatives**

All action alternatives propose to treat some of the stands susceptible to both Douglas-fir and spruce bark beetle within the West Side Reservoir Fire areas. They vary in area proposed for treatment, including salvage harvest and pheromone-baited beetle funnel traps or other “non-salvage” methods that could influence beetle populations. Assuming that beetles respond to the conditions within the fire area as expected (i.e. Beetle attack would be concentrated in the higher hazard stands), one can measure the effectiveness of treatments by the proportion of susceptible areas treated and the estimated effectiveness of the proposed treatments.

### **Acres susceptible to spruce beetle infestation with no proposed treatments**

A total of about 7700 to 8300 acres (about 80% of the total susceptible) within the fire areas that are susceptible to spruce beetle would go untreated under all action alternatives (either with salvage or non-salvage methods). There might also be some undetected acres, such as stringers along riparian areas. These stands are scattered through the fire area; about 70% are in the riparian areas and inventoried roadless areas in Blackfoot, Beta, and Doe Fires. Because of their locations in more sensitive areas (i.e. inventoried roadless or riparian) and/or their management area emphasis (such as recreation), they were not identified as high priority for salvage or other treatments. Beetles are likely to infest some of these acres, possibly 4000 acres or more. The density of susceptible trees is relatively high in many of these stands and they could produce or sustain high beetle populations. They are expected to be infested with beetles in 2004 and 2005 and would therefore contribute substantially to the potential beetle population in the project area.

### **Acres susceptible to Douglas-fir beetle infestation with no proposed treatments**

Some areas that are susceptible to Douglas-fir bark beetle infestation are not proposed for any treatments (salvage or non-salvage methods) under any of the action alternatives. These areas total an estimated 4500 to 5300 acres (65% to 75%% of the total acres susceptible) within the fire areas. These stands are scattered throughout the fire areas, within the riparian and inventoried roadless Areas, and other areas classified as unsuitable for timber management in the Flathead Forest Plan. Almost 75% of these acres are in the Ball Fire. Because of their locations in more sensitive areas (i.e. inventoried roadless or riparian) and/or their management area emphasis (such as recreation), they were not identified as high priority for salvage or other treatments. Beetles are likely to infest some or all of these acres. They are expected to be infested with beetles in 2004 and would therefore contribute to the potential beetle population in the project area. However, the density of susceptible trees is relatively low in these stands, and on their own, they're not likely to produce or sustain high beetle populations.

**Timing of salvage treatments**

Under all action alternatives, timing of treatments is important in minimizing the effects of bark beetles. The most effective method to influence beetle populations in fire areas is to salvage beetle-infested trees before emergence of adults (Gibson 2002b). Spruce beetles remain within the same tree for the duration of their two-year life cycle. In all action alternatives, it should be possible to complete proposed salvage efforts in the acres infested with spruce beetle within two years (by spring of 2006).

Douglas-fir beetles infesting trees the first year after the fire (2004) will emerge as adults starting the spring of 2005. Many of the units with Douglas-fir beetle infestations will not be harvested by spring of 2005. This means that adult beetles emerging that spring could spread to live trees both within and outside the fire area.

Field observations in the summer of 2004 and detailed surveys in the summer of 2005 will provide site-specific information on location and extent of spruce and Douglas-fir beetle infestations to determine if and where outbreak levels are developing. If an outbreak levels are detected or predicted, treatment areas may be prioritized with salvage efforts focused first on the units with highest hazard or levels of infestation and mortality.

**Acres susceptible to spruce beetle infestation with proposed salvage treatments**

Not all the susceptible, larger diameter trees on any one site would be infested. One could expect up to 80% of susceptible trees to be attacked in any one area, though zero trees would not be unusual either (Gibson 2002c). Considering the high number of susceptible trees across the spruce stands within the fire areas, this is estimated to equate to about 10 to 20 spruce trees per acre in the stands that would be attacked by beetles in 2004.

**Table 3-17: Acres within the fires susceptible to spruce beetle and acres treated with salvage harvest**

WEST SIDE RESERVOIR FIRES	TOTAL SUSCEPTIBLE within Fires	SALVAGE HARVEST TREATMENTS							
		ALT B	% Of acres	ALT C	% Of acres	ALT D	% Of acres	ALT E	% Of acres
Beta	2400	965	40	777	32	1025	43	1049	44
Blackfoot/Doe	6365	677	11	502	8	705	11	705	11
Ball	965	246	25	111	11	261	27	261	27
TOTAL	9730	1888	19	1390	14	1991	20	2015	21

Within the fires, approximately 3700 acres of susceptible spruce stands are within the suitable timber base where salvage could be used as a tool for beetle management. The action alternatives salvage 37% to 54% of these acres or 19% to 21% of all susceptible acres. Most of the proposed salvage is in areas with high and moderate burn severity where the cambium is either already charred or would be likely to dry out before beetles can successful develop. Also, most of the proposed units with susceptible spruce are in the Beta, Blackfoot and Doe fires with only a few that are contiguous to inventoried roadless and other areas unsuitable for timber harvest. All susceptible and infested trees that are removed will reduce the numbers of

beetles that can emerge and contribute to an outbreak. However, the salvage activity in all of the actions alternatives would have a low probability of successfully containing a potential spruce beetle population buildup within the fire areas, preventing a beetle outbreak, or maintaining the currently low beetle population levels outside the fire areas.

### Acres susceptible to Douglas-fir beetle infestation with proposed salvage treatments

The effectiveness of the salvage action alternatives on influencing Douglas-fir beetle populations is proportional to the amount of infested trees that are removed from the site. Removing one infested tree removes enough beetles to theoretically save 5 or more live trees from attack and mortality (Gibson 2004 personal communication). Generally, the number of infested trees removed can be determined by evaluating differences in beetle-susceptible acres treated by alternative, Acres of Douglas-fir beetle susceptible stands treated by salvage harvest vary by alternative, as displayed in Table 3-18.

**Table 3-18: Acres within the fire susceptible to Douglas-fir beetle and acres treated with salvage harvest**

WEST SIDE RESERVOIR FIRES	TOTAL SUSCEPTIBLE within Fires	SALVAGE HARVEST TREATMENTS							
		ALT B	% Of acres	ALT C	% Of acres	ALT D	% Of acres	ALT E	% Of acres
Beta	371	198	53	125	34	171	46	174	47
Blackfoot/Doe	2351	888	38	619	26	811	34	813	35
Ball	4322	1275	30	877	20	1166	27	1166	27
TOTAL	6955	2361	34	1621	23	2148	31	2153	31

Within the fires, approximately 3835 acres of susceptible Douglas-fir stands are within the suitable timber base where salvage could be used as a tool for beetle management. The action alternatives salvage 42% to 62% of these acres or 23% to 34% of all susceptible acres. Most of the proposed salvage is in areas with high and moderate burn severity where the cambium is currently ideal for attracting beetles, but in the severely burned trees it may dry out before they can successfully develop. Most of the proposed units with susceptible Douglas-fir are in the Blackfoot and Ball fires. In Ball Fire, several are contiguous to inventoried roadless and other areas unsuitable for timber harvest.

Treatments within many units would not remove all susceptible Douglas-fir, or even all trees that are infested in 2004 or 2005. Some trees would be retained in order to leave individual and patches of snags/live trees across the area for forest structural diversity, large snag and downed wood habitat, and address soil and water concerns (refer to Appendix A, unit treatment tables). In addition, depending on the extensiveness of the infestation (determined through monitoring in the summer of 2004 and subsequent years), it is highly improbable that all logging operations within beetle-infested stands would be completed before the spring of 2005, when the beetles will emerge. Flexibility in location of salvage/leave tree patches and the opportunity for winter logging in 2004/05 will provide the greatest possible effectiveness to manage beetle populations. All susceptible and infested trees that are removed will reduce the numbers of beetles that can emerge and contribute to an outbreak and beetle activity tree mortality would be less than if the beetle infestation and populations were allowed to continue

unchecked. The salvage activity in all of the actions alternatives would increase the probability of successfully containing a potential Douglas-fir beetle population buildup within the fire areas and reducing the contribution to the current beetle outbreaks outside the fire areas.

### **Alternative D**

In addition to the effects discussed above for all action alternatives, Alternative D includes bark beetle management using anti-attractant pheromones, trap trees, and pheromone baited traps

Monitoring in the summers of 2004 and 2005 will provide site-specific information on location and extent of spruce and Douglas-fir bark beetle infestations to determine if and where outbreak levels are developing. If an outbreak levels are detected or predicted, a management plan may be implemented that could include some or all of the following actions:

Prioritization of treatment areas, with salvage efforts focused first on the units with highest hazard or levels of infestation and mortality.

1. Use of “trap trees” in selected locations. Refer to discussion in next section.
2. Use of the anti-attractant pheromone MCH to protect high-value areas of live Douglas-fir. Refer to discussion in next section.
3. Use of pheromone-baited beetle funnel traps to trap out small populations of spruce or Douglas-fir beetles. This method may or may not be effective or useful, depending upon the extent and pattern of beetle infestation.

Anti-attractant pheromone could be used to protect high value Douglas-fir trees in campgrounds or other small areas. MCH pheromone sends the chemical message to the flying bark beetles, indicating the tree is at maximum capacity and the beetle should look elsewhere for breeding sites. Though it is a simple method to implement, it is relatively labor intensive, requiring stapling “bubble capsules” to individual trees in the early spring (Ross et al 2001). MCH has proven very effective in protecting trees from infestation (Gibson 2000).

Trap trees may be used to manage the spread of spruce or Douglas-fir beetles in areas where numerous live but beetle-susceptible trees remain. This method may be used in areas where salvage of infested Douglas-fir trees is delayed beyond spring 2005, or spring 2006 for spruce, when the beetles within the fire-affected trees would emerge and attack surrounding live trees. It is not known at this time the specific sites that may benefit from use of trap trees. Monitoring of the beetle populations and brood survival will provide further information on the applicability of this method, and where it might be effective.

The trap tree method involves felling about 2-4 green trees per acre (perhaps also baiting them with pheromone), which makes them extremely attractive to beetles in the vicinity. Trap trees can draw in up to 11 times the number of beetles than normal (Gibson 2002c), thereby focusing beetle attacks on fewer trees, in a more predictable pattern in concentrated locations, and protecting as many of the remaining live trees as possible. It is expected that some

“spillover” of beetles at trap tree sites would occur, with a few nearby live trees also attacked by beetles. Trap trees and adjacent infested trees must be removed before beetles within them emerge. It is very important to make sure the commitment is there to remove these trees (Gibson 2002a). Pheromone traps may be used if monitoring indicates high numbers of bark beetles are developing. The traps would be placed in early spring of 2005 for Douglas-fir beetles and spring 2006 for spruce beetles, upon emergence of the adult beetles. Traps may be used in subsequent years, as well.

The funnel traps contain an “aggregate” pheromone, the attractant chemicals naturally released by unmated female bark beetles after locating a suitable breeding site. It attracts both males and females to a tree, and in the natural system has the function of stimulating mass attacks, which allow beetles to concentrate on a scattered resource or overcome the natural defenses of a live tree. The intent of the trapping is to draw in and capture as many of the emerging adult beetles as possible before they have a chance to spread, attack and kill live trees in areas surrounding the site of infestation (Gibson 2002a, Exhibit Pb-8). With good placement of adequate numbers of traps, the majority of the emerging beetles on a particular infested site can be captured, which could be hundreds of thousands of beetles.

Funnel traps have been used to successfully “trap out” small, isolated populations of beetles in the past (Gibson 2002a, Exhibit Pb-8). Within the West Side Reservoir fires, the pheromone trap method may be more effective in managing the Douglas-fir beetle population (as opposed to the spruce beetle) for several reasons (Gibson 2002c). Susceptible Douglas-fir cover relatively small areas with good access, rather than broadly scattered over a very large area, as is the case with the spruce. However, there is live Douglas-fir in many areas that would also attract beetles, decreasing the effectiveness for the traps. With accurate location of infestation sites, treatment of the most infested sites, and weekly monitoring and emptying of the traps, this method is expected to be effective in the treatment areas, capturing the majority of the emerging adult beetles from these sites (Gibson 2002c). Best estimates at this time would involve the placement of one cluster (3 individual traps) every 1-2 acres of infested area.

This integrated approach to bark beetle management within the fire area should prove effective in some specific areas. Alternative D has the highest probability of minimizing a potential bark beetle population buildup within the fire areas and maintaining the currently low beetle population levels in the region outside the fire area. Some mortality of live spruce and Douglas-fir outside but near the fire area is expected, because the beetle traps and trap trees are not expected to capture all emerging beetles, many of the untreated stands may experience beetle attacks, and there are undoubtedly some undetected areas of fire-affected spruce and Douglas-fir within the fire area that would provide beetle breeding material.

## ***Cumulative Effects***

The following section discusses past, ongoing or foreseeable actions that, in combination with the proposed West Side Reservoir Post-Fire Project alternatives, may have a cumulative impact on bark beetle activities within and around the fire areas and on potential for outbreak conditions to develop. Refer to list of actions at the end of Chapter 1.

### **Potential Beetle Activity in Future Years (4+ years) and to Forests Several Miles from the Project Area**

As described in earlier sections, it appears that conditions are present at this time that make both spruce and Douglas-fir outbreak development likely, though not certain, within the West Side Reservoir Fires. Because of all the unpredictable and uncontrollable factors (local climatic conditions being a major factor), it is difficult to predict beetle population growth and spread into future. If large beetle populations do develop in the fire area, and conditions continue to be favorable for beetle survival over the next several years, breeding sites in and near the fires would become increasingly scarce and areas farther outside the fire area could become increasingly vulnerable to attacking beetles. It is likely to be several years before areas further from the fire experience any mortality from an outbreak initiated within the fires. The probability of widespread epidemic conditions that originate from the fires is believed to be moderate for spruce beetle, mainly due to the large, contiguous acreage of susceptible stands, the duration of and pattern noted in past epidemics, and the probability that highly favorable beetle breeding conditions may continue for several years outside the fires. The probability of Douglas-fir beetle developing widespread epidemic conditions is low, mainly due to the fragmented nature of stands vulnerable to bark beetles in this area and the duration of and pattern noted in past epidemics. However, to evaluate the cumulative effects of just such a “worst-case scenario”, the area within 5 miles from the fire boundaries (refer to earlier section Analysis Area) was evaluated for potential effects resulting from prolonged epidemic levels of beetle activity. Figure 3-12 and Table 3-13 show land ownerships and acreages within this area.

### **Effects of Spruce Beetle Activity**

#### **On National Forest system lands within 5 miles of the West Side Fires**

Susceptible spruce stands within a few miles of the fire area will be the most vulnerable to bark beetle infestation with the emergence of the adult beetles in 2006 and 2007 from the fire-affected trees in the fires. Beetles emerging from infested stands within the fire area would find an abundance of spruce beetle habitat outside the fire area (refer to Figure 3-11 and Table 3-14). If all the higher hazard fire-affected acres within fires are infested in 2004, the potential exists for about 12,000-15,000 acres of spruce stands outside the fire area to be infested in 2006 and 2007. The beetles will seek out the closest desirable breeding habitat, which are likely to be the high hazard stands closest to but outside the fire areas. Given favorable conditions, a portion of these 15,000 acres of high hazard spruce is likely to be infested in 2006 and 2007, with some of the medium hazard stands infested as well, depending upon their proximity to the initial outbreak areas in the fires and the susceptibility of the spruce within these stands. Beetles will not attack all trees within these stands the first few years; additional trees will be killed as the population increases.

If weather and other variables continue to be favorable for spruce beetles over the next several years, the acres infested could reach the total susceptible, up to 136,000 acres. Tree mortality over the course of an epidemic of this magnitude could be from 60-80% of the larger diameter

trees (>16"). Monitoring of spruce beetle populations within the fire area in the summers of 2004 and 2005 will verify the extent of beetle infestation and provide a more accurate prediction of potential spread and mortality.

### **Resource values potentially affected if spruce beetle epidemic conditions develop:**

This section will identify some of the resource values that may be affected within five miles of the fires, defined as that area most susceptible in the next 2-4 years from an outbreak initiated in the fire area.

#### ***Late Seral/Old forest; forest structure, composition and diversity***

There are an estimated 35,000 acres on national forest system lands within five miles of the West Side Reservoir fires that are either old forest or have substantial old forest/late seral character, based on past stand exams, project level analyses, and photo interpretation (Exhibit Pb-16). This represents about 12 percent of the total national forest system lands within this five-mile region. Many stands would fall short of containing all the components of "old growth" such as adequate numbers of large trees, amount and size of downed wood and snags, or diversity of canopy layers as described by the Western Montana Zone definitions (Green et. al 1992, Exhibit Q-1). However, it can be assumed that these stands are the ones highly likely to contain at least some of the values associated with old or late seral forests, particularly an older, larger overstory tree layer.

A greater amount of old forest may be desirable to better meet wildlife habitat needs, especially considering the large area of seedling/sapling early seral forest that has been created by the West Side Reservoir Fires. Loss of any remaining old forest in the surrounding area due to beetle attack and mortality is an undesirable effect.

An estimated 20,000 acres of late seral/old growth forests within five miles of the fire boundary are rated high or moderate hazard for spruce beetle infestation (Exhibit Pb-16). These acres represent about 55 percent of the total "old forest/late seral" acres in this zone. Some of these acres overlap with the stands susceptible to Douglas-fir beetle.

Because of the greater tree sizes and thus generally higher beetle hazard in the stands that are late seral/old forest, beetles are likely to be more attracted to these stands and mortality would be disproportionately higher than that of younger/smaller diameter stands. If all 12,000 acres that could be infested in 2006 were in this late seral/old forest component, it would amount to almost 35% of the 35,000 total estimated acres in this structure class near the fires. With continuing high beetle populations in successive years, a major impact on both amount and quality of spruce old forest/late seral habitat would likely occur.

#### ***Riparian values***

Forests near streams have particular value for wildlife, providing summer thermal cover, old forest habitat, and adding to the diversity of forest structural conditions across the landscape. Riparian forests are often highly valued as wildlife travel corridors, particularly in situations where past harvest has fragmented the forest cover to some degree and converted areas to

early seral stages, as has occurred in all of the fire areas. A high amount of the old forest/late seral forest is typically located in riparian areas, containing the most productive growing sites and experiencing the longest fire-free intervals. Streamside forests influence fish habitat and stream conditions.

Many spruce stands that are susceptible to bark beetle near the fires occur in riparian areas. Most of these stands have a high or medium hazard of beetle infestation (Exhibit Pb-3). Many of these are also old forest habitat. In sustained epidemic beetle conditions, these stands are especially vulnerable. Some of these stands could experience up to 60 percent mortality of overstory (>16”) spruce over a several year period. Loss of high numbers of these trees over the next 2-4 years would change the nature of these stands.

In late seral/old forest stands, loss of many of the live, large diameter overstory trees would reduce the important old forest component, as described earlier. These trees will become large diameter snags and eventually downed wood, also highly valuable forest structural and wildlife habitat components. Forests in riparian areas are not considered suitable for timber management, so economic value of trees killed from spruce beetle would not typically be a concern.

### ***Timber Productivity and Economic Value of Trees for Wood production***

On national forest system lands, approximately half of the total 145,500 acres susceptible to spruce beetle within five miles of the fire occur on lands considered suitable for timber production by the Flathead National Forest Plan. Management of these lands to produce timber, while protecting land productivity and other resource values, is a Forest Plan standard for these lands. Loss of substantial numbers of trees on these lands would have a detrimental effect on timber productivity, both by the loss of these trees as potential commercial products and by the change in forest structure and species composition that may occur.

### ***Jewel Basin and Other Inventoried Roadless Areas***

Jewel Basin Hiking Area is a popular recreation area on the Swan Range in and west of the Blackfoot Fire. It encompasses 15,350 acres of spruce and subalpine fir forest, open shrub fields, and grass meadows, with numerous lakes. Approximately 25% (4150 acres) of this area is susceptible to spruce bark beetle; 1500 acres of those stands were burned at low to moderate severity in the Blackfoot Fire, making them highly likely to attract spruce beetles in 2004 and 2005. Loss of trees in addition to those killed in the fire could have a detrimental effect on the recreational experience for hikers, as well as increased costs over many years for trail maintenance and visitor safety.

Including Jewel Basin, there are 163,400 acres of inventoried roadless area and wilderness within 5 miles in the West Side Reservoir Fires. Approximately 80,000 acres (48%) of the inventoried roadless areas are susceptible to spruce bark beetle. The highest concentrations of these stands and highest hazards are in and around Beta, Doe, and Blackfoot fires. These fires contain many spruce stands that are contiguous to the unburned stands, creating ideal conditions for an outbreak to spread into the inventoried roadless areas. Ball Fire is also surrounded by susceptible stands, but there are very few spruce stands within the Ball Fire for

an outbreak to initiate there. Widespread spruce mortality from and outbreak initiated in the fire areas would increase fuel loading and wildfire hazard in these remote areas. It would also detrimentally affect the recreation experience and trail maintenance costs in areas with trails. Much of the area has no trails and few people travel cross country to recreate there.

### **Effects of spruce beetle activity on other land ownerships within 5 miles of the West Side Fires:**

#### **State Lands:**

The estimated 1000 acres of state forest with some hazard of spruce beetle may be vulnerable to mortality of the larger diameter, >16” spruce trees. Given a substantial increase in spruce beetle population in the fire areas and several years of weather conditions favorable to the beetles, these stands could experience mortality of the susceptible spruce. However, these state lands are 3 miles from the nearest fire affected spruce stands and they are west (upwind) of the fires on the other side of the Swan Range. It is unlikely, but possible, that a bark beetle outbreak in the fires would be sustained long enough to affect the state lands.

#### **Private lands:**

Mortality of larger diameter spruce may also occur on the private lands within 5 miles of the fires, with a beetle population buildup in the West Side Reservoir Fires. For the same reasons stated above for state lands, the effects would be low. However, the value of individuals or groups of susceptible spruce trees are high for some landowners and loss of any trees would be very detrimental to them.

### **Effects of Douglas-fir Beetle Activity**

#### **On National Forest system lands within 5 miles of the West Side Fires:**

Most of the acres potentially infested two years after the fire (in 2005) are expected to be within the fire perimeters. The current levels of Douglas-fir bark beetles in the area are high, the Douglas-fir trees within the fire areas are relatively low in number but highly susceptible, and the Douglas-fir stands outside the fires are mostly separated from the fire areas. Beetles will first attack the most severely fire-stressed trees, in succeeding years attacking less severely damaged trees, flying only so far as necessary to find these suitable host trees. Thus the most Douglas-fir mortality in the next 2 to 3 years would probably be within the fire perimeter.

Given favorable conditions and high beetle populations, available host trees will become scarce within the fire areas. Stands outside the fire areas would become more vulnerable to attack and mortality of the beetle-susceptible Douglas-fir. Refer to Figure 3-12 and Table 3-15 for the acres and hazard ratings of Douglas-fir stands within 5 miles of the fires. Approximately 23,000 acres within the 5-mile zone outside the fire areas are considered moderate to high hazard to Douglas-fir beetle. These are the acres that could support and sustain high populations of Douglas-fir beetles and where substantial mortality and loss of the

larger diameter, older Douglas-fir could be seen if an outbreak develops and spreads outside the fires. These susceptible stands are mostly relatively isolated pockets, surrounded by stands with low or no hazard of Douglas-fir beetle. Under these conditions, Douglas-fir beetle may still cause substantial mortality in the Douglas-fir components of these stands, but beetle populations may not find adequate high quality food sources to allow them to build up to extreme population levels where extensive mortality can occur across the landscape (Randall and Tensmeyer 1999).

### **Resource values potentially affected if Douglas-fir bark beetle epidemic conditions develop**

#### ***Late Seral/Old forest; forest structure, composition and diversity***

As stated under the section on spruce beetle, there is an estimated 35,000 acres of forest on national forest system lands that are possible late seral/old forest within five miles of the fires (Exhibit Pb-16). About 25 percent (or 9000 acres) of these acres are susceptible to Douglas-fir beetle. These stands with the larger diameter Douglas-fir trees that are most vulnerable to attacking beetles represent about 15 percent of the total acres susceptible,

Of these 9000 acres, about 50 percent (4675 acres) are rated very low to low/moderate hazard to Douglas-fir beetle. These stands typically are low hazard because larger diameter, beetle susceptible Douglas-fir do not comprise a major portion of the stand. They may be composed of mostly smaller diameter Douglas-fir, or have high proportion of other species, such as larch or spruce. Loss of some of the overstory Douglas-fir would have a relatively minor impact on old forest character overall in these stands. However, in some of these stands, these larger, older Douglas-fir may constitute the majority of the overstory old trees. The remaining 50 percent of the stands with old forest features (4415 acres) are considered moderate to high hazard to Douglas-fir beetle. Douglas-fir generally comprises a larger portion of these stands than those of lower hazard, so loss in these stands would have a detrimental effect on the old forest character of the stand. These stands would probably not meet “old growth” definitions with the potential level of mortality. The beetle-infested trees would be converted from live overstory trees to snags, and eventually downed large wood, both of which also have high value in old forest structures and as wildlife habitat. However, their loss as live trees might reduce the stand’s old forest character as “old growth” habitat according to Western Montana Zone definitions (Q-1).

In addition to stands that have old forest character, other stands susceptible to Douglas-fir beetle infestation are not currently old forest, but have the potential to become old forest in the future. These stands are in their mid-seral stage of development. Exact acreage of these types of stands is not known. They typically have moderate to low hazard of Douglas-fir beetle and associated tree mortality, due to smaller and more vigorous trees. However, if beetle populations build to very high levels over the next few years, overstory trees in these “mid-seral” stands may be lost. The stand’s potential to achieve old forest status may be delayed or lost entirely.

### ***Riparian values***

Some of the acres susceptible to Douglas-fir beetle within the 5-mile zone are in or near riparian areas, but many of these stands are low hazard to the beetle. Douglas-fir is not typically a major component in these riparian zones, where spruce is the more dominant species. In general, the low proportion of Douglas-fir in most of the riparian stands should result in a minimal impact to riparian area values should high bark beetle populations spread to lands surrounding the West Side Reservoir Fires.

### ***Timber Productivity and Economic Value of Trees for Wood production***

On national forest system lands within 5 miles of and including the fires, approximately 77 percent, or 44,000 acres, of the nearly 57,000 acres of Douglas-fir beetle susceptible stands occur on lands considered suitable for timber production by the Flathead National Forest Plan (1986). Management of these lands to produce timber, while protecting land productivity and other resource values, is a Forest Plan standard for these lands. Loss of substantial numbers of trees on these lands would have a detrimental effect on timber productivity, both by the loss of these trees as potential commercial products and by the change in forest structure and species composition that may occur.

### ***Jewel Basin and Other Inventoried Roadless Areas***

Jewel Basin Hiking Area has no stands susceptible to Douglas-fir beetles.

As discussed under spruce beetle effects, there are 163,400 acres of inventoried roadless area and wilderness within 5 miles in the West Side Reservoir Fires. Approximately 19,590 acres (12%) of the inventoried roadless areas are susceptible to Douglas-fir bark beetle. The highest concentrations of these stands are in and around Ball and Doe fires, on the west-facing slopes of the Swan Range, and mid-elevation slopes east of Hungry Horse Reservoir. Ball fire contains many Douglas-fir stands that are contiguous to unburned stands, creating ideal conditions for an outbreak to spread into the inventoried roadless area. The other areas are one to four miles from any of the fires with little suitable Douglas-fir beetle habitat between. Widespread spruce mortality from an outbreak initiated in the Ball fire area would increase fuel loading and wildfire hazard in the remote areas surrounding the fire. It would also detrimentally affect the recreation experience and trail maintenance costs in areas with trails.

### **Effects of Douglas-fir beetle activity to forests on other land ownerships within 5 miles of the fire boundary:**

#### **State Lands:**

The estimated 1000 acres of state forest with some hazard of Douglas-fir beetle may be vulnerable to mortality of the larger diameter, >14" Douglas-fir trees. Given a substantial increase in beetle populations in the fire areas and several years of weather conditions favorable to the beetles, these stands could experience mortality of the susceptible Douglas-fir. However, these state lands are 3 miles from the nearest fire affected Douglas-fir stands

and they are west (upwind) of the fires on the other side of the Swan Range. It is unlikely, but possible, that a bark beetle outbreak in the fires would be sustained long enough to affect the state lands.

### **Private lands:**

There are no areas with substantial amounts of Douglas-fir susceptible to beetle on the 18,875 acres of private lands within five miles of the West Side Reservoir Fires. Individuals and small groups of Douglas-fir trees occur on about 1000 acres along the base of the Swan Range. For the same reasons stated for state lands the overall effects of an outbreak initiated in the fires would be small. Although Douglas-fir mortality may not cause a measurable change in terms of total stand density or species composition, they are of high value to individual landowners for a variety of reasons, such as visual aesthetics and screening.

### **Alternative B (Proposed Action), Alternatives C, D and E**

Selection of any of the action alternatives would reduce the potential for high beetle populations to buildup in the fire area and the probability they would spread outside the fire area. Alternatives D and E treat the most acres susceptible to spruce bark beetles, and Alternative B and D treat the most acres susceptible to Douglas-fir beetles. Because of the opportunity to use treatment methods other than salvage, Alternative D has the greatest ability to reduce potential beetle populations that could move outside the fires into areas with resource values discussed above.

## ***Cumulative Effects***

### **Past Harvesting on National Forest System Lands**

Past harvesting activity is described under the general vegetation section of this chapter. Harvesting in the 1950s and 60s occurred in response to a substantial spruce beetle epidemic (refer to discussion under “Affected Environment”). As a result of high mortality in overstory, old spruce and the widespread harvest activity, many acres of what were once mature and old spruce forests were converted to young, early seral seedling and sapling forests. As a result, the amount and quality of potential spruce beetle host material has been reduced from pre-1950 conditions in the local area, and the overall vulnerability of the landscape to spruce beetle is lower.

Past harvesting also occurred largely in mature and older stands dominated by larch and Douglas-fir, with spruce and subalpine fir on the more moist aspects. Hundreds of thousands of larger diameter trees were removed, also resulting in a substantial reduction of potential host trees for primarily Douglas-fir beetle, but also spruce beetle. The West Side Reservoir Fires burned over many of these past harvest areas, and if harvesting had not been done there could potentially be far more forest at high hazard of bark beetle infestation than currently exists.

Road-side and trail-side hazard trees were removed from approximately 456 acres during winter through summer 2004. Most of the trees were sub-alpine fir and spruce; some were Douglas-fir, larch and other species. The trees were felled during the fires and many were not removed until summer of 2004. It is very likely that the spruce and Douglas-fir that were removed after the spring 2004 beetle flight season served as trap trees and contributed to reducing the available adults in 2005 and 2006.

### **Past Wildfires and Fire Suppression Activities on National Forest System Lands**

Past wildfire activity and suppression efforts in the project area and surrounding lands is described under the “Fire and Fuels” section of this chapter. Past wildfires influenced the conditions and pattern of forests in the fire areas and surrounding lands, introducing diversity in forest age and size classes and species composition. This in turn has an influence on the potential activity of bark beetles, which typically require certain habitat and host conditions to prosper. Wildfire suppression activities can alter this natural disturbance pattern within an area, thus also influencing forest patterns and conditions, and the actions of associated pathogens.

The majority of the West Side Reservoir Fire area had not experienced a large-scale or stand-replacing fire for over 200 years. The long fire interval and resulting extensive area of mature forest type created a landscape of relatively high vulnerability to effects from disturbances such as fire or bark beetles. The vast blowdown and resulting large-scale spruce beetle epidemic in the 1950s and 60s illustrate this, as does the 2003 fires. These both were natural events considering the fire regimes within the area, the long fire free interval, and the forest conditions across the landscape. Because of the size and maturity, density, and species composition of these forests before the West Side Reservoir Fires, we now are experiencing post-fire conditions in this area favorable to both spruce and Douglas-fir bark beetles.

### **Proposed Reforestation Activities within the Fire Area**

Depending upon the alternative, from about 1300 to 1460 acres are proposed for planting following salvage activities. Species planted will include western larch, Douglas-fir, western white pine, and possibly spruce. This would help maintain the diversity of species within the future forest, which increases the resilience of these areas to the potential future effects of insect, disease or fire events (refer to analysis under “Vegetative structure, composition and timber resource”).

### **Potential Future Treatments, such as Pheromone Treatments and use of Trap Trees**

In Alternative D, use of pheromones (MCH for Douglas-fir beetle) and use of trap trees is anticipated and described. However, it is difficult to predict at this time if and where beetle treatments farther into the future may occur (i.e. 5 or more years from now). Monitoring beetle populations and brood survival within the fire areas and in surrounding forests over the next few years will provide information needed to ascertain whether additional actions to

manage beetle populations are needed. If so, the appropriate analysis and assessment of effects would occur before implementation.

**Past, Present and Proposed Road Decommissioning Activities on National Forest System Lands**

These actions may influence beetle activity by limiting access to portions of the forest for potentially desired beetle treatments in the future. Salvage harvest and the use of trap trees as tools to influence beetle populations would be most affected; but using pheromones, both as bait and as repellents, would also be affected due to reduced access and increased cost of application. Options for treatment of vegetation and forest stands would be reduced across 15,000 acres (Alternatives B and E) to 95,000 acres (Alternative C) with the decommissioning of 49 to 69 miles of road on Forest Service lands (refer also to discussions under “Vegetation structure and composition”).

**REGULATORY FRAMEWORK AND CONSISTENCY**

Flathead Forest Plan direction specifies that landscapes should be managed to reduce the risk of undesirable fire, insect and pathogen disturbances, and to apply an understanding of natural disturbance regimes, landscape patterns and dynamics to management of the forest (page II-5-9). Forest Plan standards for insect and disease (page II-65) specify that integrated pest management strategies should be considered in project analysis design and that “project silvicultural prescriptions would emphasize treatments that reduce losses due to insects and/or disease.” In accordance with this direction, the area has been analyzed and it has been determined that all action alternatives are within the standards of, and consistent with, the Forest Plan.