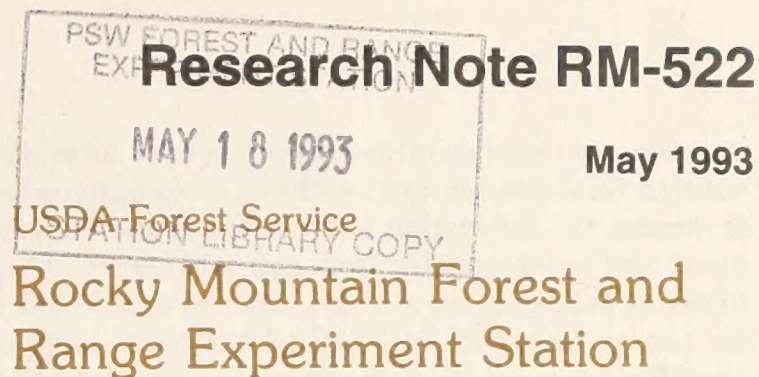


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## Mountain Pine Beetle Emergence From Infested Logs During Hauling

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Mountain pine beetle emergence from infested logs in transit was monitored during the 1992 emergence period. Portions of infested logs in eight loads were covered with screen prior to hauling. The screening was removed immediately after the loads arrived in the mill yard and the bark surface examined for live beetles. Very few beetles emerged. The incidence of beetle infestation was probably not increased along the haul route from the transport of infested logs.

**Keywords:** Mountain pine beetle, ponderosa pine, logging

The current mountain pine beetle (MPB) (*Dendroctonus ponderosae* Hopkins) epidemic in the Black Hills of South Dakota has killed substantial numbers of ponderosa pine (*Pinus ponderosa* Lawson). Tree mortality in Bear Basin—about 10 miles northwest of Custer, South Dakota—was readily apparent in 1987. The epidemic expanded in 1988 and 1989 so that groups of 5 to 20 infested trees appeared in the upper Spring Creek and White House Gulch drainages (Schmid et al. 1993). By 1990, larger groups of 25 to 50 trees were evident in the landscape. Tree mortality in the Basin averaged 5.9 trees per acre for 1989, 17.8 for 1990, and 37.6 for 1991 (Pasek and Schaupp 1992).

Tree mortality in 1991 caused the Black Hills National Forest (BHNF) to instigate an intensive stand management project in 1992. The Bearhouse project—a title derived from two geographic names within the project boundaries—sought to reduce future tree mortality through a combined program of commercial thinning, seed cut, and sanitation-salvage harvests (U.S. Forest Service 1992). Stand density was to be reduced

to  $\leq 80$  ft<sup>2</sup> of basal area per acre. Initial harvesting efforts were to be concentrated in Bear Basin, where the epidemic began and the number of 1991-infested trees was the greatest.

Tree harvesting began in Bear Basin in July 1992. Because tree harvesting and the hauling of infested logs would continue during the 1992 MPB emergence period, the BHNF and local citizens were concerned about the potential spread of the MPB infestation through the dispersal of beetles from infested logs en route to the mill on logging trucks. One designated haul route traveled through pine type for about 65 miles. Although MPB populations were endemic along this route, beetles emerging from the logs en route could create additional infestations.

MPB dispersal is poorly understood, especially with regard to emergence and dispersal from transported logs. MPB fly in all directions from the tree in which they develop and can fly more than 0.25 mile. Despite their ability to fly long distances, most beetles generally select and attack trees within 330 ft of the trees in which they develop (Knight and Yasinski 1956). The more distant infestations may be created by wind-transported beetles or a small number of more vigorous MPB that respond to more distant attractants.

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Because the possibility of creating new infestations substantial distances apart within the contiguous forest is remote, the infestation of ornamental and landscape trees in cities far removed from natural forests is thought to result primarily from transportation of infested logs for use as firewood. MPB-killed trees are commonly used for firewood because the wood is well dried and burns readily. Firewood cutters usually do not discriminate between MPB-killed trees in which the beetles still reside and those from which beetles have departed. Furthermore, cutting an infested tree into firewood lengths does not kill most of the beetles residing in the tree, so when the beetle-infested logs are transported to urban areas, the beetles can emerge and attack ornamental trees. Consequently, infestations can begin in cities. Current MPB-infested trees in Cheyenne, Wyoming, are thought to have originated from loads of infested logs hauled from the MPB epidemic in the Laramie Peak area (Dan Perko, Wyoming State Forest Service, 1992, personal communication)—a distance of more than 100 miles.

New infestations originating from transported logs apparently arise primarily at and near the destination of the logs. However, the creation of new infestations along haul routes by beetles emerging from the infested logs during transit is also possible. Because the BHNH was concerned about the creation of new infestations from infested logs hauled during the MPB flight period and our knowledge of such events was poor, we initiated this study to determine the magnitude of MPB emergence from infested logs in transit.

## Methods

MPB-infested trees from 2 locations in Bear Basin were used in this study. Trees in the first 4 loads of logs came from the southern portion of Bear Basin at an elevation of about 6800 ft. Trees in loads 5-8 came from a northern portion of Bear Basin about 1 mile northwest of the first location and about 6440 ft in elevation.

Fifteen to twenty MPB-infested trees were selected for screening the day before they were cut. MPB-

infested trees were so numerous that the selected trees were usually in proximity to each other, sometimes all from one infested spot. The trees were then cut the following morning around 0600 hours m.s.t., skidded to a landing, delimbed, and cut into 16-ft logs. Some trees were large enough to provide two 16-ft logs. The logs were then moved to a nearby location for safety and aligned parallel. The final number of screened logs per truck load varied because some logs were rejected for lack of suitable bark surface after skidding and cutting.

A piece of fine-mesh aluminum screening was attached to each log around 0900 hours m.s.t. of the day they were cut. Each piece of screen covered about 2 ft<sup>2</sup> of bark surface. We also attached two pieces of screening to some logs to increase the number of samples. Before and after each piece of screen was attached, the log was rolled 180° to prevent MPB mortality in the screened area from direct solar radiation. Previous experience indicated that direct solar radiation will kill MPB in the upper surface of horizontal logs in approximately one hour because it creates lethal temperatures within the bark. Rolling the logs eliminated the solar radiation-caused MPB mortality in the screened area but did not, of course, eliminate potential mortality in the other surfaces. Screen attachment took ≤2 hours per load depending on the number and size of the screened logs.

Screened logs were usually loaded between 1100 and 1200 hours m.s.t. Although the screened logs were generally added to the upper layers of logs in the load, less than 10% of the screened portions were in the uppermost layer and thus exposed to direct solar radiation. Most logs were intermixed in the load so the screened portion was not exposed.

We planned to have all loads hauled the same day they were screened. However, frequent rain from July 30 to August 9, 1992, stopped the hauling operation by creating slippery roads and thereby stranded screened loads 1, 3, and 4 at the landing for ≥1 day (see table 1). Road conditions on August 5 were dry enough to allow load 3 to be hauled but rain immediately thereafter prevented load 4 from being hauled the same day. The effect of these delays on the results of this study is discussed later in the results and discussion section.

Table 1.—Screening date, examination date, and mountain pine beetle numbers for screened logs by load.

Load no.	Number of logs screened	Screening date/time	Examination date/time	Number MPB emerged/ft <sup>2</sup> of surface	Mean No. MPB within screened bark	Percent of caged logs with live MPB
1	10	July 30 am	July 31 pm	0	<1	100%
2	7	July 31 am	July 31 pm	0	<1	71%
3	18	Aug. 3 am	Aug. 5 pm	0	<1	28%
4	17	Aug. 5 am	Aug. 10 pm	<0.3	<1	76%
5	17	Aug. 10 am	Aug. 10 pm	<0.1	<1	65%
6	18	Aug. 11 am	Aug. 11 pm	<0.1	<1	50%
7	24	Aug. 12 am	Aug. 12 pm	0	<1	58%
8	23	Aug. 13 am	Aug. 13 pm	0	<1	35%

The loads were in transit for 3 to 4 hours from Bear Basin to the mill in Spearfish, South Dakota. Upon their arrival in the millyard, the screened logs were offloaded and aligned parallel on the ground. Logs with their screened portion facing upward were rolled so the screen was facing toward the ground. This precaution eliminated possible MPB mortality from solar radiation. Logs were rerolled for examination.

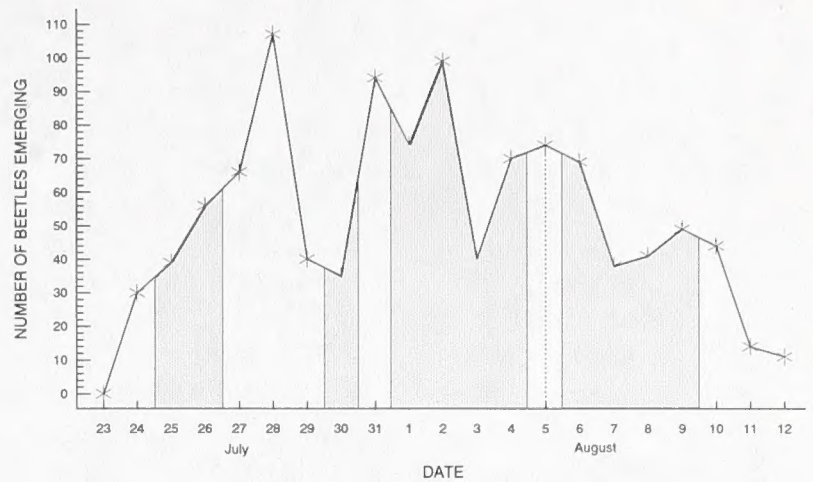
The logs were examined immediately after unloading. The screening was removed and the bark surface examined for live MPB. Once the surface was examined, the bark was removed to determine if live MPB were present. Numbers of live MPB on the bark surface beneath the screening and the presence of live MPB beneath the bark were recorded.

MPB emergence was monitored daily from July 23 to August 14, 1992, in an area within 2 miles of the loading sites. Cages attached to 31 MPB-infested trees in the White House Gulch area were checked each morning and the number of emerging MPB recorded for each cage. Total numbers per day were calculated and plotted for the respective date.

### Results and Discussion

No beetles emerged from five loads (loads 1, 2, 3, 7, 8), one beetle emerged from one log in each of loads 5 and 6, and several beetles emerged from several logs in load 4. The average for all loads was  $<0.3$  per  $\text{ft}^2$  (table 1). Logs in loads 1, 3, and 4 remained at the landing in Bear Basin for  $\geq 1$  day before they were moved (table 1). No MPB emerged from loads 1 and 3; therefore remaining at the loading area for about 1 day did not influence subsequent emergence for these loads. MPB were present outside the bark and beneath the screening in load 4 but we believe these beetles emerged during the five days the logs laid at the landing before transit. Because very few beetles emerged while the infested logs were en route and successful infestation of a tree requires several hundred beetles to attack it within a few days, the creation of new infestations along the haul route was highly unlikely.

This study will probably be cited in the future to dispel the same concerns when dealing with future MPB epidemics. However, the reader should be aware that the strength of our conclusion regarding the creation of new infestations is tempered by low numbers of MPB and poor hauling conditions. Low MPB numbers were evident in our samples (table 1) and corroborated by data from other studies. The trend of the 1991-1992 MPB population indicated a declining status (J.M. Schmid, unpublished data), so numbers of live MPB within the bark were expected to be low. Further, except for load 1,



**Figure 1.—Number of MPB emerging per day in 1992. Shaded area below the emergence line represents days when no loads were hauled because of precipitation or because truck drivers did not work on the weekend. The dashed line represents one day when road conditions permitted load 3 to be hauled before 11:30 MDT but rain thereafter prevented load 4 from being hauled.**

live beetles were present on average in only 55% of the screened logs in the remaining loads and averaged  $<2$  beetles per caged area (table 1). Assuming the screened area reflected beetle numbers within each screened log and the screened logs were representative of infested trees from the Bear Basin area, the low incidence of logs with live beetles is further evidence of a low MPB population. In addition, most of the beetles in loads 5-8 may have emerged before the logs were hauled (fig. 1) and thus left the logs with still smaller numbers. Greater numbers within the bark would have increased the chances that a beetle(s) might have emerged and thus provided a more definitive statement regarding emergence during hauling.

Poor hauling conditions also compromised our conclusion. Frequent rain during the first week of monitoring decreased the number of hauled loads during August 1-7 (fig. 1) and thus decreased the number of samples. More loads were preferred during this period because beetle numbers within the bark would decrease as emergence progresses (see fig. 1). Although the reduced number of loads between August 1 and August 7 was obviously beneficial because it decreased the number of beetles transported out of the area and lessened the potential for MPB dispersal from logs en route, the loss of samples during this period was detrimental to the strength of our conclusion.

Despite these compromising aspects, we believe insignificant numbers of beetles emerged from the logs en route and new infestations were not created along the haul route. The final evaluation will be conducted in August 1993 when Forest Health Management conducts their survey to determine the incidence of new MPB infestations in the Black Hills.

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### Acknowledgments

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