# STATUS OF SPRUCE BEETLE NELSON FOREST DISTRICT

by
R. J. Andrews and A. C. Molnar

FOREST RESEARCH LABORATORY
VICTORIA, BRITISH COLUMBIA
INFORMATION REPORT BC-X-31

FORESTRY BRANCH
DEPARTMENT OF FISHERIES AND FORESTRY
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## INTRODUCTION

A severe outbreak of spruce beetle, Dendroctonus obesus (Mann.), was reported in Engelmann spruce, Picea engelmanni Parry, in the Flathead Region of the Nelson Forest District in September 1967. Ground surveys during the winter of 1967 - 1968 revealed heavy timber kill in the Harvey Pass and the Cabin and Howell Creek areas, and forecast large beetle flights for 1968. It was felt likely the infestation was more widespread than the limited survey indicated.

Spruce beetle has a complex life history[2/], greatly influenced by weather conditions during its development. Briefly, there are four distinct developmental stages: egg, larva, pupa and adult. Virgin beetles and those adults that have overwintered after establishing the first brood the previous summer, emerge and attack fresh host material from late May to July. Windfall, freshly cut logs and shaded slash are preferred but where such material is not sufficient to absorb the population, standing trees are attacked. Eggs are laid, hatch in 3 to 4 weeks and, depending on weather conditions, the larvae may 1) complete development, pupate and become teneral adults the same fall, ready to attack fresh material the next summer, 2) overwinter as larvae and attain adulthood the following fall, or 3) pass a second winter in the larval stage. Thus, a one-, two- or three-year life cycle is possible; the warmer the weather conditions, the more rapid the development. This feature has extremely important implications for population buildup. A further important feature of the life cycle is that the beetle must overwinter as an adult before it can fly and attack trees.

It is generally considered that healthy, vigorous trees growing under good moisture conditions are not subject to attack by spruce beetle. Hot, dry summers, which produce drought symptoms in trees, serve to accelerate beetle brood development as well as to predispose trees to attack by the insect.

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1/ Forest Research Technician and Survey Head, Forest Insect and Disease Survey, Forest Research Laboratory, Victoria, B. C.

2/ Grant, J. and Cottrell, C. B. 1964. Spruce beetle in British Columbia. Forest Research Laboratory, Victoria, B. C. Forest Pest Leaflet No. 13.

The heavy losses in spruce sustained in British Columbia in recent years, 12 million $ft^3$ in Nelson Forest District, 1952 to 1956, and 444 million $ft^3$ in the Prince George and Prince Rupert Forest districts, 1962 to 1964, stressed the serious implications of the present outbreak in the Nelson District. The present report summarizes the results of spruce beetle surveys during the summer and fall of 1968.

## METHODS

The infestation areas were mapped from a fixed-wing aircraft in late summer and adjusted by more accurate helicopter methods during September. In the fall, strip cruises, cutting across valleys to pick up the effect of topography, were run in preselected locations based on infestation maps. Observations on cruise strips included recording of trees by diameter, condition class and year of attack. No attempt was made to designate the year of mortality of trees killed before 1966. The condition and development of beetle broods was checked every few chains to aid in forecasting 1969 beetle flight.

Gross volumes were computed by using volume tables supplied by the Nelson District office of the B. C. Forest Service. The adjustments to net volumes were made by applying net volume factors, supplied by the B. C. Forest Service. Acreages within the infestation were determined by polar planimeter.

It should be noted that the infestation was mapped on the basis of the discolored 1967-attacked trees; trees attacked in 1968 will not discolor until 1969. An appreciable spread beyond the 1967 infestation zone may be expected, but its extent cannot be determined until color change of 1968-attacked trees next summer. Within the zone of 1967 infestation, the incidence of 1968 attack was measured by observing boring dust and other attack symptoms on cruise strips, included in the incidence and volume estimates herein reported. While the cruise strips extended beyond the 1967 infestation zone as much as possible, this was felt to be a most inadequate basis on which to extrapolate acreage spread of beetle attack.

The forecasts of 1969 beetle flight are based on observations of brood development and knowledge of weather influences.

## RESULTS

The major areas of spruce beetle infestation occurred in the Elk, Bull, Wildhorse, Flathead and Wigwam drainages. The general distribution of attack is shown in the map (Appendix 1). Detailed, large-scale infestation maps have been supplied to the forest agencies concerned. An estimated 16,000 acres of spruce was involved in the infestation, encompassing a total gross volume of 75 million $ft^3$, of which an estimated gross volume of 41 million $ft^3$ was attacked by the beetle (Table 1).

Table 1.

Area and Volume ($ft^3$) of Beetle-Attacked Engelmann Spruce, East Kootenay Region, Based on Aerial Surveys in September 1968 of 1966-67 Attacked Trees.

| Drainage | No. acres* attacked | Gross volume in infestation* | Gross volume attacked |
|---|---|---|---|
| Elk River | 765 | 2,755,530 | 983,790 |
| Bull River | 3,690 | 16,760,305 | 7,782,555 |
| Wild Horse River | 135 | 888,300 | 272,160 |
| Flathead River | 8,384 | 40,755,140 | 23,430,400 |
| Wigwam River | 3,100 | 13,729,360 | 8,651,010 |
| Grand total | 16,074 | 74,888,635 | 41,119,915 |

* Includes timber only within zone (Infestation Map, Appendix 1) of 1967 and older discolored trees.

On the basis of cruise strips attack intensity varied considerably, but a high proportion of the stands sustained an attack exceeding 31% of the spruce stems (all condition classes) and reached 70% of the stems attacked (Table 2). Well over one-half of the gross volume loss was concentrated in high-damage-incidence stands.

Table 2.

Summary of Attack Intensity, Spruce Beetle,

Nelson Forest District, 1968.

| Attack intensity class (% of stems attacked) | Drainage | Minimum acreage involved | Estimated gross volume attacked ($ft^3$) | Estimated net volume attacked ($ft^3$) |
|---|---|---|---|---|
| Very heavy 51 - 70 % | Flathead | 2,670 | 9,996,310 | 8,138,090 |
| | Wigwam | 500 | 1,770,500 | 1,054,500 |
| Heavy 31 - 50 % | Flathead | 4,760 | 12,288,692 | 8,734,844 |
| | Bull | 515 | 2,019,315 | 1,675,810 |
| | Wigwam | 2,210 | 6,548,230 | 5,370,300 |
| Moderate 6 - 30 % | Flathead | 954 | 1,145,398 | 947,306 |
| | Bull | 3,175 | 5,763,240 | 4,812,665 |
| | Elk | 765 | 983,790 | 787,950 |
| | Wigwam | 390 | 332,280 | 271,200 |
| | Wild Horse | 135 | 272,160 | 225,855 |
| Grand Totals | | 16,074 | 41,119,915 | 32,018,520 |

The incidence of attack (per cent of stems by condition class) is detailed in Appendix 2 by drainage and individual sample strip. The startling increase in incidence of attack which occurred in 1968 is well illustrated.

A detailed breakdown with estimated acreages, by drainage and creek, with respective total gross volumes of spruce and gross volumes attacked, are shown in Appendix 3. Net volume losses by condition class for each drainage and creek involved are shown in Appendix 4.

Observations on brood development indicate that only a small proportion of beetles reached the teneral adult stage in the fall of 1968 and most of the brood will overwinter as larvae. On that basis beetles in condition for flight and fresh attack in 1969 will include parent adults in relatively small numbers, a small residual from the 1967 brood and the very small proportion of the 1968 brood which developed to adults.

## DISCUSSION AND CONCLUSIONS

Surveys have shown that very large volumes of mature Engelmann spruce timber in the Elk, Bull, Wild Horse, Flathead and Wigwam drainages of the East Kootenay Region have been killed by the spruce beetle in 1967, and particularly in 1968. The volume estimates shown here are conservative and do not include the areas where spread beyond the 1967 infestation zone may have occurred. They do, however, include 1968 losses within the 1967 zone as shown on the infestation maps. The adjusted acreages involving 1968 infestation limits will be defined as soon as color change occurs next summer.

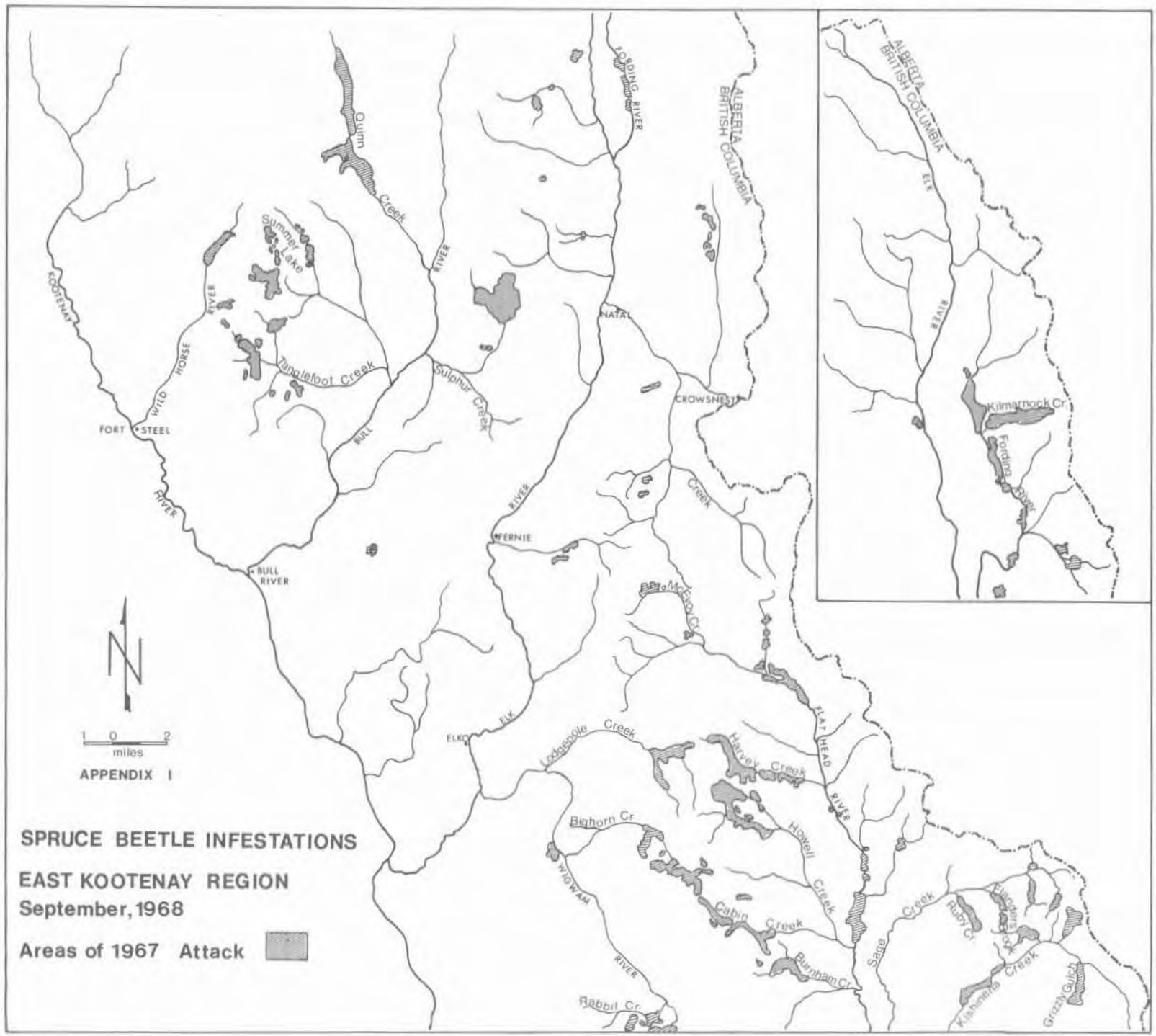
The sharp increase in spruce beetle attack of green trees in 1967 and 1968, while related in part to buildup in extraordinary windthrow, may, for the most part, be attributed to weather conditions in 1967. Precipitation and temperature summaries for the east Kootenay weather stations show that below normal precipitation occurred during September 1966 and from May to September 1967. At the same time above-normal temperature was recorded every month except May 1967. This hot, dry summer weather pattern probably affected the spruce stands adversely while at the same time favoring the development of larger numbers of spruce beetles. It is likely that weakening of a proportion of the trees, caused by drought, was carried over to 1968, predisposing the trees to the large beetle flight.

At least a temporary reversal of this trend occurred because of the cool, moist weather conditions experienced in 1968. Recovery of drought-weakened trees was promoted while development of beetle broods was markedly retarded, suggesting a smaller successful attack in 1969. It is hoped that the extreme 1968-69 winter temperatures may also have some impact on beetle populations but this must await confirmation through studies of overwintering mortality.

Salvage of beetle-killed trees on the basis of priorities suggested by damage distribution reported herein are the only recommendations feasible at this time.

## ACKNOWLEDGEMENTS

The active support of the B. C. Forest Service during the course of this survey is gratefully acknowledged. Their valuable assistance included the provision of a helicopter to ferry crews and for aerial mapping, accommodation and board for crews and several men to assist in ground surveys. The officers of the Nelson District office and the East Kootenay Ranger stations were unstinting in their help.


ALBERTA
BRITISH COLUMBIA
ELK
BLAIR
Kilmarnock Cr.
Fording River
ALBERTA
BRITISH COLUMBIA
FORDING RIVER
Quinn Creek
Summer Lake
KOOTENAY
WILD HORSE RIVER
Tanglefoot Creek
Sulphur Creek
BULL RIVER
NATAL
CROWSNEST
FORT STEEL
BULL RIVER
FERNIE
Michel Cr.
Coal Creek
ELKO
ELK
Lodgepole Creek
Harvey Creek
FLAT HEAD RIVER
Bighorn Cr.
Howell Creek
WIGWAM RIVER
Cabin Creek
Burnham Cr.
Sage Creek
Ruby Cr.
Elkhorn Creek
Grizzly Gulch
Rabbit Cr.
N
1 0 2
miles
APPENDIX I
SPRUCE BEETLE INFESTATIONS
EAST KOOTENAY REGION
September, 1968
Areas of 1967 Attack

Appendix 2.

Engelmann Spruce Attacked by Spruce Beetle,

East Nelson District, 1968.

| Location | Avg no. spruce/acre | % of stems by condition class (Avg) | | | | |
|---|---|---|---|---|---|---|
| | | Unattacked | Killed 1968 | Partial attack 1968 | Killed 1967 | Killed 1966 & before |
| Elk River Drainage | | | | | | |
| Kilmarnock Cr. | 82 | 78.0 | 4.6 | 6.0 | 2.9 | 8.5 |
| Bull River Drainage | | | | | | |
| Tanglefoot Cr. | 49 | 48.2 | 35.5 | 6.4 | 5.2 | 4.7 |
| Summer L. | 44 | 74.4 | 14.0 | 5.1 | 2.8 | 3.7 |
| Quinn Cr. | 40 | 75.8 | 7.6 | 4.8 | 4.2 | 7.6 |
| Sulphur Cr. | 46 | 82.4 | 5.3 | 2.8 | 4.7 | 4.8 |
| Wild Horse River Drainage | | | | | | |
| Wild Horse R. | 57 | 79.3 | 6.8 | 1.4 | 3.9 | 8.6 |
| Flathead River Drainage | | | | | | |
| Howell Cr. | 119 | 38.8 | 40.5 | 3.2 | 8.2 | 9.3 |
| Twentynine Mile Cr. | 74 | 52.8 | 34.3 | 2.3 | 2.2 | 8.4 |
| Burnham Cr. | 39 | 45.4 | 33.5 | 3.4 | 5.1 | 12.6 |
| Grizzly Gulch | 58 | 32.6 | 29.8 | 19.1 | 9.6 | 8.9 |
| Sage Cr. | 51 | 46.3 | 29.5 | 5.1 | 2.9 | 16.2 |
| Unnamed Cr. (Sage) | 53 | 63.0 | 25.5 | 3.6 | 4.4 | 3.5 |
| Flathead Townsite | 71 | 56.8 | 24.8 | 9.2 | 2.1 | 7.1 |
| Harvey Pass | 66 | 67.0 | 23.5 | 5.9 | 2.1 | 1.5 |
| Flathead R. | 84 | 62.2 | 22.9 | 2.8 | 4.6 | 7.5 |
| Akan Cr. | 105 | 54.2 | 17.9 | 10.3 | 10.9 | 6.7 |
| Cabin Cr. | 40 | 66.1 | 10.6 | 7.0 | 4.5 | 11.8 |
| Lower Sage Cr. | 47 | 67.3 | 10.7 | 4.2 | 8.7 | 9.1 |
| Ruby Cr. | 54 | 69.2 | 11.5 | 2.5 | 3.3 | 13.5 |
| McLatchie Cr. | 45 | 81.4 | 5.1 | 2.4 | 5.1 | 6.0 |
| Commerce Cr. | 76 | 85.8 | 4.8 | 1.9 | 2.4 | 5.1 |
| Storm Cr. | 52 | 56.5 | 2.7 | 8.5 | 9.2 | 23.1 |
| McEvoy Cr. | 50 | 82.0 | 1.3 | 1.8 | 2.0 | 12.9 |
| Wigwam River Drainage | | | | | | |
| Bighorn Cr. | 78 | 46.2 | 14.9 | 10.8 | 4.8 | 23.3 |
| Lodgepole Cr. | 58 | 44.9 | 30.4 | 16.3 | 1.9 | 6.5 |
| Wigwam R. | 68 | 76.9 | 6.3 | 1.8 | 9.5 | 5.5 |
| Rabbit Cr. | 48 | 84.7 | 0.8 | 0.8 | 1.7 | 12.0 |

Appendix 3.

Gross Volume ($ft^3$) of Engelmann Spruce and Volume Attacked by Spruce Beetle as Determined by Aerial and Ground Surveys, East Kootenays, September, 1968.

| Location | No. acres | Acreage ground sampled | Gross vol per acre | Total gross vol | Gross vol attacked |
|---|---|---|---|---|---|
| Elk River Drainage | | | | | |
| Kilmarnock Cr. | 765 | 8.0 | 3,602 | 2,755,530 | 983,790 |
| Bull River Drainage | | | | | |
| Tanglefoot Cr. | 515 | 9.4 | 6,079 | 3,130,685 | 2,019,315 |
| Summer L. | 1,900 | 16.6 | 4,760 | 9,044,000 | 3,853,200 |
| Quinn Cr. | 780 | 16.9 | 3,965 | 3,092,700 | 1,226,940 |
| Sulphur Cr. | 495 | 7.0 | 3,016 | 1,492,920 | 683,100 |
| Wild Horse River Drainage | | | | | |
| Wild Horse R. | 135 | 14.6 | 6,580 | 888,300 | 272,160 |
| Flathead River Drainage | | | | | |
| Howell Cr. | 1,190 | 14.0 | 6,310 | 7,508,900 | 4,658,850 |
| Burnham Cr. | 475 | 12.0 | 5,511 | 2,617,725 | 2,005,925 |
| Twentynine Mile Cr. | 1,220 | 8.4 | 8,370 | 10,211,400 | 6,473,320 |
| Grizzly Gulch | 605 | 15.0 | 4,177 | 2,527,085 | 2,049,135 |
| Sage Cr. | 400 | 11.6 | 4,807 | 1,922,800 | 1,282,400 |
| Unnamed Cr. (Sage) | 230 | 10.6 | 4,586 | 1,054,780 | 576,610 |
| Flathead Townsite | 90 | 2.0 | 4,731 | 425,790 | 252,720 |
| Harvey Pass | 490 | 8.0 | 2,420 | 1,185,800 | 552,720 |
| Flathead R. | 110 | 6.0 | 6,383 | 702,130 | 324,060 |
| Akan Cr. | 305 | 12.0 | 4,430 | 1,351,150 | 341,600 |
| Cabin Cr. | 1,500 | 15.2 | 3,465 | 5,197,500 | 2,380,500 |
| Lower Sage Cr. | 500 | 16.6 | 3,362 | 1,681,000 | 903,500 |
| Ruby Cr. | 460 | 16.0 | 3,377 | 1,553,420 | 736,920 |
| McLatchie Cr. | 50 | 8.4 | 2,423 | 121,150 | 43,250 |
| Commerce Cr. | 90 | 5.4 | 5,034 | 453,060 | 81,720 |
| Storm Cr. | 270 | 5.0 | 2,915 | 787,050 | 409,970 |
| McEvoy Cr. | 400 | 9.0 | 3,636 | 1,454,400 | 357,200 |
| Wigwam River Drainage | | | | | |
| Bighorn Cr. | 2,210 | 20.0 | 4,718 | 10,426,780 | 6,548,230 |
| Lodgepole Cr. | 500 | 8.0 | 4,056 | 2,028,000 | 1,770,500 |
| Wigwam R. | 90 | 5.6 | 3,982 | 358,380 | 138,780 |
| Rabbit Cr. | 300 | 7.4 | 3,054 | 916,200 | 193,500 |
| Totals | 16,074 | 288.7 | | 74,888,635 | 41,119,915 |

Appendix 4.

Net Volume ($ft^3$) of Engelmann Spruce and Volume Attacked by Spruce Beetle as Determined by Ground and Aerial Surveys, East Kootenays, September, 1968.

| Location | No. acres | Net vol per acre | | | | | Total net vol | Total net vol attacked |
|---|---|---|---|---|---|---|---|---|
| | | Healthy | 1968 | | 1967 | 1966+ | | |
| | | | Killed | Partial | killed | killed | | |
| Elk River Drainage | | | | | | | | |
| Kilmarnock Cr. | 765 | 1,853 | 276 | 242 | 176 | 336 | 2,205,495 | 787,950 |
| Bull River Drainage | | | | | | | | |
| Tanglefoot Cr. | 515 | 1,791 | 2,115 | 301 | 501 | 337 | 2,598,176 | 1,675,810 |
| Summer L. | 1,900 | 2,295 | 1,075 | 248 | 189 | 191 | 7,596,200 | 3,235,700 |
| Quinn Cr. | 780 | 1,985 | 490 | 222 | 264 | 328 | 2,566,200 | 1,017,120 |
| Sulphur Cr. | 495 | 1,341 | 349 | 111 | 436 | 235 | 1,224,135 | 559,845 |
| Wild Horse River Drainage | | | | | | | | |
| Wild Horse R. | 135 | 3,788 | 796 | 109 | 336 | 432 | 737,235 | 225,855 |
| Flathead River Drainage | | | | | | | | |
| Howell Cr. | 1,190 | 2,075 | 2,001 | 130 | 571 | 397 | 6,157,060 | 3,687,810 |
| Burnham Cr. | 475 | 1,082 | 2,249 | 124 | 375 | 799 | 2,198,775 | 1,684,825 |
| Twentynine Mile Cr. | 1,220 | 2,546 | 3,565 | 204 | 180 | 453 | 8,476,560 | 5,370,440 |
| Grizzly Gulch | 605 | 654 | 1,525 | 557 | 392 | 337 | 2,096,325 | 1,700,655 |
| Sage Cr. | 400 | 1,328 | 1,615 | 190 | 174 | 683 | 1,596,000 | 1,064,800 |
| Unnamed Cr. (Sage) | 230 | 1,725 | 1,387 | 159 | 360 | 176 | 875,610 | 478,860 |
| Flathead Townsite | 90 | 1,578 | 1,421 | 398 | 212 | 271 | 349,200 | 207,180 |
| Harvey Pass | 490 | 1,020 | 641 | 134 | 70 | 45 | 936,390 | 436,100 |
| Flathead R. | 110 | 2,853 | 1,524 | 128 | 417 | 376 | 582,780 | 268,950 |

Appendix 4. (Continued)

| Location | No. acres | Net vol per acre | | | | | Total net vol | Total net vol attacked |
|---|---|---|---|---|---|---|---|---|
| | | Healthy | 1968 | | 1967 | 1966+ | | |
| | | | Killed | Partial | killed | killed | | |
| Akan Cr. | 305 | 2,715 | 398 | 189 | 219 | 112 | 1,108,065 | 279,990 |
| Cabin Cr. | 1,500 | 1,578 | 502 | 208 | 221 | 401 | 4,365,000 | 546,000 |
| Lower Sage Cr. | 500 | 1,291 | 408 | 138 | 431 | 522 | 1,395,000 | 749,500 |
| Ruby Cr. | 460 | 1,473 | 342 | 95 | 155 | 737 | 1,289,380 | 611,340 |
| McLatchie Cr. | 50 | 1,246 | 167 | 84 | 246 | 194 | 96,850 | 34,550 |
| Commerce Cr. | 90 | 3,342 | 211 | 112 | 132 | 280 | 355,840 | 66,150 |
| Storm Cr. | 270 | 1,171 | 134 | 215 | 350 | 548 | 653,130 | 336,690 |
| McEvoy Cr. | 400 | 2,276 | 134 | 137 | 90 | 380 | 1,207,200 | 296,400 |
| Wigwam River Drainage | | | | | | | | |
| Bighorn Cr. | 2,210 | 1,439 | 629 | 387 | 233 | 1,181 | 8,550,490 | 5,370,300 |
| Lodgepole Cr. | 500 | 1,258 | 1,281 | 527 | 69 | 232 | 1,683,000 | 1,054,500 |
| Wigwam R. | 90 | 1,976 | 224 | 121 | 566 | 339 | 290,340 | 112,500 |
| Rabbit Cr. | 300 | 1,975 | 46 | 18 | 65 | 400 | 751,200 | 158,700 |
| Totals | | | | | | | 61,952,635 | 32,018,520 |