HISTORICAL PERSPECTIVE OF MOUNTAIN PINE BEETLE IN KOOTENAY NATIONAL PARK

by

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INTRODUCTION

Next to fire, the mountain pine beetle (*Dendroctonus ponderosae* Hopk.), more than any other single biological agent, has had a major influence on the present structure and composition of lodgepole pine forests in Kootenay National Park. Historically, large catastrophic fires, recurring on average every 70 to 100 year intervals, have helped to maintain lodgepole pine ecosystems in western North America (Brown 1975). Consequently, lodgepole pine is presently the dominant tree species at lower elevations in Kootenay National Park and extends from one end of the park to the other. Mountain pine beetle infestations have been a natural component within the lodgepole pine forests of the park. Our knowledge of the outbreak history of the mountain pine beetle within the park extends back some 60 years to 1929 - 1930.

I will attempt to review the important aspects of this beetles' influence that have a bearing on discussions at this workshop. There are a number of issues related to the consequences of beetle-killed trees during outbreak periods. These may be cited as the main reasons for the present emphasis on this insect:

a) During outbreaks, the mountain pine beetle creates large numbers of dead and dying lodgepole pine over a relatively short time (8 - 10 yrs);

b) Beetle-killed trees tend to be the largest within mature-overmature stands and provide large volumes of standing and downed fuels, thus adding to burn risks;

c) Faded crowns of new beetle-killed trees have a visual impact on park visitors, and similarly for large areas of grey-topped trees;

d) During post-outbreak years (i.e., 5 - 20 yrs), blowdown of beetle-killed trees become a hazard along hiking trails, park visitor sites, etc.;

e) Blowdown of beetle-killed trees may impact on game trails, game movement patterns, etc.;

f) Depletion of the lodgepole pine component within stands will hasten forest succession and change stand composition to more shade-tolerant species;

g) Persistence of active infestations provide concern for jurisdictions adjacent to the park (re: control programs, fire supression, MPB Interagency Committee, Can/USA Memorandum of Understanding on MPB).

Outbreak of 1930 to 1942

Earliest records of the mountain pine beetle in Kootenay National Park date back to about 1930. A survey for bark beetle epidemics was conducted in both Kootenay and Yoho national parks in 1929 but no infestations were reported (Powell 1961). In 1930, infestations were observed on the east side of Kootenay River, between Cross River and Pitts Creek. Two years later, infestation patches were noted on the west side of the Kootenay River with small patches between Mcleod Meadows and Dolly Varden Creek, and scattered patches along the Vermilion River as far north as Numa Creek. Between 1929 and 1934, there was extensive mortality on the east side of Kootenay River, and a high concentration of dead trees near McLeod Meadows in 1935. Advancement and intensification of the outbreak in the park was from south to north.

Surveys in 1937 revealed that pine mortality had exceeded 80% near Pitts Creek and between Nixon Creek and McLeod Meadows and was concentrated in the oldest (130 - 140 yrs) stands of pine (Fig. 1). Tree mortality decreased to 40 - 50% northward and to less than 10% near Dolly Varden Creek (Anon. 1943).

A decline in the outbreak occurred during 1937-38, then general increases to about 1941. Ground plots established at the time between McLeod Meadows and Dolly Varden Creek to monitor the progress of the infestations, showed 46 to 79% mortality by 1941. North of Dolly Varden Creek in 60 - 70 yr old pine stands, some mountain pine beetle infestations occurred but they did not appear to be very successful.

At the close of the outbreak (about 1942), large areas of beetle-killed trees were evident in the Kootenay valley and along west-facing slopes from about 3 km south of Pitts Creek to Mount Selkirk. On the west side of the Kootenay valley, tree mortality was extensive between Nixon Creek and Dolly Varden Creek. In 1941, scattered patches of tree mortality occurred between Kootenay Crossing and Simpson River, and heavy infestations between Simpson River and Vermilion Crossing. In summarizing the

outbreak, Hopping (1941, 1951) estimated 85 - 90% pine mortality over some 650 km^2. This translated into over 2.87 million trees killed by the beetle between 1934 and 1940. A few isolated small patches of infestations remained active in the park near Vermilion Crossing until 1945.

It is worth noting that the mountain pine beetle infestations in Banff National Park commenced in 1940, less than 20 km distance from the severe infestation areas in Kootenay National Park where the source of beetles are believed to have originated.

Outbreak of 1978 to 1993

No mountain pine beetle activity was reported in the park between 1945 and 1979. The current outbreak of mountain pine beetle probably began in 1977 or 1978; the first appearance of beetle-killed trees was in 1979 along the east side of the Kootenay River valley between the south end of the park and Pitts Creek (Hiratsuka *et al.* 1980). By 1980, about 200 trees had been killed in several patches south of Pitts Creek and about 80 trees in a single patch north of Kootenay Crossing (Hiratsuka *et al.* 1981, 1982). In 1981, about 2400 new fader trees were mapped in 55 patches distributed from the south end of the park to slightly north of Kootenay Crossing, and mostly on the east side of the Kootenay valley. This sudden increase in beetle spread and tree mortality prompted an increase in surveillance in 1982 (Cerezke 1983) and the development of park policy guidelines for control and management of the beetle (Turnbull 1982).

During 1982 to 1987, the infestation areas continued to intensify slightly but mostly within the same locations south of Kootenay Crossing. Major expansion of the infestations occurred from 1988 to 1992, especially in areas south of Mount Daer, between Pitts Creek and the south end of the park, along Kimpton Creek, and near the west end of the park (Fig. 5). The largest single infestation occurs on the east side of the Kootenay River between Daer and Pitts creeks (Cerezke *et al.* 1991). Only a few relatively small infestations, to this date (1992), have progressed eastward between Kootenay Crossing and Simpson River. The largest area covered by infestations was estimated as 1600 ha and occurred in 1986 (Koot and Vallentgoed 1987), while the highest number of beetle-killed trees (72,900) occurred in 1992 (Unger and

Stewart 1993).

As a comparison of the two outbreak periods, the maximum number of beetle-killed trees estimated between 1979 and 1993 was about 250,000, or about 11.5 times less than that killed during the previous outbreak between 1934 and 1940. The pattern of beetle spread and distribution during the two outbreaks has been similar, though less extensive during the current outbreak.

Ecological Consequences of Mountain Pine Beetle

As part of the increased surveillance of the mountain pine beetle, a major portion of the outbreak area between Pitts Creek and Mount Wardle was photographed aerially in true color in 1982 (Fig. 2). This was a project jointly shared by the Canadian Park Service and Canadian Forestry Service. The objectives of the photography were to provide a detailed and permanent record of the distribution of current infestations, area covered, numbers of trees affected, and the potential for spread, particularly northward.

In addition to the aerial photography, a number of ground plots was established, mostly within the photographed area. The purpose of these was to provide estimates of beetle-caused mortality by year of attack and to verify the interpretation of the aerial photo counts, and to provide information on stand composition and structure. The results of the study were summarized in a file report (Cerezke 1983).

Figure 3 shows the distribution of tree diameter classes, summed over all plots and shows the distribution patterns of the four main tree specie components: lodgepole pine, Engelmann spruce, Douglas-fir, and trembling aspen. It is noteworthy that both Engelmann spruce and Douglas-fir were about equally abundant and were represented in most diameter classes. Both species, however, are well represented in the small diameter classes, indicating considerable ingrowth during the past 40-50 years since the previous outbreak. This perhaps is evidence for a hastening of the process of stand succession as a direct result of the extensive stand openings created by the mountain pine beetle.

Within the plot areas, the mountain pine beetle attacked more of the largest diameter size trees (ave. dbh of 22.0 cm), compared to green unattacked trees (ave. dbh of 18.5 cm). Of the trees attacked,

75.6% were killed; the remainder 24.4% were either lightly attacked or were resistant.

The ground plot areas were rated as to potential for expansion by the beetle; the highest potential was in plot areas on the lower slope of Mount Daer. This potential was realized in subsequent years.

Within the area of photo coverage, the total numbers of beetle-killed trees was 4867. These were subdivided into two classes: those resulting from pre-1981 attacks and those resulting from 1981 atttacks.

Park Management Policy

Following the establishment of an Interagency Committee on the mountain pine beetle for western Canada and concerns of spread of the beetle eastward from the three national parks (Kootenay, Yoho, Banff), a management policy was developed by the Canadian Parks Service, Western Region. The guiding framework of the policy was the establishment of a boundary line running north-south through Yoho and Kootenay parks, and along the west boundary of the south end of Banff National Park (Turnbull 1982). Mountain pine beetle infestations occurring to the north and east of this line would be subjected to control action by the park. In Kootenay National Park, this boundary line cut across between Mount Wardle and Split Peak (Fig. 4).

Control Project on Mountain Pine Beetle

As a result of the Park Management Policy, the decision was made to undertake control action an infestation area during the fall and winter of 1981-1982 (White 1982). Two sites were selected for removal of beetle-attacked trees north of Kootenay Crossing and within a short distance to the west of the control boundary line. The total number of beetle-attacked trees removed at each site was, respectively 499 and 21. The control action was undertaken to reduce the risk of spread eastward through the park and involved the cutting and burning of attacked trees as well as peeling of the bark on the cut stumps. This has been the only control project undertaken during the current outbreak period.

Some Historical Points of Interest

A comparison of the two outbreak periods indicates that the 1930 - 1942 outbreak resulted in a

more widespread area of tree mortality (i.e., south end of park northward to Numa Creek), an estimated 11.5 times more trees killed, and a greater abundance of beetles. Historical evidence of previous infestations of the mountain pine beetle in Kootenay National Park can be observed on dead standing and fallen lodgepole pine by the presence of galleries engraved in the outer sapwood by the adult and larval stages (Cerezke 1983). Some trees ,still alive in 1993, may show the presence of "strip attacks", resembling old fire-caused wounds. Both larval and adult galleries and blue-staining of the sapwood may be recognized in the dead strip areas, identifying mountain pine beetle attack areas (Stuart *et al.* 1983). Old strip attacked trees, dating back to 1939-40, have been found on the lower slope of Mount Daer and on the west side of Kootenay River bewteen Kootenay Crossing and McLeod Meadows (Cerezke 1983).

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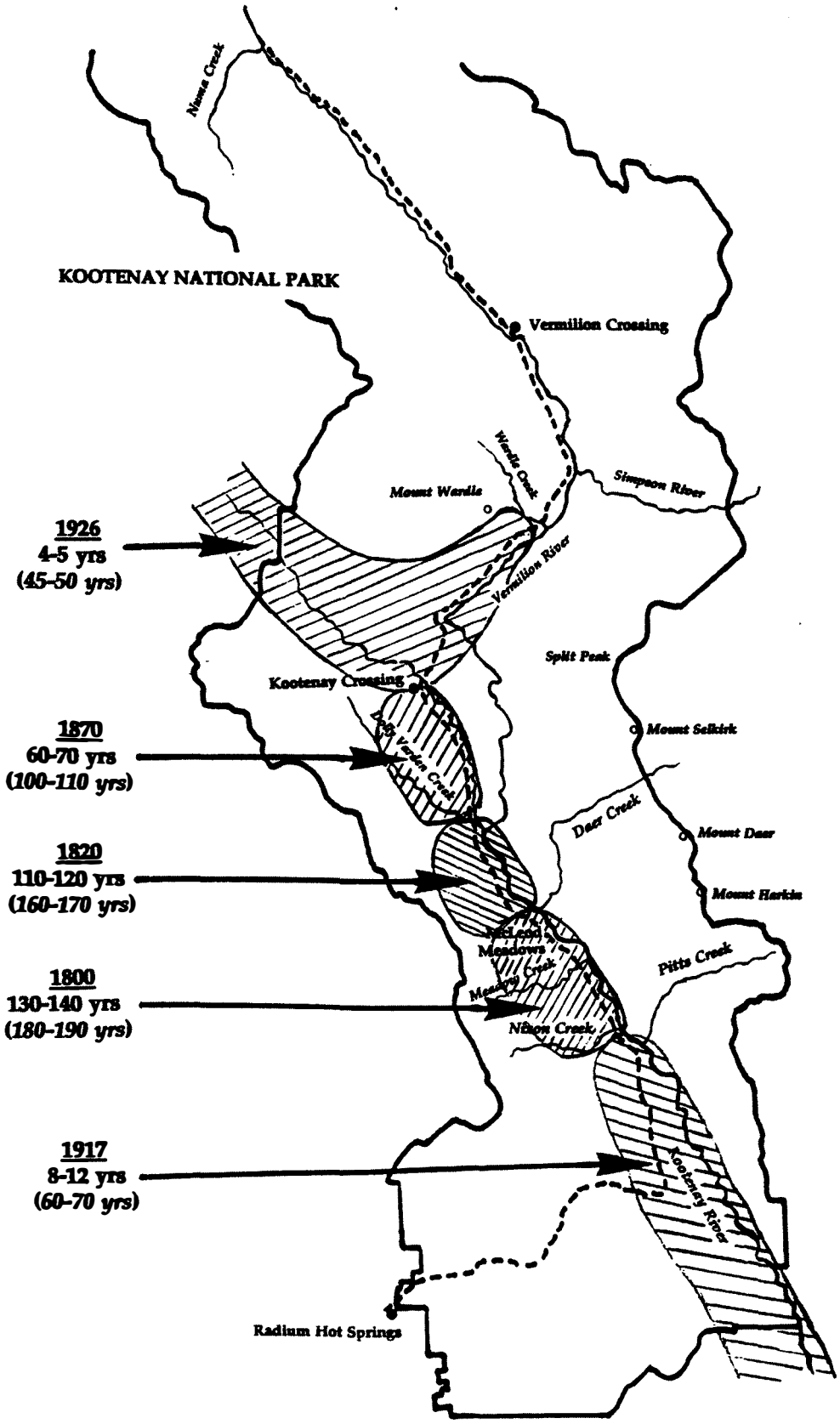


Fig. 1. Historical perspective of fire history in Kootenay National Park based upon observations of G.R. Hopping (Powell 1961). Shaded areas indicate approximate north-south spread of stand ages. Underlined value indicates year of burn and stand origin, followed by estimated stand age in 1930 (start of first known MPB outbreak); age in brackets indicate stand age in 1980 (start of second known MPB outbreak).

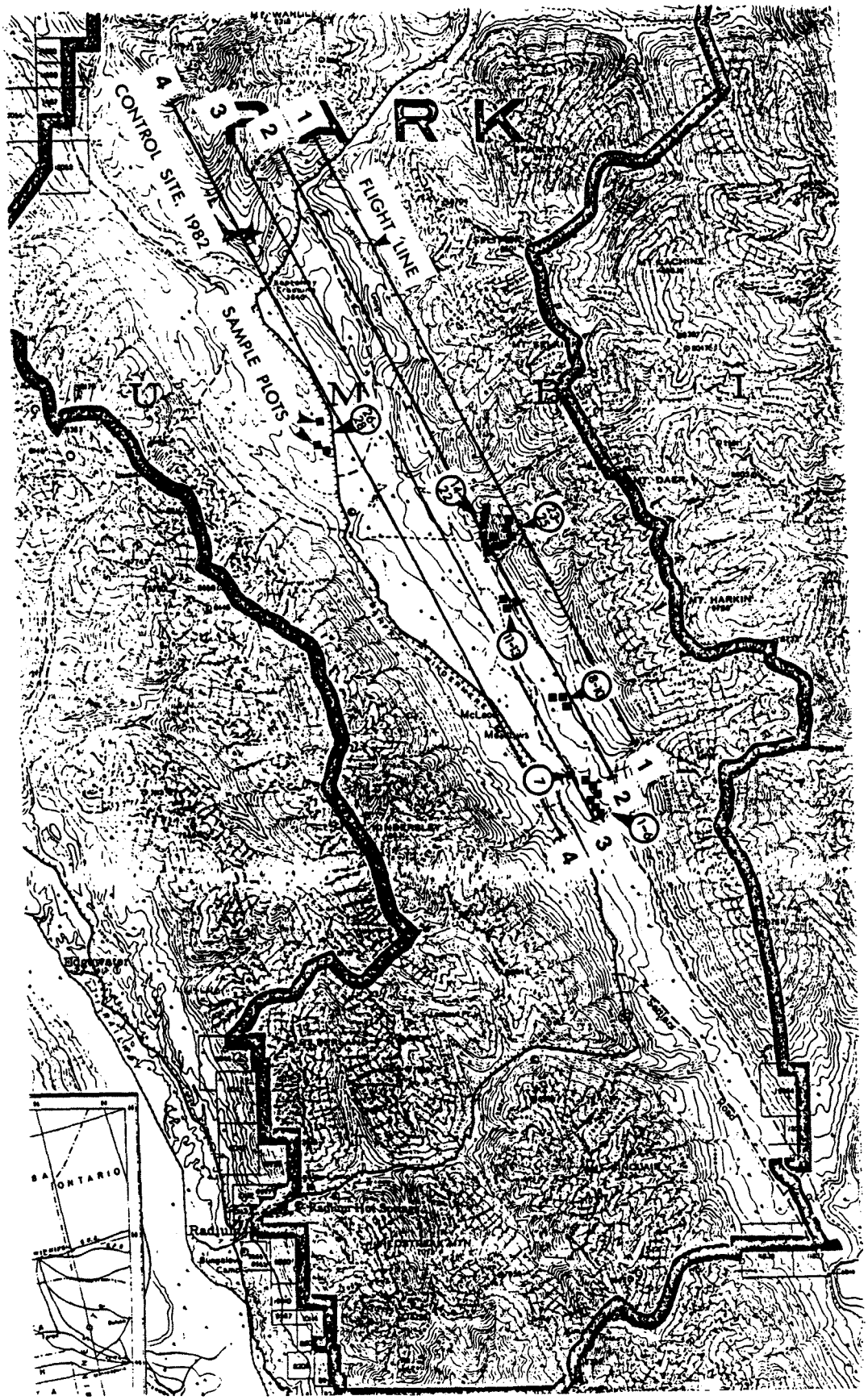


Fig. 2. Map of southern portion of Kootenay National Park showing the four flight lines flown for aerial photography, 28 ground plot locations grouped into seven sample areas, and the main site of 1982 mountain pine beetle control. Scale: 1 : 126,720.

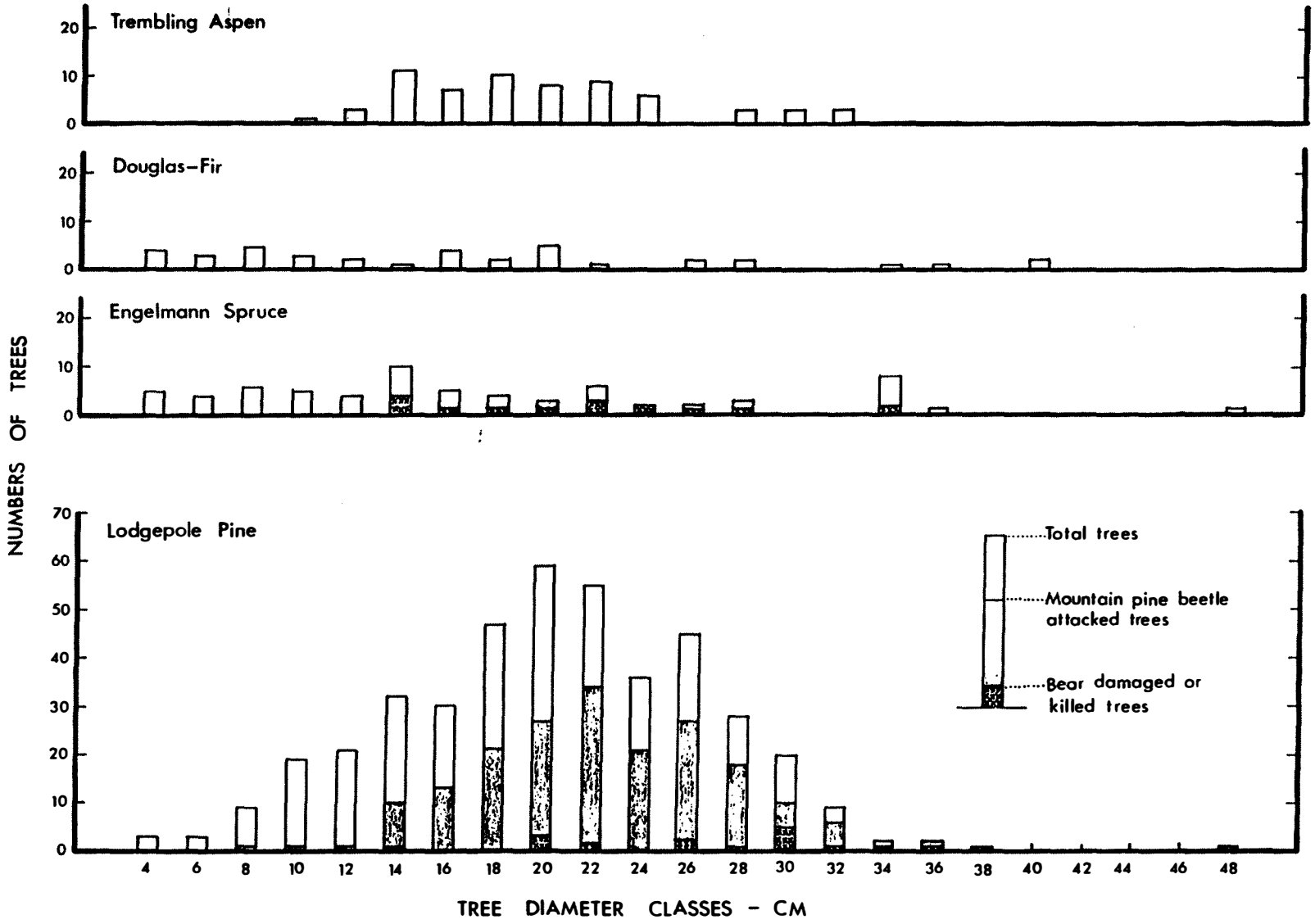
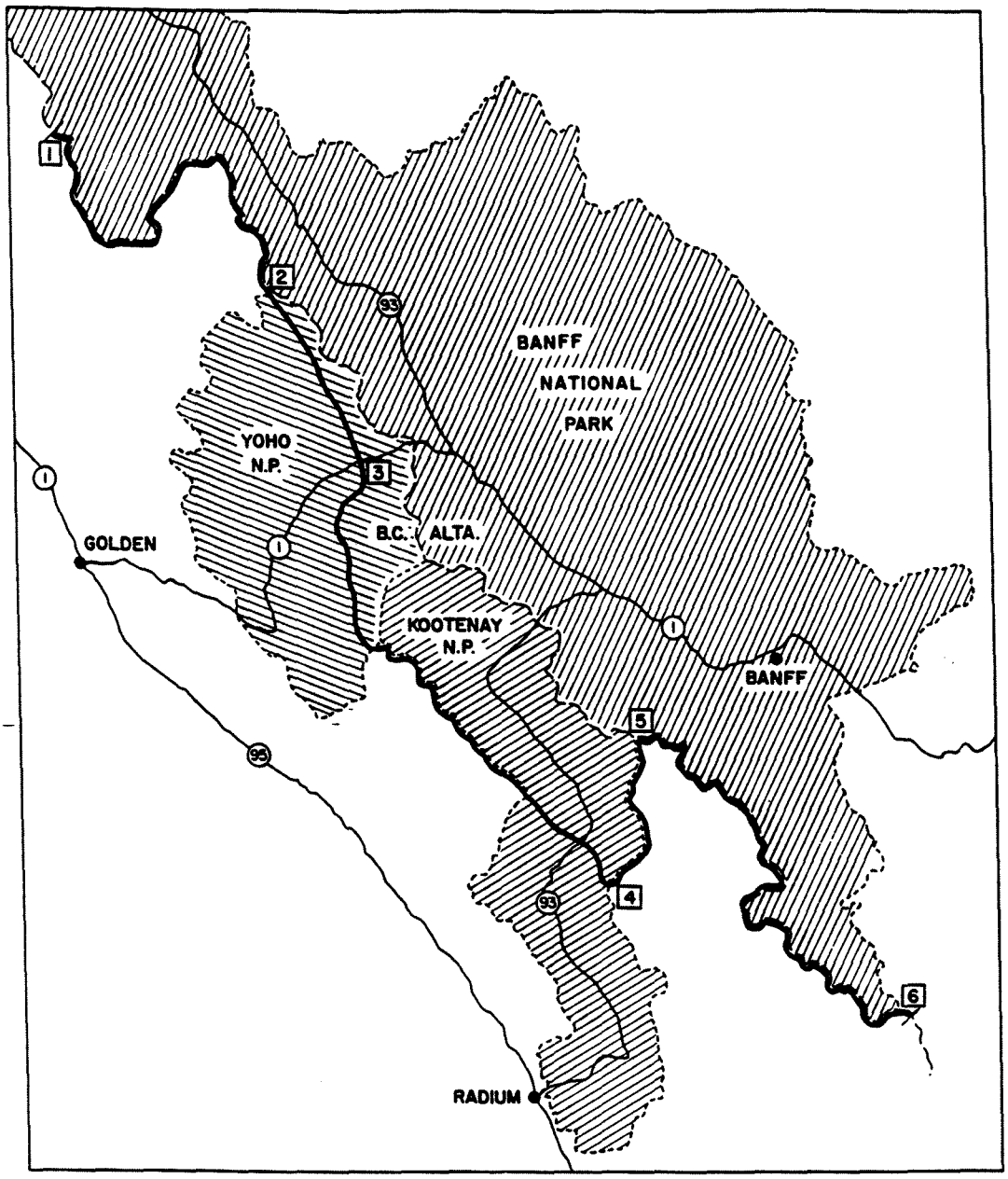


Fig. 3. Frequency distributions by diameter class (cm) of the four main tree species combined from the 28 ground plots sampled for mountain pine beetle attacks in Kootenay National Park, September 1982. Note proportions and distributions of mountain pine beetle attacked lodgepole pine and incidence of bear-damaged lodgepole pine and Engelmann spruce.



BANFF, KOOTENAY AND YOHO NATIONAL PARKS

Mountain pine beetle infestations to the north and east of the heavy black line will be subjected to control actions. Numbers in squares along the line are reference points—from north to south, between 1 and 2, the line follows the park boundary; from 2 south, follows the Yoho River to Highway 1 at number 3; then follows the height of land to Mount Goodsir; then follows the west boundary of Kootenay Park and across Highway 93 to Split Peak number 4; and then follows the national park boundaries to Mount Sir Douglas at 6.

Source: Turnbull, W.C.; 1982. Proc. Joint Can/USA Workshop on mountain pine beetle related problems in western North America. Environ. Can., Can. For. Serv., Victoria, B.C. BC-X-230.

Fig. 4. Map of Banff, Kootenay, and Yoho national parks showing boundary line (dark bold line) established as a guideline for control and management of mountain pine beetle infestations during the current outbreak (Turnbull 1982).

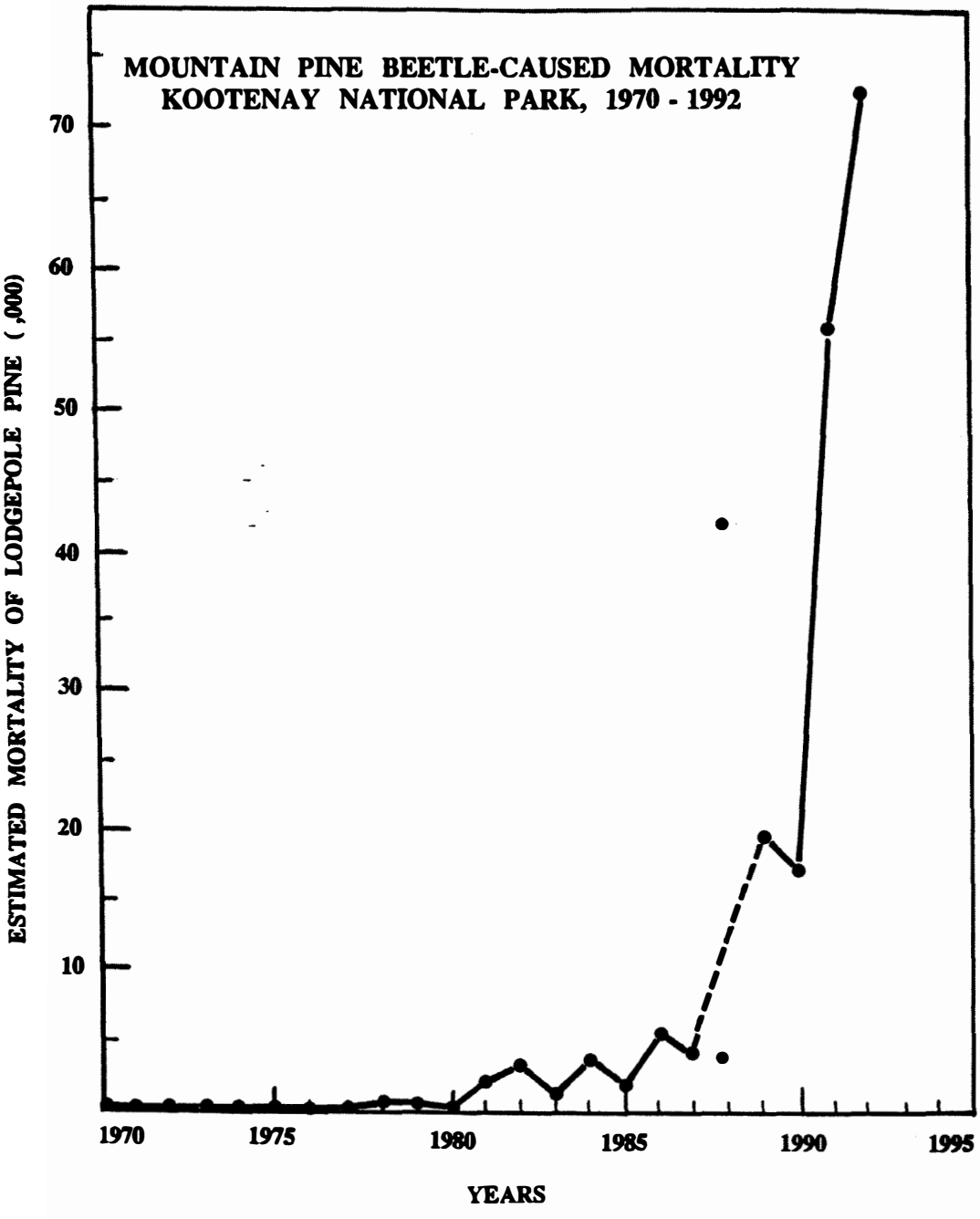


Fig. 5. Estimated annual mountain pine beetle-caused mortality of lodgepole pine in Kootenay National Park between 1970 and 1992. Data from Canadian Forestry service, Forest Insect and Disease Surveys of Northern and Pacific regions.