

DISTRIBUTION AND OUTBREAKS OF DENDROCTONUS PONDEROSAE HOPK. IN FORESTS OF WESTERN CANADA

by
J. M. Powell

**FOREST RESEARCH LABORATORY
CALGARY, ALBERTA
INFORMATION REPORT A-X-2**

**DEPARTMENT OF FORESTRY
MAY, 1966**

Distribution and outbreaks of Dendroctonus ponderosae Hopk.
in forests of Western Canada

by

J. M. Powell

Forest Research Laboratory

Calgary, Alberta

Information Report A-X-2

Department of Forestry

May, 1966

CONTENTS

	Page
INTRODUCTION	1
SOURCES OF INFORMATION	2
DISTRIBUTION OF DENDROCTONUS PONDEROSAE AND ITS HOSTS IN WESTERN CANADA	3
GENERAL DESCRIPTION OF OUTBREAKS	5
Princeton - Peachland, 1910 - 1918	6
Aspen Grove - Kamloops, 1917 - 1932	9
East side of Okanagan Valley - Kettle River, 1922 - 1930	10
North of Thompson River, 1920 - 1932	10
Tatla Lake, 1930 - 1936+	11
Kootenay and Banff National Parks, 1930 - 1945	11
Shuswap - Arrow Lakes - Columbia River, 1946 - 1965 . .	12
Babine - Takla Lakes, 1947 - 1965	13
Skagit River, 1947 - 1965	14
Vancouver Island, 1955 - 1965	14
SUMMARY	15
ACKNOWLEDGEMENTS	15
REFERENCES	16

Distribution and outbreaks of Dendroctonus ponderosae Hopk.
in forests of Western Canada

J. M. Powell

INTRODUCTION

Dendroctonus ponderosae Hopk. (= D. monticolae Hopk.) has been one of the most destructive insects which attack the forests of British Columbia. The beetle attacks ponderosa pine, Pinus ponderosa Laws., lodgepole pine, P. contorta Dougl., and western white pine, P. monticola Dougl., over much of their range in British Columbia. One record reports beetle attacks near Kamloops on Scots pine, P. silvestris L., an introduced species. Engelmann spruce, Picea engelmanni Parry, has occasionally been infested when closely associated with the pines in a large outbreak.

Hewitt (1910) made the first reference to bark beetles in Western Canada, followed by Swaine (1912, 1913, 1914). From 1913 to the present there have been annual reports of the activity of D. ponderosae in British Columbia. These reports have varied in their completeness from year to year. Losses of timber during this period have amounted to several billion board feet. Pine stands often remain unaffected for a hundred years or more, then suddenly succumb to attack by D. ponderosae. These outbreaks may occur in epidemic proportions covering hundreds of square miles within a few years, destroying mature and sometimes younger forest growth. The out-

break usually continues until pine trees are exhausted or another factor causes a decline in the bark beetle population.

Various studies (Craighead 1925; Blackman 1931; Beal 1943; Hopping and Mathers 1945; Hall 1956; and Powell unpublished data) have been undertaken to relate outbreaks with stand conditions, tree growth or climatic factors, but no close association has been found. By destroying the mature lodgepole and western white pine trees, which have usually originated in old burns, the beetle contributes to the natural ecological forest succession to the climax type. It plays a similar role in ponderosa pine stands changing them to uneven-aged stands of even-aged groups (Keen 1950, 1956). Forest management requires a system utilizing the mature, or near mature, pines before the beetle ravages the stand making salvage operations necessary.

This paper presents a cartographic history of outbreaks since 1906 and the recorded distribution of D. ponderosae in Western Canada. Ten of the major outbreaks are briefly mentioned with estimates of timber losses where these were available.

SOURCES OF INFORMATION

Distributional data were obtained from specimen collection records at the Forest Research Laboratories at Vernon and Victoria, B. C., and Calgary, Alta.; the Canadian National Collection, Entomology Research Institute, Ottawa, Ont.; the University of British Columbia, Vancouver, B. C.; the California Academy of Sciences, San Francisco, Calif.; and the University of Alberta, Edmonton, Alta.

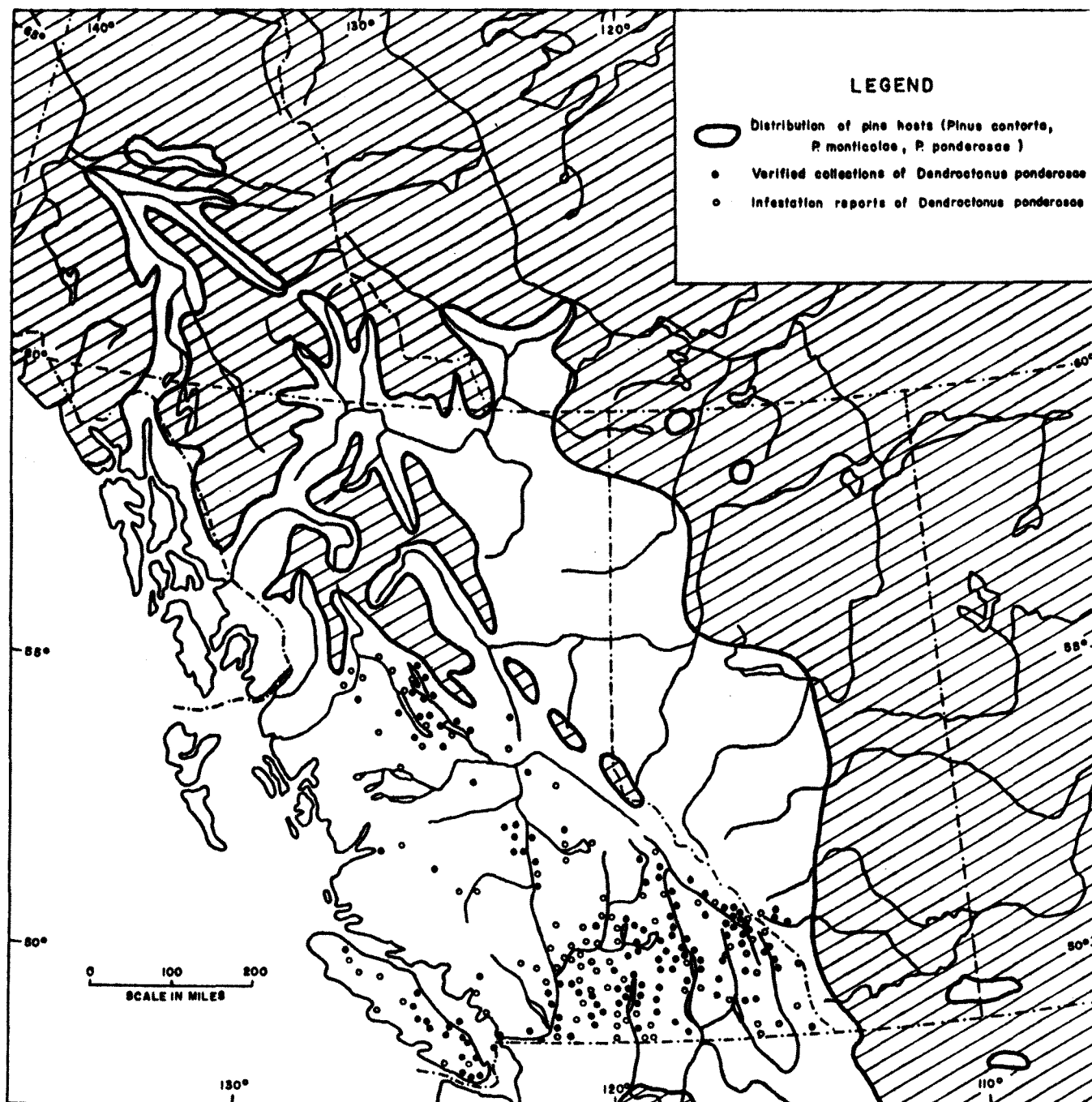
Information on population trends and outbreaks was largely obtained from Annual Reports of the Forest Insect Survey, Vernon (1921-53) and Victoria, B. C. (1949-1965). Other reports of bark beetle activity are credited where mentioned.

All areas of infestation have been mapped to give a cartographic history of the activity of the beetle in Western Canada. The reporting of all outbreaks previous to 1921 was unreliable, and even since then the intensity of reporting by Forest Entomology personnel, or co-operating agencies has varied. Even today, with the advantages of regular aerial surveys and greater accessibility into forested areas, some infestations are not reported until they have reached an advanced stage. Surveys in more accessible parts of southern British Columbia have been made annually for the period of record. In central and northern British Columbia coverage was poor prior to 1945.

DISTRIBUTION OF *DENDROCTONUS PONDEROSAE* AND ITS HOSTS IN WESTERN CANADA

The distribution of *Dendroctonus ponderosae* in Western Canada is given in Fig. 1. Areas from which adults were collected and identified are noted separately from reported infestations where no adults were obtained for verification. Most earlier maps indicated that the beetle occurred over a much more limited area (Struble and Johnson 1955; Hay 1956). The recent map by Wood (1963) indicates the probable geographical distribution much further north than any collections have been made and appears to be based on the distribution of host species (cf. Fig. 1). The Edmonton collection

Fig. 1. Distribution of Dendroctonus ponderosae and of its pine hosts in Western Canada.



reported by Wood (1963, p. 63-64) is questionable as there are few pine at this location (cf. Fig. 1). A search of the collection on which the record was based failed to locate the specimen.

The distribution of the three host species of Pinus in Western Canada is indicated in Fig. 1. D. ponderosae occurs throughout the range of P. ponderosa and P. monticola, but only over the southern parts of the range of P. contorta. Extreme cold winter temperatures may be a limiting factor for brood survival in the northern part of the range of P. contorta as indicated by Swaine (1925). The absence of collections from coastal areas north of Bella Bella may be due to the sporadic occurrence and relatively poor growth of P. contorta.

GENERAL DESCRIPTION OF OUTBREAKS

Brief summaries of the major outbreak areas in Western Canada in the last 60 years are outlined below. Most outbreaks occurred during three main periods. Widespread outbreaks occurred between 1910 and 1932 in P. ponderosa and P. contorta stands of southern British Columbia. A large area of mature timber was destroyed between Princeton, Ashcroft, Kamloops and Barriere, and in the Okanagan Valley, as well as smaller around Adams Lake, Mabel Lake, Glacier National Park and south of Cranbrook. Control measures were carried out with some success at a number of places. Two major outbreaks in P. contorta stands were reported between 1930 and 1945, one around Tatla Lake, and the other in Kootenay National Park. In the early 1940's an outbreak, subjected to

control measures, occurred in Banff National Park, the only recorded instance in Alberta. Outbreaks have occurred from 1945 to the present largely in P. contorta and P. monticola stands of southeast and north-central British Columbia. A major outbreak occurred in P. contorta near Takla and Babine Lakes, and scattered occurrences have been reported in P. contorta and P. monticola around Shuswap, Adams and Mabel Lakes, and in the Columbia River Valley between the Arrow Lakes and Columbia Lake. In the same period an outbreak in P. contorta occurred in the Bella Coola Valley, and much of the P. monticola on Vancouver Island and in the Skagit River Valley was killed.

The locations of all reported infestations from 1906 to 1965 are indicated by 5-year periods in Figs. 2 and 3. A detailed summary of all the outbreaks occurring between 1906 and 1960, including area covered, dates of build-up and decline of beetle populations and amount of timber destroyed, is contained in an earlier report (Powell 1961).

Princeton-Peachland, 1910-1918

Between 1910 and 1919 large areas of P. ponderosa and P. contorta were infested in the valleys of the Similkameen and Tulameen Rivers near Princeton to the slopes west of Peachland. Mortality ranged from 40 to 90 per cent. In the Princeton area the infestation spread more slowly in 1914 than in 1913 (Hewitt 1915), but by 1916 it was "beyond any reasonable hope of control" (Swaine 1916). Hopping (1921) reported that the infestation in the Princeton area, which killed 150 million board feet, died out in 1919 probably due to a slow increase of parasitic and predaceous enemies.

Fig. 2. Infestations of Dendroctonus ponderosae in Western Canada from 1906 to 1935 in 5-year periods.

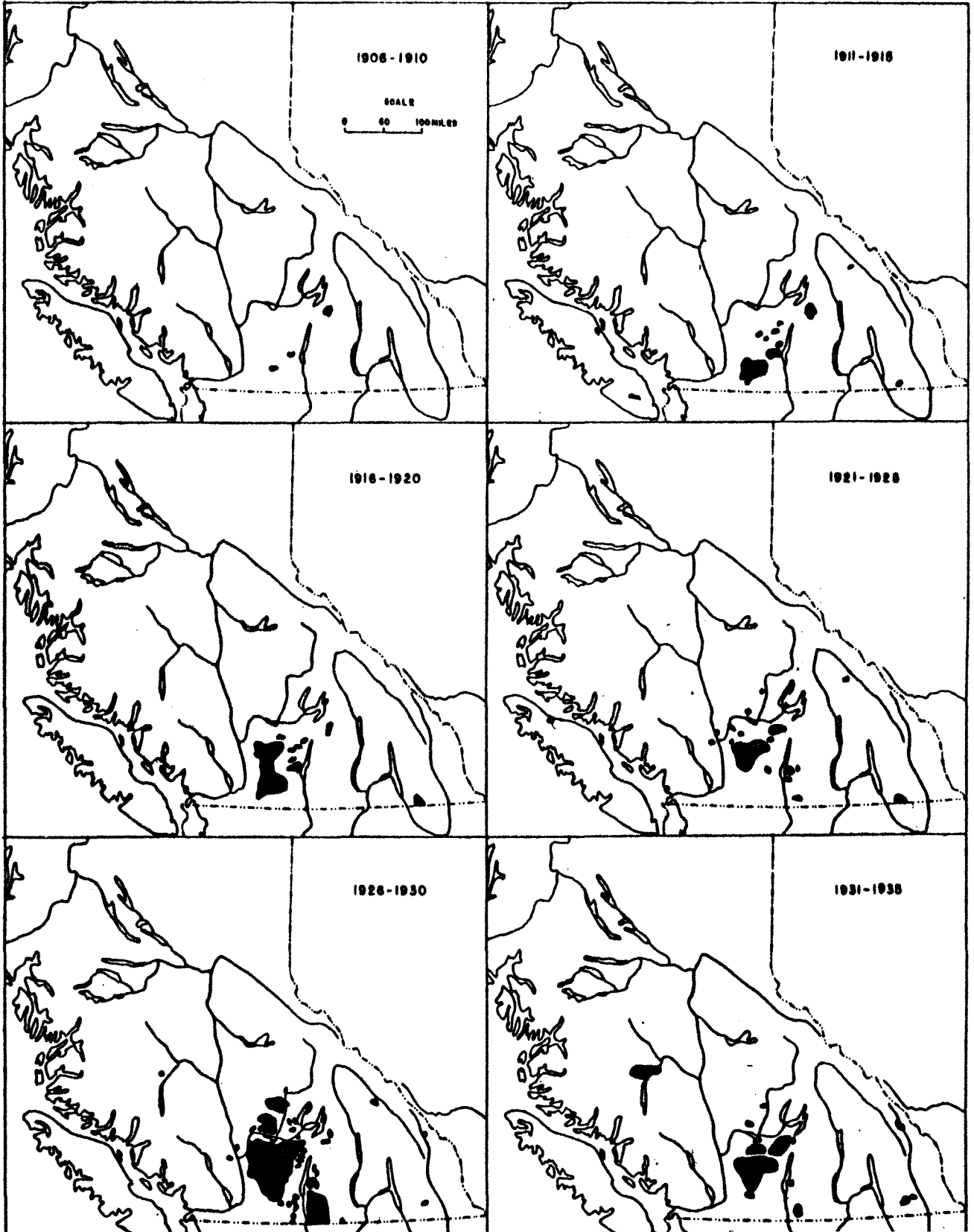
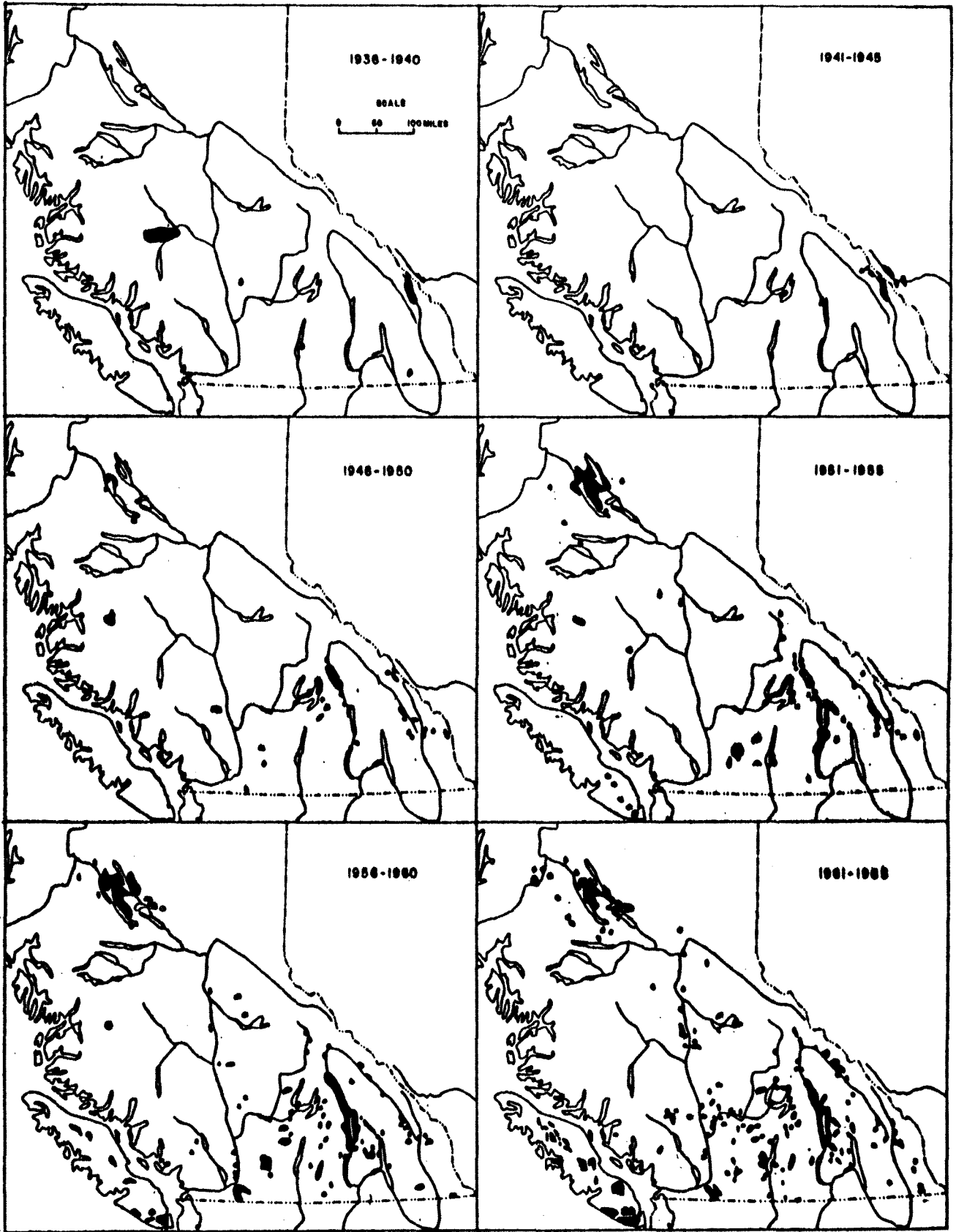


Fig. 3. Infestations of *Dendroctonus ponderosae* in Western Canada from 1936 to 1965 in 5-year periods.



Aspen Grove-Kamloops, 1917-1932

An outbreak in P. ponderosa and P. contorta stands began about 1917 in the Coldwater River-Nicola River-Spius Creek area (Swaine 1919), and spread rapidly in all directions but particularly north and east. By 1921 infestations extended as far east as the Fly Hills and included large areas around Long, Chapperon and Douglas lakes, in the Monte Hills and Martin Mountain Forests, and south of the Thompson River. In 1920 control work began in Midday Creek Valley, and by 1922-23 work was being carried out at Pike Mountain, Voght Creek, Coutlee Plateau, Spius Creek, and around Aspen Grove. Loss in the Aspen Grove area during 1921-25 was estimated at 20 to 25 million board feet; 335 million was saved. Between 1925 and 1928 the population was much lower in the southern portion but continued at a high level in the northern portion of the area and much of the mature pine was killed. A rapid increase occurred in 1929. The Annual Reports suggested this may have been due to an extremely dry summer, which gave better conditions for growth of the larvae, less mortality, and less resin flow. Infestations continued to increase from 1930 to 1931 by 5 to 300 per cent, and on many of the areas 75 to 100 per cent of the mature pine was killed. By 1932 the infestation declined considerably through lack of suitable host material. The beetle was then concentrated in immature pines, and the cool summers of 1932 and 1933, when emergence was as late as August, further checked an increase. In the spring of 1933 there was heavy mortality of larvae reported to be due to extreme winter temperatures. The dying of larvae was far heavier in P. contorta, with its thinner bark, than in P. ponderosa. In 1934 the outbreak had collapsed in all areas.

East side of Okanagan Valley-Kettle River, 1922-1930

Small outbreaks were reported in 1917 (Swaine 1918) and again in 1922 on the east slopes above Okanagan Lake between Kelowna and Penticton. By 1924 the infestation, near Lorna, had assumed large proportions, a 600 per cent increase over 1921. Control work was carried out here between 1924 and 1926. By 1925 many outbreaks were noted south of Lorna, and an aerial survey in 1928 indicated between 10 and 90 per cent of the timber killed in many areas throughout the Okanagan Valley. This included 150 square miles of mature P. contorta killed southeast of Penticton and extending into the Kettle River Valley. Approximately two million trees were infested in the southern part of this area, and by 1930 over 90 per cent of mature P. contorta was killed. This outbreak apparently declined rapidly as there is no record of it after 1931.

North of Thompson River, 1920-1932

North of the Thompson River from Lillooet to Kamloops and north of the South Thompson River from Kamloops to Adams Lake large outbreaks occurred particularly in the latter half of the 1920's. Between 1921 and 1925 control work was carried out around Adams Lake in P. monticola stands, but a fire swept through the entire control area. West of the North Thompson River several outbreaks in P. contorta stands occurred in the same period and these increased rapidly between 1928 and 1930. The 1930 survey reported a 400 per cent increase since 1928 in Tranquille Forest Reserve. An infestation near Barriere covered an area of 130 square miles, and killed over 300 million board feet of timber between 1925 and 1930.

Tatla Lake, 1930-1936+

Little is recorded about this outbreak. It is reported to have started about 1930, reaching a peak prior to 1936 when it covered an area over 100 miles long and 25 to 40 miles wide. Sixty to 90 per cent of the P. contorta was destroyed. It is possible that this outbreak began before 1930 and continued after 1936.

Kootenay and Banff National Parks, 1930-1945

An infestation in P. contorta started about 1930 on the east side of the Kootenay River near the southern boundary of Kootenay National Park, and spread rapidly northwards on both sides of the river. This outbreak commenced in an old stand and moved progressively into younger stands. By 1936 the infestation covered 72 square miles in the southern portion of the park, with some areas showing a decline but others intense activity. The infestation decreased rapidly in 1937, and by 1938 there was only one active area. In 1939 and 1940 a sharp increase occurred, particularly in the northern portion. In 1942 the infestation increased further but wet weather during June and July delayed emergence, and low temperatures in January 1943 further depleted the broods, so that in 1944, there was a decline of population, except at the northern end of the outbreak. By 1943 the outbreak had covered 250 square miles, 85 to 90 per cent of the timber was destroyed (Hopping and Mathers 1945), and the loss between 1934 and 1940, totalled 460 million board feet. Small infestations occurred in the 1940's north of Kootenay National Park, along the Ice River and at various points in Yoho National Park. An outbreak in 1940 in Banff National

Park covered 10,000 acres along the Bow and Spray rivers. It was successfully controlled by cutting and burning infested trees. This, together with sub-zero weather in January 1943, practically exterminated the broods (Hopping and Mather 1945).

Shuswap-Arrow Lakes-Columbia River, 1946-1965

In the south-central region, outbreaks in P. monticola stands were concentrated in three areas: Shuswap, Adams and Mabel lakes; the Columbia River Valley from Sidmouth north to the Canoe River; and around the Upper Arrow, Trout and Slocan lakes. The beetle fluctuations have been similar in each area from 1946 to the present. Outbreaks were reported in 1946-47 from Mabel and Shuswap lakes, Downie Creek north of Revelstoke, and near Nakusp and Arrowhead on the Upper Arrow Lake. In the next few years it spread to most areas of P. monticola north of the Lower Arrow Lake. Activity remained high from 1950 to 1953 in all areas except the Shuswap Lakes, where a decrease in the number of red-tops was apparent by 1953. By 1954 the concentrations of fresh attacks in the Columbia River and Upper Arrow Lake areas were found on the fringes of old infestations, and the population had dropped appreciably. During 1955-57 the population continued at a low level, with a tendency to decrease further. In 1958 there was an increase of the beetle population in old areas and many new localized infestations were reported. In the Columbia River area a slight decline was evident in 1959, but other areas reported continuing activity. Increases occurred in the period 1960 to 1965, especially in the Shuswap Lake and upper Shuswap River drainage,

along the Columbia River from Arrowhead to Cance River, along the east and west slopes of Upper Arrow Lake, and in the Slocan-Trout-Duncan Lake areas. In the Arrow Lakes area, pole-blight disease symptoms were often found on P. monticola in the infested areas. This may have been a contributing cause to the susceptibility of the tree to bark beetle attacks. In the whole area some 160,000 pine trees with an estimated volume of more than $3\frac{3}{4}$ million cubic feet were killed between 1951 and 1960 (Ross 1957; Cottrell and Fiddick 1962).

Babine-Takla Lakes, 1947-1965

A serious outbreak in P. contorta stands occurred throughout much of this north-central area in the last 20 years. First reports of activity were in 1947, and by 1953 much of the area around Babine Lake had become infested, varying degrees of tree mortality being recorded in the overmature stands. By 1955 areas around Babine, Takla, Natowite and Tochcha lakes were infested. Between 1956 and 1959 the infestation generally declined, but spread further south in 1959. In 1960 and 1961 the populations remained steady or exhibited only slight increases. By 1962 the outbreak included areas around Trembleur and Tezzeron lakes, and scattered infestations north of Babine Lake, as well as continuing activity around Babine and Takla lakes. From 1963 to 1965 further increases were reported both in distribution and intensity. Between 1951 and 1960 some 540,000 trees were killed in the Babine Lake and Takla Lake areas with a volume loss of approximately $17\frac{1}{2}$ million cu. ft. (Ross 1957; Cottrell and Fiddick 1962); this figure does not include losses in the Babine Lake area prior to 1955.

Skagit River, 1947-1965

A small infestation was reported in P. monticola in 1947 on the Skagit River. Reference to outbreaks in this area was not made again until 1960 when some 6,000 acres were infested in the lower Skagit River Valley and about Snass Creek in Manning Park. In 1961 infestations extended over 12,000 acres in the Silverhope Creek and lower and upper Skagit River areas. Activity continued in 1962 but a decrease was noted in 1963 and again in 1964. Cottrell and Fiddick (1962) reported that approximately 177,600 P. monticola trees representing a total volume of 6 million cu. ft., were killed between 1956 and 1960.

Vancouver Island, 1955-1965

Small groups of dying P. monticola were first reported from six areas of southern Vancouver Island in 1955. By 1957 P. monticola was heavily attacked throughout its range on southern Vancouver Island. Heavy tree mortality occurred prior to 1960, with the heaviest losses south of Cowichan Lake and around Buttle Lake. An appraisal of the damage, completed in 1964, estimated that much P. monticola on 338,244 acres had been killed with a timber loss of over 144 million cu. ft. (Collis and Alexander 1966). A loss of 85 per cent of the mature pine had occurred in the southern part of the Island, and losses in the northern part averaged 57 per cent, with mortality ranging from 39 to 95 per cent on sampled areas. By 1964 the outbreaks had declined to a low level with very few of the remaining pines attacked. Some of the mortality in younger class trees may be due to the white pine blister rust, Cronartium ribicola Fischer, which is present in the same area.

SUMMARY

Dendroctonus ponderosae occurs throughout the range of Pinus ponderosa and P. monticola in Western Canada, but only over the southern parts of the range of P. contorta. It has not been recorded north of latitude 56°N. in British Columbia and has only been recorded from one small area in Alberta. A cartographic history of infestations of D. ponderosae since 1906 is given. These infestations occurred during three main periods. Widespread outbreaks occurred between 1910 and 1932 in P. ponderosa and P. contorta stands of southern British Columbia. Two outbreaks in P. contorta stands occurred between 1930 and 1945, one around Tatla Lake and the other in Kootenay National Park. Outbreaks have occurred from 1945 to 1965 in P. contorta and P. monticola stands of southeast and north-central British Columbia and on Vancouver Island. Ten of the major outbreak areas are briefly discussed giving dates of beetle population, build up and decline, and estimates of amount of timber killed. Since 1950 over 170 million cu. ft. of pine has been lost in the four major outbreak areas, and estimates are not included for three areas for the period after 1960.

ACKNOWLEDGMENTS

The writer wishes to acknowledge the assistance of Dr. D. A. Ross, Forest Entomology Laboratory, Vernon, for making available the early reports of that Laboratory, and for specimen

collection data. He also wishes to thank Dr. G. E. Ball, Department of Entomology, University of Alberta, Edmonton; W. J. Brown, Entomology Research Institute, Ottawa; H. B. Leech, California Academy of Sciences, San Francisco; and D. Evans, Forest Research Laboratory, Victoria, for specimen collection data. Dr. T. C. Brayshaw, Petawawa Forest Experiment Station, Chalk River, Ontario, kindly gave permission to use his Pinus species distribution maps.

REFERENCES

- Beal, J. A. 1943. Relation between tree growth and outbreaks of the Black Hills beetle. *J. For.*, 41: 359-366.
- Blackman, M. W. 1931. The Black Hills beetle (Dendroctonus ponderosae Hopk.). *Bull. N. Y. St. College Forestry, Syracuse Univ.* 4(4), *Tech. Bull.* 36. 97 pp.
- Collis, D. G. and N. E. Alexander. 1966. Damage to western white pine on Vancouver Island by the mountain pine beetle, 1964. *Can. Dep. For., For. Res. Lab., Victoria, B. C. Inf. Rep.* (In press).
- Cottrell, C. B. and R. L. Fiddick. 1962. An appraisal of timber killed by insects 1956-60 inclusive in British Columbia. *Can. Dep. For., For. Ent. and Path. Lab., Victoria, B. C. Inf. Rep.*
- Craighead, F. C. 1925. Bark-beetle epidemics and rainfall deficiency. *J. econ. Ent.* 18: 577-586.

- Hall, R. C. 1956. Environmental factors associated with outbreaks by the western pine beetle and the California five-spined pine engraver in California. Proc. 10th Int. Congr. Ent., Montreal, 4: 341-347 (1958).
- Hay, C. J. 1956. Experimental crossing of mountain pine beetle with Black Hills beetle. Ann. ent. Soc. Amer. 49: 567-571.
- Hewitt, C. G. 1910. Insects destructive to Canadian forests. In First Annual Report-Commission of Conservation - Canada 1910.
- Hewitt, C. G. 1915. Report of the Dominion Entomologist for the year ending March 31, 1915. Can. Dept. Agric.
- Hopping, G. R. and W. G. Mathers. 1945. Observations on outbreaks and controls of the mountain pine beetle in the lodgepole pine stands of western Canada. For. Chron. 21: 98-108.
- Hopping, R. 1921. The control of bark-beetle outbreaks in British Columbia. Can. Dep. Agric., Entomological Br., Cir. 15.
- Keen, F. P. 1950. The influence of insects on ponderosa pine silviculture. J. For., 48: 186-188.
- Keen, F. P. 1956. Progress in bark-beetle control through silviculture in the United States. Proc. 10th. Int. Cong. Ent., Montreal 4: 171-180 (1958).
- Powell, J. M. 1961. The mountain pine beetle, Dendroctonus monticolae Hopk., in western Canada. Can. Dept. Agric., For. Ent. & Path. Br., Calgary, Alta. Interim Rep. May.

- Ross, D. A. 1957. A preliminary report on appraisal of the amount of timber killed by bark beetles of the genus Dendroctonus, Interior B. C. Can. Dept. Agric., For. Biol. Lab., Vernon, B. C. Interim Rep. 1956-2.
- Struble, G. R. and P. C. Johnson. 1955. The mountain pine beetle. U. S. Dep. Agric., For. Service, For. Pest Leaflet. 2.
- Swaine, J. M. 1912. Notes on some forest insects of 1912. 43rd Annu. Rep. ent. Soc. Ont. : 87-91.
- Swaine, J. M. 1913. The economic importance of Canadian Ipidae. Proc. ent. Soc. B. C., n. s. 3: 41-43.
- Swaine, J. M. 1914. Forest insect conditions in British Columbia, a preliminary survey. Can. Dep. Agric., Div. of Ent., Entomological Bull. 7. 41 pp.
- Swaine, J. M. 1916. Some features of interest in connection with our studies of forest and shade tree insects. 47th Annu. Rep. ent. Soc. Ont. : 95-106.
- Swaine, J. M. 1918. Insect injuries to forests in British Columbia. pp. 220-237. In Whitford, H. N. and R. D. Craig (eds.). Can. Commission of Conservation, Forests of British Columbia. Pt. I.
- Swaine, J. M. 1919. The bark-beetle outbreak in the Coldwater-Nicola-Spious Area. August, 1919. Can. Dept. Agric., Ann. Rept. Div. of Forest Insects. p. 43.

Swaine, J. M. 1925. The factors determining the distribution of
Canadian bark-beetles. Can. Ent. 57: 261-266.

Wood, S. L. 1963. A revision of the bark beetle genus Dendroctonus
Erichson (Coleoptera : Scolytidae). Great Basin Naturalist
23: 1-117.