A. Graham

PROCEEDINGS

of the Seventh Annual

WESTERN FOREST INSECT WORK CONFERENCE

Spokane, Washington

December 1-3, 1955

(For Information of Conference Members Only,

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1955-56 EXECUTIVE COMMITTEES

Chairman		
	1955	R. L. Furniss, Portland
	1956	M. G. Thomson, Victoria
Secretary-Treasurer		
	1955	M. G. Thomson, Victoria
	1956	A. D. Moore, Berkeley
Counsellors		
	1953-1955	N. D. Wygant, Fort Collins
	1954-1956	C. B. Eaton, Berkeley
	1955-1957	R. W. Stark, Calgary
	1956-1958	D. E. Parker, Ogden

TABLE OF CONTENTS

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WESTERN FOREST INSECT WORK CONFERENCE*

Spokane, Washington

December 1-3, 1955

Chairman R. L. Furniss called the meeting to order at 9:20 in the Blue Room, Hotel Spokane.

The chairman introduced the following guests and new members.

- Mr. P. Vite, Fulbright Scholar at Oregon State College.
- Dr. B. M. McGugan, Co-ordinator, Forest Biology Survey, Ottawa, Ontario.
- Mr. J. W. Bongberg, Assistant Chief, Division of Forest Insect Research, Washington, D. C.
- Mr. R. R. Lejeune, Officer-in-Charge, Forest Biology Laboratory, Victoria, B. C.

The remaining delegates then introduced themselves in turn.

December 1, 9:30-10:15

Initial Business Meeting

Secretary M. G. Thomson read the Secretary's Report for 1955. It was moved by F. P. Keen and seconded by K. Graham that the minutes of the 1954 general meetings be adopted as presented in the Proceedings. Carried.

The secretary read the Financial Statement for the year ending November 30, 1955. Moved by W. J. Chamberlin, seconded by G. R. Hopping that the financial statement be approved. Carried.

The secretary then gave a brief review of the executive meeting of November 30.

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* Proceedings prepared by the Secretary-Treasurer, A. D. Moore, from summaries submitted by the various discussion leaders. The form followed was established by the former Secretary-Treasurer, Mr. M. G. Thomson, in 1955.

The Chairman appointed the following committees.

Standing Committee on Insect Conditions Review.
G. T. Silver
J. W. Bongberg
B. H. Wilford, Chairman.
to review the presentation of insect conditions reports and the symposium on outbreaks.

A Committee of
W. F. Barr
P. C. Johnson
W. F. McCambridge
M. G. Thomson, Chairman
to prepare a letter for presentation to the Experiment Station Directors, Washington and Ottawa on the views of the Conference regarding the frequency of meetings.

A Committee of
D. A. Ross
F. Knight
R. A. Underhill
F. M. Yasinski
R. R. Lejeune, Chairman
to recommend a time and place for the 1956 meetings; suggest possible conference topics; nominate a Program Committee chairman and to approach the pathology Conference with respect to policy on joint meetings in the future.

A Committee of
D. E. Parker
K. H. Wright
M. G. Thomson, Chairman
to recommend necessary changes in the constitution.

A Committee of
G. T. Silver
P. G. Lauterbach
J. M. Whiteside
B. H. Wilford
R. W. Stark, Chairman
to nominate candidates for Chairman, Secretary-Treasurer and 1956-58 Counsellor.

The chairman commended the activities of the Common Names Committee.

The chairman introduced the 1955 Program Committee responsible for the program and local arrangements.
P. C. Johnson
J. C. Evenden
W. F. Barr, Chairman

Dr. B. M. McGugan then reviewed the arrangements being made for the 10th International Congress of Entomology in Canada especially the sections on Forest Entomology.

Meeting adjourned at 10:15.

December 1, 10:30-12:00 T. T. Terrell, Discussion Leader

Review of Current Forest Insect Conditions

In Western United States, Canada and Alaska

A review of the insect conditions reported upon by each of the eight regions comprising the Conference area was given by describing the occurrence of the insects and showing their range of activities. It was stated that 34 different insects had been reported upon by the regions but that not all of these insects were necessarily in an epidemic status. The frequency of reporting of the various insects gave a rough index of their current importance.

It was pointed out that the Douglas-fir beetle had been reported upon by 6 regions which gave the insect an activity range reaching from Arizona and New Mexico in the United States to central British Columbia in Canada.

Although reports on the mountain pine beetle were received from 5 regions the general impression was that the activity of this insect was at a fairly low point.

Engelmann spruce beetle infestations were reported from 5 regions all of which indicated the current trend to be a decline.

Black Hills beetle infestations were reported from 3 regions where direct control measures hold the insect's activities to a static condition.

The western pine beetle was reported upon by 2 regions where the current condition is either endemic or at a low point.

Of all the insects reported upon the spruce budworm was given the widest range. Six regions described the activities of this insect with many millions of acres infested, extending from the Southern Rocky Mountain Region in the United States to a point just below the arctic circle in the Northwest Territories of Canada. The indicated trend of the insect activity is decreasing or static in the Pacific Northwest, Alberta, and British Columbia and increasing in the Southern Rocky Mountain, Central Rocky Mountain, and the Intermountain Regions.

Black-headed budworm infestations were reported from 4 regions: Alberta, British Columbia, Alaska and the Intermountain Regions.

Douglas-fir tussock moth infestations were reported from the Intermountain and Alberta Regions.

The Great Basin tent caterpillar, (Malacosoma fragilis) was reported as in an epidemic status in the Southern Rocky Mountain and Central Rocky Mountain Regions while forest tent caterpillar (Malacosoma disstria) infestations were described as declining in the 2 regions reporting: British Columbia and Alberta.

Lodgepole needle miner (Recurvaria milleri) infestations were reported as highly epidemic in Sequoia and King's Canyon National Park in California and declining in Yoho, Kootenay and Banff National Parks in Canada.

Douglas-fir needle miner (Contarinia sp.) infestations were reported on from British Columbia where populations of the insect are high in parts of the interior and where an infestation has been reported on the coast for the first time.

The fir needle miner (Epinotia meritana) was reported as very active in Bryce Canyon National Park in the Intermountain Region.

Reports from three regions indicate that the fir engraver beetle (Scolytus ventralis) is currently endemic in California and the Pacific Northwest Region but is causing heavy losses in the Southern Rocky Mountain Region.

Pine engraver beetle (Ips sp.) infestations are reported from California, the Pacific Northwest and Alaska. In these three regions the damage is reported as light or spotty but the infestation seems to be on an upward trend.

An outbreak of the lodgepole pine sawfly (Neodiprion burkei) was reported to be active in Yellowstone National Park in the Intermountain Region; hemlock sawfly (Neodiprion tsugae) infestations were reported along the Alaskan coast where pockets of infestation cover extensive areas, and infestations of the larch sawfly (Pristiphora erichsonii) were reported to be present throughout northern Alberta.

Western hemlock looper (Lambdina fiscellaria lugubrosa) infestations were reported from British Columbia where the general trend was downward although there are areas of rather severe defoliation.

Other insects reported upon were the balsam wooly aphid (Chermes piceae) in the Pacific Northwest, the spruce mealybug (Puto sp.) in the Intermountain Region, the western cedar bark beetle (Phloeosinus sp.) and willow leaf beetle (Chrysomela interrupta) in the Alaska Region, and 2 unknown defoliators: one in larch and one in lodgepole pine from the Intermountain Region.

The foregoing resume of forest insect conditions was followed by a general discussion of control and survey activities in the regions.

Mr. R. L. Furniss described the outbreak of the balsam wooly aphid as anything but minor in the Pacific Northwest. Top killing of silver fir could be observed during July and August.

Mr. Philip Johnson, speaking of the Intermountain Region told us that 300,000 acres of spruce budworm infestation were sprayed in an effort to control a portion of the outbreak. He also outlined the logging and trap-tree control program for Engelmann spruce beetle during which some 60,000 trap trees were felled. Of future projects the current tussock moth outbreak in northeastern Washington may have to be sprayed but further surveys will be made to determine the need.

Dr. B. M. McGugan stated that ground collections of insects furnished much of the information needed in Canada and therefore aerial surveys were somewhat limited.

Mr. G. T. Silver discussed insect surveys in British Columbia where it was pointed out that aerial surveys are used to a limited extent.

Mr. George R. Hopping stated that airplanes are not much used for aerial surveys of budworm damage but were used on needle miner surveys in Alberta.

It was pointed out that considerable use is made of Provincial airplanes for aerial observation of insect damage in Canada but rentals are quite high on commercial planes. Dr. McGugan indicated that the Dehaviland Beaver was their most desirable airplane for such work but Noorduyn Norseman planes were also used.

Mr. T. T. Terrell told of the extensive use of aircraft for insect surveys in the Intermountain region: approximately 350 hours flying time were devoted to the work in 1955.

Dr. Ralph Hall, speaking of control, stated that aerial spraying with DDT to control a needle miner outbreak in Yosemite was not successful because they were unable to fly low enough. Plans for 1956 call for the use of malathion with a mist blower around recreational areas.

Mr. Richard I. Washburn described the use of a dictaphone as an aid to aerial surveys in the Intermountain Region. He uses a code number on the map to show the location of his oral notes.

In Colorado Mr. F. B. Knight told us that 325,000 ft. b.m. were felled for trap trees to control the Engelmann spruce beetle. About one third of the trap trees were logged. Mr. H. E. Ostmark described the treatment of Black Hills beetle infested ponderosa pine and indicated the work would continue next year with the treatment of several thousand infested trees.

December 1, 1:15 - 5:00 PM F. P. Keen, Discussion Leader

Forest Insect Damage Surveys and Population Sampling.

1. Purpose and Kinds of Surveys

The moderator opened the session with an introductory statement, pointing out that the objectives of surveys determine methodology. There is no one survey method that is best for all purposes. Many types of surveys are dictated by the objectives to be served. These fall into two broad types:

A. Research surveys

(1) Species reconnaissance.
Object: To determine what insect species are present in a given area, their relative abundance and potential destructiveness.
How made: By collecting all insect species in the forest and noting character of damage and extent. No sampling procedures are involved.

(2) Population trend surveys (Infestation studies).
Object: To determine causes of insect outbreaks, and their decline, in order to have a basis for predicting the course of infestations and need for and timing of control, or effects of control.
How made: By sampling populations from year to year and studying associated insects and factors. Because of intensive nature of work only a few important insects can be studied at any one time; and often records are needed over a long period of years to obtain any information on cycles or causes.

(3) Timber damage or drain surveys.
Object: To determine timber loss from insect activity, either on a local or region-wide basis, and to correlate loss with growth and timber resource values, for purpose of forest management.
How made: Requires plots randomly distributed in all forest types of concern and periodically measured to obtain total loss sustained over a given period of time. Cause of loss and trend is not important and drain records can be taken at five or ten year intervals.

B. Insect Control Surveys.

(1) Damage detection surveys - all insects.
Object: To detect forest damage due to insects, as the first step in a forest protection plan.
Questions to be answered: (a) Is timber damage occurring? (b) Are insects primarily responsible? (c) What insects are involved? (d) What trees or parts of trees are affected? (e) Where is it and how wide-spread?
How made: By observations of entomologists or cooperators, either on the ground or by flying over forested areas.

(2) Infestation reconnaissance surveys.
Object: To obtain more specific information on a suspected insect outbreak to see what action seems advisable.
How made: By technical personnel to decide either for or against control or a more detailed appraisal survey.

(3) Infestation surveys.
Object: To collect detailed information on a known insect outbreak for use in planning a control program, or to collect equally detailed information on the efficacy of a control program after its completion.
Questions to be answered: (a) What is the trend of the outbreak? (b) Are natural control factors operative? (c) Will applied control be needed? (d) How many acres or trees will be in need of treatment when control operations can be applied?
How made: Methods will vary depending upon insect involved, size of area, time available for appraisal and many other factors. May involve population sampling to determine immediate trends.

(4) Control surveys (Spotting).
Purpose: To mark trees or areas in need of treatment for guidance of control crews.

(5) Area hazard surveys.
Object: To classify forest stands according to relative degrees of hazard to insect attack so control through forest management may be applied.
How made: Special methods will vary. Some reliable guide to relative hazard of areas is essential.

The moderator pointed out that the methods used for the various types of surveys were dependent upon objectives and funds available for the work. For the remainder of the session, only one type of survey, i.e., infestation appraisal, and population sampling would be discussed.

2. Bark beetle infestation appraisal surveys.

A. Methods of damage appraisal.

Fred B. Knight opened this phase of the program by discussing the current sampling methods used in the central Rocky Mountain region in surveys of the Black Hills beetle and Engelmann spruce beetle to determine damage. Due to emphasis on chemical control, the number of infested trees is needed by the land manager to plan control operations. Hence, an estimate is made for the number of trees infested:

(1) Black Hills beetle.--Because of losses caused by this bark beetle, which occurs both in groups and scattered over large areas, it was necessary to devise methods to get reliable estimates for the entire area of infestation. The methods tested consisted of 1/2-chain strips, 1-chain strips, 1/5-acre plots, 1/10-acre plots, and 1/4-acre plots. These were compared for efficiency with results which showed that 1/2-chain strips were economically most suitable to provide reliable estimates of number of infested trees. The intensity of cruise found to be most feasible is about 2-1/2 percent on 5,000 acres for the assigned accuracy. Areas under 500 acres in size require very intensive surveys and should not be undertaken in most cases.

Aircraft was used in accurately estimating numbers of dead trees. However, ground ratio surveys are needed to convert aerial count to number of "green infested trees." The time consumed in doing the necessary ground work is, in most areas, the same or more than that required to run 1/2-chain strips, so there is no need to spend the time and effort on aerial appraisals for Black Hills beetle. Aircraft are a necessity for delineation of areas and detection surveys.

(2) Engelmann spruce beetle.--The objective of surveys for this beetle is to determine the number of infested trees in a given area. The habits of the insect are different from those of the Black Hills beetle, hence survey methods must be different. Infested Engelmann spruce are hard to detect. It is necessary to note frass around the base of the tree in order to determine if a tree is attacked. Strip surveys are extremely slow; small plot surveys are efficient and relatively fast. In the central Rocky Mountain region, small plot surveys (1/10-acre plots) are used on a one-man-per-crew basis. The number of plots and lines vary depending on the size of the area and the degree of infestation. Detection of spruce beetle outbreaks is difficult and special methods are necessary. Aerial reconnaissance is not reliable; trees often do not show up from the air. Scattered blowdown also is not observed readily from the air.

According to T. T. Terrell, the methods of survey for the Engelmann spruce beetle in the northern Rocky Mountain region differ from those used by Knight in Colorado, due to differences in type of infestation, terrain, and forest cover. Strip cruises are spaced 10 chains apart. Aerial methods are useful in the winter when the litter of bark flakes around the base of infested trees, caused by woodpecker feeding, are plainly visible. Woodpecker feeding is also visible on the bole of infested trees. Aerial detection surveys based on woodpecker evidence are thus possible.

(3) Comparison with mountain pine beetle surveys.--D. A. Ross described how mountain pine beetle surveys were made in Canada. Rough estimates of volume of timber killed are determined by chain-wide strip surveys recording number of trees and d.b.h.

T. T. Terrell described mountain pine beetle surveys in the Northern Rocky Mountain area. Objectives desired are: (1) number of trees infested; or, (2) percent of volume infested. In lodgepole, surveys are made on a tree basis- infested trees and percent of trees. In almost every other tree species, the survey is not so much concerned with the number of trees infested as with the percent of volume infested. To determine number of trees, Knight's methods are employed except as to intensity. Strips are spaced 10-chains apart regardless of infestation, D.b.h. is also recorded on a sample basis in lodgepole and western white pine. Only percent of volume infested is needed where control by logging is used. So green stand is measured on a sample basis to provide information as to percent of stand volume killed.

(4) Douglas-fir beetle surveys.--Paul Lauterbach described the value of aerial surveys in detecting 100 percent of Douglas-fir red-topped trees killed by Douglas-fir beetle, thus locating the place and amount of damage so that roads and salvage operations can be planned. Aerial methods are improved by use of color photography, The double-sample method was found to be accurate in determining amount of mortality. Aerial methods yielded 70 percent accuracy, but the error is compensating. Ground sampling and color photographs provide an accurate and economical method of appraising the mortality caused by Douglas-fir beetle.

R. C. Hall described helicopter trials for counting and mapping infested Douglas-firs in California. The method was not found to be 100 per cent accurate, but 85 percent of the trees were counted from the helicopter and 95 percent of the volume was located.

(5) Recent aerial photographs of sample plots for western pine beetle surveys.

R. B. Pope described recent experiments to determine the usefulness and accuracy of aerial photographic methods for appraisal of mortality caused by western pine beetle infestations in ponderosa pine. The purpose of the experiments was to see if combined aerial photographs plus limited ground work would be cheaper than ground work alone. Photo results on Panchromatic, color and camouflage-detection film all looked good. Photo samples plus ground samples would reduce the cost of ground surveys by 40 to 60 percent, it was estimated.

David McComb pointed out that the number of trees was not the most useful figure in research surveys. Volume of loss was also needed due to the variable size of trees. F. P. Keen commented that this problem bothered early investigators. Number of trees over-estimates population if the trees are small; while volume over-estimates population if the trees are large. Infested bark surface is the best measure, but this is bothersome to obtain and apply.

B. Bark beetle population sampling techniques.

(1) Fred B. Knight opened this phase of the discussion with a review of his studies of populations of the Black Hills beetle and the Engelmann

spruce beetle. He pointed out that, while damage can be measured and expressed, this does not indicate population of the insects. We need to know the net effect of factors causing fluctuations of populations in addition to the effects of any single factor. The Engelmann spruce beetle has been studied in seven areas in a continuing research project to sample populations. On each area 25 newly infested trees were sampled. In an early fall examination, 2 samples, each 6" x 6", were selected from each tree, a total of 50 samples per study area. At that time cages were installed over portions of the tree boles to protect against woodpeckers. The following spring, 4 samples on each tree were examined - 2 from inside the cages and 2 outside. In August, 4 more samples were taken to determine adult emergence. It was found that 50 samples were o.k. for desirable error limits (10% error at the 95% level). Results indicate no correlation between attacks or inches of egg gallery per square foot of bark surface and trend of infestation. The number of beetles per square foot is correlated with the infestation trend. Woodpeckers are a major mortality factor, and the number of heavily woodpeckered trees is also correlated with the infestation trend.

(2) Western pine beetle population sampling.

F. P. Keen commented that a great deal of bark counting had been done in connection with western pine beetle studies with negative results. Population counts had been made of over 4,000 square feet of bark over a period of 14 years. Such correlation as was found during the 10-year period of 1917 to 1926 on the Jenny Creek area of southern Oregon was inverse; i.e., heavy emergence was followed by low loss, and low emergence was followed by high loss. These studies indicated that the greatest mortality of beetles and the trend of infestations was determined through the flight period.

(3) The mountain pine beetle.

R. F. Shepherd told of work underway in Canada to study populations of the mountain pine beetle. Counts were being made on a square foot basis of the number of strikes per tree throughout the entire length of the bole, looking toward development of a system of sampling to determine the amount of bark area per tree, and the number of trees needed in a sample in order to give a good appraisal of populations. This sampling system will form the basis of studies of the fluctuations of populations and the development of life tables with the appraisal of various causes of mortality.

Archie Gibson told of the early work of W. D. Bedard to develop a slide rule by which population trends of the mountain pine beetle in western white pine might be computed. This, in fact, was an early attempt to construct a life table by computing the population potential and the mortality experienced at different life stages. The formula developed from basal sampling of infested white pines was:

$$\frac{B \times 0.75 \times V}{A} = \text{Ratio of increase or decrease.}$$

B= D_cm brood corrected for basal examination.
0.75= D_cm. brood corrected for sex ratio and flight mortality.
A= Attacks per square foot.
V= Value given infested bark surface on basis of average.

He then explained how this formula was used by giving an illustration.

Gibson stated that mountain pine beetle-infested western white pine less than 10 inches in diameter breast high should not be treated because of their large parasite and predator populations.

During development from egg to adult, the mountain pine beetle suffers an average mortality of approximately 90 percent. A female lays an average of 50 eggs in a gallery, and as most of them emerge and make a second attack and gallery, the potential increase per female is about 100. (The discussion was interrupted at this point by an urgent message from a prominent dancer.) When this matter was cleared up, it was necessary to start with the next subject on the agenda to hold to the time alloted for the discussions.

(4) The Douglas fir beetle.

J. M. Kinghorn stated that the trend of an outbreak may be determined by either beetle population samples or by damage samples(tree killing); however, large scale population sampling is frequently so difficult that it would be more advantageous to use damage samples to determine the trend of an outbreak and to restrict population sampling for determining the cause of these outbreak fluctuations.

3. Defoliator infestation appraisal surveys and population sampling.

R. W. Stark took the lead in this part of the session using the needle miner as an example of how population sampling can be coordinated with degree of defoliation, and this in turn with tree mortality.

(1) Needle Miner.

Stark brought out that, in recent work, sequential sampling has been revised so as to indicate the degree of defoliation. This involves four classes, the heaviest of which (above 55 larvae per tip) would result in tree mortality if that density were maintained. The other three classes reflect different degrees of defoliation. From more detailed population sampling, it is possible to estimate the actual time to tree mortality in the heavy infestation. He believes that sequential sampling procedures developed in Canada can be applied to the needle miner in California.

J. A. Cook explained the difficulties of accurately measuring the effect of defoliation on lodgepole stands, which have suffered little to no mortality in the Canadian outbreak of lodgepole needle miner. Increment measured radially, has been used but there are many problems involved. A new technique developed by Duff and Nolan* was explained.

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* G. H. Duff and Norah J. Nolan. The Growth and Morphogenesis in the Canadian Forest Species. I. The controls of cambial and apical activity in Pinus resinosa Ait. Canadian Jour. of Botany, 31:471-513, July 1953.

An adaption of these principles was explained whereby the damage appraisal could be reduced to an easy sample, retaining the sample technique of the standard radial increment measure, at different levels in the tree, oriented to each other so that the analytic concepts of Duff and Nolan are retained. Normal growth curve was determined, and compared to growth influenced by the defoliated portion of the same tree. The resultant difference determined the defoliation influence on increment reduction.

Geo. R. Struble discussed the use made of population data on needle miner in California to determine need for control. The objectives of California needle miner population surveys are: (1) to determine the need for control; and (2) to check effectiveness of control work undertaken. To attain a desired accuracy of ±10%, a minimum of 100 tips is required as a general average, with 50 tips needed in heavy and 200 in light infestations. All tips are randomly collected (4/tree at 12-foot level). Tips are sampled for populations by examination of 10 randomly selected needles, and the data used to calculate populations per tip within an accuracy of ±10%. The information is used as a basis for estimating subsequent defoliation. Two pre-control samplings are necessary: (1) in October after egg hatch; and (2) in June or July after the first winter. Post-control sampling is 4 to 6 weeks after spray application.

(2) Spruce Budworm.

Dr. Blair McGugan reviewed the work of Dr. R. F. Morris and his associates on the Green River Project. This project is located in Northern New Brunswick and is a long-term integrated study involving forestry, pathology, and management, as well as entomology. The entomological work to date has been concerned mostly with the spruce budworm with one of the most important developments being the "life table" approach to population studies. The Green River area has been particularly suitable for such studies which were initiated in 1944 when the budworm population level was very low. The first marked increases in abundance were noted in 1947 and very high levels were reached by 1950. At the present time, the first tree mortality has been recorded, and although budworm numbers remain high, they have declined appreciably from the peak levels of a few years ago.

Life tables themselves are not a sampling technique, but rather an objective to be kept in mind when intensive population studies are being developed. They simply record in a systematic fashion the distribution of mortality throughout one or a series of generations; in short, they keep books on death. The accuracy of life tables is directly dependent upon the accuracy and comprehensiveness of the various sampling techniques employed. Construction of a life table was demonstrated using data drawn directly from Dr. Morris' publications.

R. R. Lejeune commented on the life table approach and pointed out some of the difficulties encountered in constructing these tables and the hazards of misinterpreting them.

Tom Silver of the Victoria Laboratory and V. M. Carolin of the Portland Laboratory commented on the use of sequential sampling as applied to their particular spruce budworm problems.

Time did not permit a discussion of sampling free-feeding defoliators.

December 2, 8:30-9:30 M. M. Furniss, Discussion Leader

Status of Douglas-Fir Beetle Control

The discussion was introduced with mention of the importance of Douglas-fir beetle damage. The beetle was reported by 6 regions during the accounting of current insect conditions. No other insect was reported by so many regions.

It was pointed out that relatively recent literature, such as the U.S.D.A. Douglas-fir Beetle Circular No. 817, states that in regard to artificial control, "the only effective means yet discovered is to destroy the beetles with fire." The ensuing discussion clearly indicated that various formulations of penetrating sprays now bolster the old recipe of "fell-peel-burn". In addition, residual contact insecticides show promise. Systemic insecticides and attractants have not proven fully effective as yet, but further work may result in improvement. Also, salvage-logging of confined infestations in interior stands shows promise, especially from the standpoint of cost. Indirect control is imperfectly developed as yet, but studies are in progress which may prove fruitful.

History of Douglas-fir Beetle Control

In spite of the beetle's impressive record as a tree-destroyer, relatively few control projects have been undertaken. Some factors which help to account for this are:

1. Infestations often occur in inaccessible areas.

2. Stumpage value is low, especially in interior stands.

3. Proven control methods are expensive.

4. Infestations often cover large areas and may die out rapidly, especially in coastal stands.

A full accounting of all control projects would be difficult to accomplish because many projects were reported in sketchy fashion and most reports reside in files at various locations. However, certain highlights may be listed as follows. Some recollections of the old timers may well result in corrections.

1. First Project.

   1909-10. 5,000 trees were treated by the fell-peel method in the Northern Rocky Mountain Region. Although the project was declared a success, subsequent study has proved that merely exposing the brood is not an effective control method.

2. First Cut-burn Project.

1926. An infestation on Eight-Mile Creek, Cache N.F., Utah, was controlled by cutting trees and burning the slabs at a mill.

3. First Use of Chemicals.

1931. W. E. Bedard experimented with injections of sodium arsenate and wood alcohol in freshly attacked trees in northern Idaho. The wood alcohol gave no control and sodium arsenate was not satisfactory because a portion of the larvae fed in the outer bark where they escaped the chemical.

4. First Use of Trap Trees.

1935. Trap trees were employed on the Cache N.F. in Utah in connection with the treatment of 405 trees and 540 stumps. The traps were composed of overmature defective trees which were cut and piled in rollways. The logs became infested during the summer, after which they were peeled and the bark was burned.

Direct Control Methods: Their Application and Limitation.

1. Peel - expose brood.

W. E. Bedard felled and peeled 6 infested Douglas-fir trees on September 16, 1931. Brood and parasite counts were made before peeling. On May 2, 1932, 22 square feet of bark that had lain on the ground all winter were placed in cages.

Results:

	Before peeling (No. per sq. ft.)	Peeled & Exposed over winter (No. per sq. ft.)	Percent Mortality
D. pseudotsugae	36	5	86
C. brunneri	25	1	96

It was concluded that beetle mortality was not sufficiently high to be successful and that it had a drastic effect upon the most important parasite.

Other cages were set up to determine if the beetles would attack green logs after emerging, and whether or not beetles had overwintered in the duff as well as the bark. Results: No attacks appeared in the cage over the duff, but the log in the cage enclosing the bark was attacked.

2. Fell-peel-burn.

This method has been used more commonly than any other means of destroying beetle populations. It has proven effective, but the high cost of treatment and the danger of injuring surrounding trees make it certain that other methods will completely replace it.

3. Chemical control.

First use of insecticide was reported by Bedard in July 1931. He injected 5 trees with solutions of sodium arsenate in water. Wood alcohol was added to some of the sodium arsenate solutions. Injection was by the saw-kerf, tin-collar method. All trees at the time of medication showed comparatively recent attacks indicated by the presence of living cambium and brood in the egg and young larval stages.

The trees were examined 10 months later. Bedard reported that the tree injected with alcohol was the only one that showed no beetle kill. Mortality in the other trees was not satisfactory because a portion of the larvae fed in the outer bark rather than between the bark and the wood. He further reported that the presence of the poison increased the number of larvae that migrated from the cambium to the bark. He concluded that the method was not an efficient means of control.

Mr. Archie Gibson presented the results of his work with toxic oil sprays and emulsions which was begun in 1949. Various insecticides were used on standing and felled trees in order to destroy Douglas-fir beetle brood. The insecticides included water emulsions of ethylene dibromide and oil solutions of orthodiclorobenzene, trichlorobenzene, dichloroethyl ether and ethylene dibromide. Good results were obtained by all formulations but best results (98% - 100%) were obtained in felled trees. The oil solutions gave good results when applied at a rate of one gallon of spray to 40-100 sq. ft. of bark surface. However, emulsions had to be applied at approximately one gallon per 25 sq. ft. of bark surface. It was pointed out that the bark of the interior Douglas-fir employed in the experiments was 3/4" to 1 1/4" thick. Results with the much thicker bark of coastal Douglas-fir might be expected to differ.

Jim Kinghorn described his work with chemical control, which was begun in 1951. The results obtained appear in a recent issue of the Journal of Economic Entomology. Injections of systemic insecticides (Systox and concentrated Schradan) were ineffective. Work with penetrating oil sprays composed of ethylene dibromide, aldrin and heptachlor gave results similar to work conducted in the United States.

An interesting outcome of his studies with Trypodendron was the discovery that the Douglas-fir beetle was killed by the residual contact insecticides employed to prevent attacks by the pin hole borer. Dieldrin proved superior to lindane and DDT (in that order) in preventing attacks by the Douglas-fir beetle.

Art Moore has determined the relative toxicity of a number of promising insecticides against several insects. This study, designed to culminate in field trials after much basic information is compiled, will involve next an investigation of the physical state of deposits. This information remains to be determined for the Douglas-fir beetle. It was pointed out that one of the objectives of the study is to develop a means of preventing attacks. Application of the insecticide most probably would be by mist blower rather than airplane.

Salvage - logging of infested trees

Jim Evenden described the circumstances surrounding a "pilot plant" test of the effectiveness and cost of control by logging compared with ethylene dibromide spray in 1953 on the Coeur d'Alene N. F. in northern Idaho. Three contiguous side drainages were selected: one, of 1121 acres, was salvage logged; another, of 1821 acres, was sprayed; and a third, composing 380 acres, served as a check. Result:

	Infested Trees/AC. 1953	Infested Trees/AC. 1954	% Reduction
Check	.27	0	100
Oil Spray	.66	.13	80
Logged	.76	.05	93

It required an average of 11.8 gallons of spray per tree and the average treating cost per tree was $30.10. (These were later sold at $6.60/M.)

5,432 M bd. ft. was logged. This included trap trees and poor vigor trees as well as 1,500 M bd. ft. of non-host species. This volume was sold for $22.70/M.

The disappearance of damage in the check area points up a behavior characteristic of the beetle. The damage in any particular localized area often subsides rapidly or shifts to a new location after a few years. Also, it shows that while we tend to ascribe loss reduction to applied control the effect of natural control may readily be a greater one. Further studies of this sort should be replicated and an attempt should be made to examine the beetle population before, during, and after the test to evaluate the effect of natural control factors as much as possible.

Vaughn McCowan told of the efforts of the Weyerhauser Timber Company to salvage the windthrown and beetle-killed timber in Oregon. Salvage has been difficult because much of the timber is inaccessible at present.

However, measures have been taken to reduce the amount of damage occurring adjacent to road right of ways and windthrown areas. Wherever possible, right of way timber is removed from the woods before March of the year following infestation. If it is known in advance that this cannot be done, the right of way timber will be felled in the period from September to January, inclusive. Observations made in the course of biological studies indicate that brood success is quite low in timber felled and bucked during this period.

Indirect control

Prevention of Douglas-fir beetle damage through management practices is an ultimate goal. The reduction of western pine beetle loss by removal of high risk ponderosa pine trees in northeastern California has been such a development. But in the case of Douglas-fir, a similar method has not been perfected. One difficulty has been that the Douglas-fir beetle attacks groupwise which suggests a lack of preference for individual trees. However, those who are engaged in developing tree susceptibility classifications advance the theory that certain trees are the focal points for the group attacks which are characteristic of the insect.

Mr. J. A. Walters of Vernon, B. C., has developed a tree classification which he plans to test against freshly infested trees. The classification consists of a correlation of tree characteristics with growth rate and age.

Ralph Hall has applied the California risk rating system to Douglas-fir on seven 20-acre plots in the transition area where westside and eastside timber types join near Burney, California. Although the loss has tended to occur in trees rated as high risk, the loss record is not sufficient to enable a determination of the effectiveness of the method as yet. He mentioned that loss in the coast range, where the problem is more severe, has occurred in large groups which does not suggest any selection on the part of the beetle.

December 2, 9:45-12:00 B. H. Wilford, Discussion Leader

Bark Beetle Control by the Use of Trap Trees

In this discussion the term "trap trees" refers to trees or logs used as instruments or tools which attract and are attacked by large numbers of injurious forest insects for the subsequent destruction of those insects, thus reducing insect populations -- a means of insect control. These traps are felled, green host trees that may be used as a whole tree or may be cut into logs; or mechanically or chemically killed standing trees; or they may be chemically treated logs.

This controversial means of control was introduced with a very brief review of: its use abroad, especially in Europe; its early consideration by A. D. Hopkins for forest insect control in the United States; its early trials by Paul Keen in Regions 5 and 6; and an original trap-tree control program in northern California by the Weed Lumber Company in 1921-1924. The results of the latter were of doubtful efficiency (the traps apparently created group infestations).

Trap trees have been a controversial subject in the United States because of the occasions where the use of traps resulted in a bark beetle buildup or in no apparent reduction of an outbreak. However, trap trees have been utilized effectively in insect control. Although such effective use may have been local or regional, or otherwise specific, it has proved feasible. Still, it is a controversial matter; and as a working tool, trap trees must be approached with caution and used with consideration.

Fred Knight reviewed the earlier trap-tree work, in the 1941-1952 Engelmann spruce beetle outbreak in Colorado, initiated by Calvin Massey and carried further by Roy Nagel, Red McComb, and Fred. Fred explained his more recent studies which were undertaken in conjunction with large control jobs themselves, in mopup work on the 1941-1952 outbreak and through the entirety of the more recent 1953-1955 control job in southwestern Colorado. He said that trap trees continue as a promising means of spruce beetle control in Region 2. The use of traps, however, has been on a practical basis. Preliminary results in areas of moderate to heavy woodpecker activity indicate that: (1) 1 trap per 4 or 5 trees containing insects of the generation which attack the traps is sufficient; (2) the traps should be felled in groups in the shade; and (3) the groups should be placed at least at 1/2-mile intervals. Time of trap-tree felling is pretty much dependent on logging conditions which, as a general rule, dictate fall cutting.

Red McComb gave the results of his 1953-1955 studies and the status of trap-tree control as used in Region 1, where spruce stands as well as spruce beetle biology differ markedly from Region 2. The trap-tree method of control has not proved nearly so practical in Region 1 as in the central Rockies, but it needs continued study. The traps, as indicated by the data presented, pick up many attacking beetles. It appears that the proportion of traps per beetle-infested tree is greater than suggested as practical in Region 2. His tests have shown that trap-tree felling immediately prior to beetle flight will pick up the most adults. This is at variance with the indications in Region 2.

Doug Ross reported that in 1954 green spruce trees were laid down as traps in outbreak area in British Columbia. The traps absorbed attacking beetles and neighboring standing green spruce were not attacked.

Ken Wright and Bob Stevens in their respective regions (Pacific Northwest and California) have not had the opportunities to properly test and appraise trap trees in Douglas-fir beetle control. Ken elaborated on his observations and considerations of Douglas-fir beetle traps in the west side Douglas-fir type.

He reported that 3 years ago there was considerable agitation to embark upon a trap-tree program to control the Douglas-fir beetle in Oregon and

Washington. This was caused by reports of success with trap-tree logging in spruce beetle outbreak areas in Montana. Although it seemed reasonable that such logging drastically reduced the beetle population, there was no evaluation of actual accomplishments, no evaluation of green timber protection.

He stated that when the Douglas-fir beetle outbreak in western Oregon and Washington was at its height, a lot of thought was given to experimenting with trap trees. However, neither experimental or operational control by trap trees was attempted, because:

1. Without the basic information on flight and attack habits of the beetle, it was not known how to proceed. (Some basic information on attack habits now is known.)

2. The rugged terrain, size of the trees, and scarcity of roads in most of the Douglas-fir belt precluded the intensive work required in trap-tree felling and pickup. Usually a single road up the drainage bottom is the only access, and it seemed doubtful that traps along that road would have much effect on the beetles on the ridges. Further, it did not seem practical to fell and care for trap trees any great distance from that road.

3. The attack habits of the Douglas-fir beetle do not lend themselves to the trap-tree principle. Some of the heaviest attacks in green timber come in early or mid-summer from beetles that made their initial attack in windthrown trees in April and May. To time the removal of trap trees before the adults fly and make a second attack is far-fetched under actual logging conditions. If timing were not exact, more harm than good would result.

4. The peak of a Douglas-fir beetle infestation in west side stands rapidly follows a major disturbance and then drops out in a year or two. Usually the stands are full of red-tops and the bulk of the tree mortality has occurred before direct control could be started. Infestations in inland Douglas-fir stands, however, usually extend over several years and allow time for testing the effectiveness of a control method.

5. The scope of an experiment to evaluate trap trees for control is staggering. To have sufficient replication of treatment a number of drainages harboring comparable infestations would be needed. It is doubted that anything short of an all-out project involving a large appropriation of funds could accomplish much in evaluating the effectiveness of trap trees in Douglas-fir.

Ken further stated that the testing of trap trees in the Pacific Northwest has not been ruled out even though this method of control is viewed with pessimism. He would like to see the collected evidence for and against the advocating of traps in other regions sifted down to Region 6.

Bob Stevens reported that in Region 5 the subject of trap trees for Douglas-fir beetle control is in the discussion stage.

Royce Cox asked two questions (these are pertinent questions, and the objective of trap-tree studies and discussions):

1. Are trap trees practical?

2. If trap trees are practical, at what stage in an outbreak should they be used?

Mr. Cox expressed the probable feeling of others in the logging industry, namely, that they favor and will support continued research on trap trees if trap trees show any promise as a feasible means of bark beetle control.

Dr. Pierre Vitte gave us an account of trap trees in Europe. His description of their use there gave us an appreciation of the intensive management to which European forests are subjected. In Europe trap trees are only one means towards an end, and not the sole means.

Such is the case in our own country. We must consider traps, generally speaking, as one means of control, not the only means. Recommendations of trap trees for control cannot be general or all inclusive. Traps may be useful against one insect in one region, useless against the same insect in another region.

Even where now accepted as a means and a practical means of control, trap trees must be used with caution and discretion. Trap trees for control is still a controversial subject.

December 2, 1:00-3:20 J. A. Chapman, Discussion Leader

Factors Responsible for Population Fluctuations of the Douglas-Fir Beetle

(Participants: K. Wright, V. McCowan, K. Graham, L. McMullan, G. Hopping, G. Struble, A. Gibson, F. Knight)

This subject is important because attempts to control natural populations are dependent on knowledge of what is happening to these populations. Control may be unnecessary or useless. If control procedures are carried out, they are dependent in timing, type and extent on ideas of what is happening to the population. The subject is complex and difficult. Fluctuations, small or great, are characteristic of all natural populations. The problem of causes of animal population fluctuation has long been studied. Answers have been sought in terms of certain important species and attempts have been made to develop and formulate principles which are general in their application. The subject is receiving current attention from ecologists. There is still lack of agreement as to patterns of main causal factors, with some feeling that physical factors have a predominating influence and others who feel that biotic factors play the major roles, in keeping populations from attaining their theoretically possible growth over any given time period.

In Douglas-fir beetle populations, the host itself, the Douglas-fir tree, by no means plays an inert role. In considering population fluctuations of this insect, therefore, we have to deal with: (1) a complex of physical environmental factors; (2) a complex of biotic environmental factors; and (3) the variability in response of the host to beetle attacks, dependent itself on innate tree variability and the complex of environmental factors affecting the tree.

Discussion cnetered first on the Douglas-fir beetle and what is known and conjectured about causes of its population fluctuations. Following this there were summary discussions of population fluctuation causes in other important Dendroctonus species in western North America, the Engelmann spruce beetle, the western pine beetle and the mountain pine beetle.

Recent tremendous populations of the Douglas-fir beetle, and consequent heavy tree mortality, in west side forests of Washington and Oregon seemed clearly to follow widespread and heavy blow-down in preceding years (1949, 1950, and to a lesser estent 1952). Comparison, by a series of paired strip plots, between areas of heavy and light beetle losses showed no differences with respect to stand density, but clear differences in amount of blow-down. Aspect and increment were not correlated with beetle kill. Studies were made of slash produced by clear-cutting as a factor in beetle population changes. Heavy attacks typically occur in such slash, but beetle productivity is very low except where bark is very thick and along south and west edges of cut areas, where some shading occurs. Eggs are deposited following the heavy initial slash attacks, but very high brood mortality usually occurs, apparently due to drying of bark. Standing trees with heart or butt rot do not seem to be "preferred" by the beetles. Studies on relation of attacks to rainfall have showed lack of correlation for total rainfall. Late summer moisture appears to be important. Rainfall deficiencies have not been correlated with attack densities.

Studies in this area appear to support the following views of population fluctuations. Suitable brood material in large amounts is necessary for marked population increase. In this respect blow-down and right-of-way logs are important, but clear-cut slash is not productive as far as beetles are concerned. Productivity of beetles in attacked standing green trees is difficult to evaluate and is not known. Cold weather in spring after emergence, but before attacks are well-established, appears to be unfavorable for beetles. In southwestern Oregon, wind-throw was quite bad in 1952, and a considerable amount of tree killing was expected in 1953, but it did not materialize. During the spring of 1953, air temperatures rose to over 70° F. for a four-day period early in May, bringing the beetles out in large numbers. The temperature then dropped considerably, and cold, cloudy weather continued until the second week in July. This weather was apparently detrimental to the beetles seeking tree material or initiating attacks. Parasites (Celoides) and predators (particularly Clerids) may be important at times. Evidence indicates that the relative numbers and importance of these forms and of predaceous diptera larvae vary within single trees from butt to crown. The possibility that different strains of beetles may occur is suggested by the fact that gallery length progressively decreased during and following heavy beetle outbreaks as did size of beetles. In one series of samples, beetles taken in 1955 were only about half the size of those taken in 1952, a heavy epidemic year.

Studies have been carried out in west side Douglas-fir to try to establish a relationship between gallery length and number of eggs, in order to secure a simple figure, obtainable from a practical standpoint, upon which to base population forecasts in an area. So far around 10 eggs per inch have been fairly consistently found. It is felt that causes of mortality must not be emphasized to the neglect of measurement of final survival, which is after all the really important factor in population change.

In British Columbia, beetle populations show some differences depending on whether they are in the interior or coastal region. In the interior, logging slash appears to cause population build-up, and killing of standing trees frequently follows cessation of logging in an area. Wind-throw and winter injury also appear to be important factors in population increase. Studies have shown that mites may cause mortality of eggs and early larvae by up to 30 per cent. Presence of nematodes, both external and internal, has been correlated with rate of gallery construction and egg deposition. Ectoparasitic forms had no apparent affects. Endoparasitic nematodes appeared to cause up to 60 per cent reduction in rate of gallery construction and eggs laid per day. A start has been made on development of life tables for this species.

On the British Columbia coast Douglas-fir beetle populations are quite variable. Attacks usually begin earlier than in the interior but vary much in time depending on weather conditions. Attacks may be heavy following blow-downs, but sometimes occur in areas remote from logging or blow-down. Frequently there is good larval development but little final survival. Celoides and Clerids are lacking in some areas. Nematodes are frequently found within beetles, and mites, diptera, and birds are possibly important agents in causing population reduction under certain conditions. Recently, evidence was found of a polyhedral virus disease in this species. It was suggested that genetic variability in populations from year to year or place to place may operate on reproductive output, viability of different stages, etc., to cause differences in population level. There does not appear to be a correlation of beetle attacks with tree vigor. Some standing trees attacked are affected with root rot (Armallaria) and some are not. Nutritional conditions within trees and competition with other bark feeding insects were both suggested as factors having a role in determining population levels.

Woodpeckers have occasionally been noticed working on trees attacked by the Douglas-fir beetle, but they appear to work mostly above the main brood area. It was generally felt that they are a very minor factor in affecting populations of this species, mainly due to the thick bark of Douglas-fir.

Discussion of factors affecting populations of the mountain pine beetle, western pine beetle and Engelmann spruce beetle brought out the following points.

Winter mortality is a very significant factor in population reduction at times. Various Dendroctonus species show much tolerance, both as larvae and adults, to low temperatures, and evidence indicates that unseasonable cold, or early warming followed by return of intense cold, is important rather than low temperatures as such. The make-up and condition of stands in terms of diameter and age distribution, etc., affects beetle populations in that distribution of mass attacks is certainly influenced by nature of stand. Considerable egg mortality is present at times. Overcrowding, parasites and predators may be important population control factors. Thickness of bark affects parasites and woodpecker work. Tremendous variation may occur in mortality attributable to different biological factors in different areas. Studies with the western pine beetle have indicated that over 20,000 square feet of bark would be needed to provide an adequate sample on which to base conclusions as to bark populations. Productivity of beetles by a given tree is affected by various factors in the tree including presence or absence of top attacks by other species of beetles.

Woodpeckers frequently cause considerable mortality in mountain pine and Engelmann spruce beetle populations. Nematodes may cause large reductions in eggs produced in the latter species, but parasitism by Celoides appears to be very low in general. Condition of the tree does not seem to be an important factor in this species either.

A disconcerting but quite relevant and important consideration was introduced during another discussion period, namely that the large amount of work on various phases of western pine beetle mortality has failed to show any correlation between population estimates and subsequent tree mortality in a given area. Therefore, even if populations in bark could be adequately sampled, and mortality there determined, a large gap would still exist in knowledge necessary for predicting attacks. This gap is largely due to lack of information on post-emergence, pre-attack adults. Although it is extremely difficult to secure information on the adults between the time they leave the brood logs and the time they select and successfully attack other trees, radioactive tracer tagging of adult Engelmann spruce beetles is providing some important data on beetles at this stage of adult life.

In conclusion, it may be stated that almost every factor known to influence Douglas-fir beetle mortality needs further investigation. Study of the adult stage is beset with tremendous physical difficulties, but is very important. Studies on brood development and mortality are relatively much easier because of the record left by larval activity within bark. Careful investigations of the roles played by weather in beetle and tree ecology are needed. We are far from being able to accurately forecast population trends, but some workers are faced with decisions to be made concerning trees or stands in relation to beetle killing, and so there is need for rule-of-thumb methods which can result in at least intelligent guesses as to population changes. In this connection, it is certain that right-of-way logs and wind-falls are potential sources of population increase and must be carefully watched and treated in some way, if necessary. Number of trees killed from year to year, though lagging the actual beetle population changes, is a useful study tool. Nutritional requirements of the beetles must not be ignored for they may shed light on variability of brood success in different trees. In this respect more work is needed on the subject of beetle tree preference and its causes. Because of the complexity of the subject and the time necessary to secure needed data, it is fairly clear that study programs on the Douglas-fir beetle should have good continuity. Finally, it should be emphasized that studies at low as well as high population densities are needed.

December 2, 3:35-5:00 P. C. Johnson, Leader

Kodachrome Slide Session

This period in the program was set aside for showing kodachrome slides. This practice gave conference members an opportunity to see some very good illustrations of the insects and problems being discussed, but avoided the necessity of taking time from the regular discussions to make preparation for slide projection.

December 3, 8:30-10:00 J. M. Kinghorn, Discussion Leader

Current Life History Studies on the Douglas-Fir Beetle

The first topic discussed in this session was the general life history pattern of the Douglas-fir beetle in the coastal and inland regions of the Pacific Northwest. Wright outlined the seasonal developments for the coastal area and McMullen reviewed the results from studies in the Interior of British Columbia.

Wright stated that initial spring flight occurs earlier on the coast than in the Inland Empire. Coastal flights usually occur in May, although the time depends on the occurrence of the first hot weather period of spring. Incubation period of the eggs is about 10-15 days. Development is sometimes delayed for several weeks by cold weather, but usually the broods reach maturity in about 6 weeks so that mature larvae and pupae are produced by early July. Four larval instars have been recorded.

The second brood resulting from re-attack of parent adults is highly variable in size and timing. Wright pointed out that instances have been observed where parent adults have completed a short first gallery and have commenced the second brood gallery in as brief a period as ten days. Most beetles overwinter as adults, including some from the second brood.

McMullen reported that in the interior, one generation and two broods also occurred, but second brood beetles overwinter as partly developed larvae.

Spring flight occurs later than on the coast and lasts more or less seven weeks. The flight peak occurs shortly after the commencement of spring activity. Eggs of the second brood occur up to mid-August, and in a few cases as late as September. Four instars, based on 2500 head capsule measurements, were reported. Second broods are smaller than the first brood. Some adults emerge in autumn following a long, warm summer. Multiple emergence has been observed; as many as 3.5 beetles per exit hole were noted.

Stevens stated that preliminary studies in northern California indicate that the seasonal history of the beetle is similar to that in coastal Washington and Oregon. Gibson mentioned that rates of development in the Inland Empire coincide with those in the Interior of British Columbia.

In the duscussion that followed, several interesting points were brought out by McCowan, Rudinsky, Wright and Allen:

(1) Size of brood varies considerably and frequently depends on exposure of the trees or logs.

(2) From 125 to 150 eggs per adult gallery were reported for attacks in the coastal region.

(3) During cool seasons, it is often difficult to delineate first and second attack period because broods become so overlapped.

(4) On the coast, the second attack sometimes kills green standing trees, but more often these beetles attack slash, blowdown and standing trees infested with, but not fully occupied by beetles of the first brood. Both adult and larval galleries of the second broods are shorter, and the general vigor of the progeny seems poorer than first brood beetles. Second brood attacks extend over a considerable length of time.

(5) Abandoned attacks were reported to occur frequently at times, and appeared to depend mostly on the condition of the host.

(6) The general vigor of Douglas-fir beetle populations have been observed to vary from year to year. Towards the termination of a population flare-up, the size of parent adults, the gallery lengths, and the size of the progeny seem to markedly, although unexplainably, decrease. It was noted that the individuals of the second brood of _Dendroctonus brevicomis_ are smaller than those of the first brood.

Chapman described current studies of the reporductive system of _Trypodendron_, including a method for determining the physiological age of adult beetles. The technique provides a useful tool for estimating the parent and teneral adult composition of a beetle population. Results from this work indicate that at least some _Trypodendron_ live for more than one season.

In a discussion of rearing techniques, McMullen described attempts to rear D. pseudotsugae larvae. Larvae were placed in increment borer holes and chisel slits cut into the inner bark; incisions were sealed with wax. Better results were obtained with these methods than by attempts to rear larvae on an artificial medium containing ground inner bark and nutrient agar. Struble described a successful method of rearing bark beetle larvae several years ago in California. Each larva was introduced into a small glass tube tightly packed with strips of inner bark. In general, rearing techniques have not been developed to the degree where they are conveniently useful for determining larval development stages.

December 3, 10:15-11:15

Summary of Conference

Each discussion leader gave a brief summary of his session.

December 3, 11:15-12:15

Final Business Meeting

The meeting came to order at 11:15 in the Blue Room, Hotel Spokane, with Mr. R. L. Furniss in the chair.

The chairman called on Mr. D. E. Gray, Ottawa, for a few comments on the session. Mr. Gray commented on how effective the informal nature of the conference had been. He had found the meetings very stimulating and enlightening but was sorry to see that arrangements for a joint meeting with the pathologists had not materialized.

Dr. B. M. McGugan, Ottawa, commented that the conference seemed to have achieved that delicate balance between formality and informality, retaining the advantages of both. He commended the recommendation to maintain annual meetings.

Mr. J. W. Bongberg, Washington, felt that this had been a very excellent meeting. He understood there was some concern over holding meetings annually but his impressions were that these concerns should have been dispelled by this meeting.

The Secretary presented the report of the committee on annual meetings in the form of a memorandum (appendix A).

Moved by R. R. Lejeune, seconded by J. M. Whiteside
that the secretary be instructed to forward the memorandum to the senior active members of the conference in each institution or agency, outlining the views of the conference on the frequency of meetings.
\- Carried.

The Secretary presented the changes recommended by the committee on the constitution and rules of procedure, namely that:

1. Section (2) and section (3) of Article IV be designated section (3) and section (4) of Article IV.
2. The following section be designated Section (2) of Article IV, namely: (2) An Immediate Past Chairman; who shall assume office immediately upon retiring as chairman, without further election; whose duties shall be to fill the chair at any meeting in the absence of the chairman; to act until the election of a new chairman.

The following to be added to Article IV.

3. The chairman shall have the power to appoint members to fill vacancies on the Executive Committee occurring between meetings. The appointment to stand until December 31st following the next general meeting.
4. It is the responsibility of a counselor, should he be unable to attend an executive meeting, to appoint an alternate to attend the executive meeting and to advise the chairman in writing accordingly. The alternate shall have full voting privileges at the meeting to which he is designated. Moved by W. F. Barr, seconded by B. H. Wilford that these changes be approved.

- Carried.

B. H. Wilford gave the report of the Surveys Committee. They commended Mr. T. T. Terrell on his handling of the first session, especially the use of a unified map with all major outbreaks indicated.

They recommend that:

1. The same style of reporting forest insect conditions by regions (insect name, principal host, and current conditions and trend) be continued.
2. The paper used in reporting be uniform in size, namely, 8 1/2" by 11".
3. The individual reports be analyzed, summarized, and presented by one conference member. *
4. An outline map of western United States, western Canada, and Alaska be used*. This map, approximately 4' X 6', to show the states in light outline, the U. S. Forest Service Regions, the provinces and Alaska in heavy outline. The map for the 8th Annual Conference will be prepared by the Fort Collins Laboratory. Overlays to show insect outbreak and control areas may be used.
5. After the overall presentation has been made, the subject of insect conditions be open for further presentations and discussions by the conference members but held in bounds and terminated by the review assignee.

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* Following T. T. Terrell's precedence at the 7th Annual Conference.

6. Any time in excess of that consumed by the review and discussions, be allotted to the next subject on the program or to whatever subject the conference chairman decides.

In the absence of the chairman, P. Keen, W. F. Barr presented the report of the Common Names Committee. He reviewed the work of the committee leading up to the form lists which were distributed to the members prior to the Conference. He advised the conference that the Common Names Committee of the Entomological Society of America had stated that they will forward all nominations they receive for common names of western forest insects to this committee for screening. He pointed out that the committee was a clearing house and sounding board and should not take indiscriminate action. He presented the proposed rules of procedure for the Common Names Committee (Appendix B).
Moved by P. C. Johnson, seconded by H. R. Dodge that the rules of procedure as presented be adopted. - Carried.

R. R. Lejeune reported for the committee on Meetings.

The committee agreed to accept the Fort Collins offer if a joint meeting with the Western International Forest Pathology Conference could be arranged. There was a strong sentiment in favour of holding the next conference in Canada since it had only once been held there previously, in Victoria in 1952. When it became impossible to arrange a joint meeting, the committee recommended that:

1. the 1956 conference be held in Calgary, Alberta.
2. G. R. Hopping be appointed program committee chairman.
3. the conference be held in mid-November, on a Wednesday, Thursday and Friday.

R. C. Hall moved and G. R. Struble seconded that the recommendation be accepted. - Carried.

The committee suggested to the new program committee chairman that the lodgepole needle miner or the tent caterpillar might be suitable topics for the 1956 conference. He reported that the general feeling of the pathology conference was that the two groups should try to meet every second year in a central area and spend the other year independently in the fringe area.

Before presenting the recommendations of the nominating committee R. W. Stark moved a vote of thanks to M. G. Thomson for his efforts on the Conference's behalf as Secretary-Treasurer.

The following slate of officers was presented:

Chairman - M. G. Thomson
Secretary-Treasurer - A. D. Moore
1956-1958 Counselor - D. E. Parker

The chairman called for nominations from the floor.

Moved by R. W. Stark, seconded by K. Graham that the recommendations of the nominations committee be accepted and the individuals be appointed to the offices to which they had been nominated. - Carried.

The chairman extended a vote of thanks on behalf of the Conference to W. F. Barr and his committee for their handling of the conference.

R. L. Furniss introduced M. G. Thomson as the chairman-elect.

The meeting was adjourned at 12:15.

APPENDEX A

MEMORANDUM

To: Members of the Western Forest Insect Work Conference

From: M. G. Thomson, Secretary-Treasurer

Subject: Policy on General Meetings

The executive was asked by several members to consider the need for continuing the Work Conference on an annual basis. After serious discussion the executive came around to the unanimous decision that it was highly desirable for the Conference to continue annually for the reasons mentioned below. This decision was supported by the Conference as a whole in the General Meeting.

1. Holding the sessions in the various regions of the Conference area tends to influence the numbers attending from any given region.

2. The current policy of restricting the discussion to one survey and one research problem at each session and to examine these problems in detail at the project level, will influence the number of members wishing to attend any particular session.

3. It is felt that if the sessions were held at longer than one year intervals, interest in the Conference would decrease rapidly amongst those attending regularly and even more so amongst those currently attending less frequently, particularly in view of the possible reduction in attendance.

4. The great number of problems facing western forest entomologists and the time limitations of the sessions means that the same subject is not likely to be reviewed again for quite an extended period unless changing conditions warrant it. The urgency of some of these problems support the view that the sessions should be held annually.

5. The accelerated research programme of the various institutions and agencies forming part of the Conference make it highly desirable that those members actively engaged in project work meet frequently to stimulate new concepts, to challenge critically those concepts currently being held in various regions and to compare methods and techniques.

6. The rapid change in the status of forest insects makes it highly desirable to review conditions on a Conference wide basis. An example: in 1954 the Pine butterfly caused severe damage to stands for the first time in Region 4. Conference members were very interested in details of this outbreak. In 1955 the problem has dropped to a minor one.

Spokane, Washington.
December 3, 1955.

APPENDIX B

Recommendations of the Common Names Committee (WFIWC)

1. That the Common Names Committee of the Western Forest Insect Work Conference be a standing committee of seven members appointed for an indefinite term by the chairman.

2. That members of the Conference submit all proposed changes in the list of names approved by the Entomological Society of America through the Common Names Committee (WFIWC), and that such changes be kept to a minimum.

3. That members of the Conference likewise submit all proposed new names through the Common Names Committee (WFIWC).

4. That a two-thirds majority of the Common Names Committee (WFIWC) constitute approval.

5. That lists of Committee-approved names will be submitted annually to the membership at large before November 1. Names not objected to by December 31 will be referred to the ESA Common Names Committee for action. Names receiving objections will be reconsidered by the Common Names Committee (WFIWC).

6. That current lists of approved and unapproved common names will be maintained and submitted to the members as needed.

7. That eastern committees on common names of forest insects be urged.

8. That comments on List Number 2 be considered through January 15, 1956.

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