FOREST INSECT SURVEYS

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Probably no single phase of entomological activities offers a wider field for variety in object and methods than surveys, for each survey must vary according to its size, purpose, and the circumstances governing it. This paper deals in general with the Forest Insect Survey in which we are presently engaged in Canada and specifically with its operation in British Columbia.

The Forest Insect Survey in Canada had its inception in 1935 when an organized attempt was made to keep an annual check on the spread and distribution of the European spruce sawfly in Eastern Canada. Since that time the survey has expanded in size and purpose and today it operates from Newfoundland to British Columbia. No longer restricted to the recording of species distribution and insect outbreaks, it now includes within its function general ecological consideration of our forest insect populations. In brief, its objects may be outlined as follows: to report annually on the fluctuations of insect populations encountered in the forest on a scale sufficiently broad to be representative of the entire forest area; to amass records as complete as possible on parasites and their hosts; to follow the course of disease of insects, particularly of those species known to be our more important forest destroyers; to locate incipient outbreaks as early as possible; to locate and, if possible, control any newly arrived foreign pest before serious damage or dispersal has occurred; to provide information on life histories, habits and identification of immature forms and to gather such specialized data as may be vital to some specific research undertaking. Within the last year the survey has expanded to include the procuring of data relative to certain specific tree diseases.

In its immediate application the survey provides information on the current status of forest insects over specific areas, permitting those concerned to take such action as may be expedient to prevent or reduce possible losses. On a long-term basis the survey provides much important data for specialized projects and points up many problems requiring intensive study. It is therefore as much a tool to the service as it is an end in itself.

In the operation of a continent-wide survey, methods and procedures must fit local conditions and hence no one standard method can be applied. In the beginning the survey was primarily qualitative in nature. The general method of sampling the insect population on a tree was to spread a sheet of standard size on the ground below the tree and to strike the limbs above with a pole of standard length. Dislodged larvae fell to the sheet, were collected, placed in a mailing container with food and a completed enclosure slip, and mailed to a regional laboratory for identification and rearing. Data from such collections were quantitative only in a very gross way. Although referred to as the earliest method of sampling, it is still used quite widely in random sampling for defoliators over extensive and remote regions. As the value and application of survey data became evident, new and specialized sampling methods were developed to meet peculiar requirements and situations. In many areas, sampling is now being done on permanent sample plots selected as representative of the forest stand of the region. Sampling from the same plot may be done three or four times a season. The use of plots has been developed on a rather restricted basis pending a thorough appraisal of the relative merits of random observations in contrast with similar data derived from representative plots. Work of this nature is possible only in areas readily accessible, free from cutting and with assurance of a degree of permanency. Another sampling method has been the cutting of measured branches or twig samples and recording the number of larvae present. Collecting moss for egg counts

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and sampling of the forest floor for hibernating insects are other special methods employed.

Probably the greatest difficulty in sampling for defoliators on the west coast is the size and height of trees and the impossibility of reaching up the bole even a short distance. In an effort to cope with this problem, research of recent years suggests the practical application of the collection and measurement of frass fall from the feeding population. In this procedure, portable canvas trays are established below representative trees in the area concerned and through the accumulation of frass over a definite period correlated with the increase in body weight of the larvae in the same period, an index of the feeding population is obtained.

Although the survey is still in its early development we have learned much from it, but no doubt its greatest value will be evident in the future as more data are amassed. Illustrative of this is the relationship of one species of insect to another in the chronological sequence in their cyclic recurrence. There is reason to believe that during the general population increase of defoliators in the west, the build-up of the various species may follow a fairly definite pattern. In other words the increase of a certain species may presage the later rise in population of another and perhaps more important species. If and when increased knowledge permits an accurate prediction of events before they happen we will have passed an important milestone on the way toward coping with our forest insect problems.

With the extension of random surveys, however, a point of diminishing return is eventually reached when successively less new information is obtained for equal expenditure of effort. More and more attention is now being directed to selected problems to provide more critical information on population trends, control factors, and damage caused by infestations. In the West, such work has centred about the western hemlock looper and bark beetles.

Since major outbreaks such as the hemlock looper occur at intervals of 12 or 15 years, opportunities are infrequent for the study of events in the insect complex that lead up to such outbreaks. We are, in fact, only beginning to accumulate data relative to such phenomena. The early records of insect outbreaks were for the most part very general in nature, concerned only with the species responsible for the damage and restricted to the one or two years when the insect was most prevalent. While probably quite adequate at that time, these early records give little historical or scientific background information with respect to the rise and fall of the outbreak. The inclusion of data on the associated species of no apparent importance was obviously impossible with the limited personnel employed in the early days of entomology in this country.

The survey in which we are engaged places equal emphasis on insects whether they be of minor or major importance economically. Knowledge of these so-called minor associates may eventually supply the key to long term predictions of population trends of other pests: to an understanding of the survival of parasites during periods of low population of its preferred host, or the zoning of the forest for possible distribution of certain major pests. One might speculate at great length on future possibilities of such work. Since important outbreaks recur but a few times in the life of any worker, few workers today will live to realize the full significance or value of such surveys. Our successors will benefit from the fuller, deeper understanding that must accrue from long-term, intense surveys.

With this general review of the survey, mention should now be made of something of the mechanics of its operation. The sampling of insects, the establishment of plots, mapping, reporting and the many phases of work in the field are handled by a specially trained non-technical staff of insect rangers. An important requirement in field work is familiarity of the particular region concerned, the

forests of that area, personnel engaged by either the Forest Service or industry, methods of travel, etc. Permanence of staff is therefore essential to give continuity from year to year and to produce maximum efficiency. For these and other reasons a ranger staff as mentioned is considered best. Rangers are chosen with great care since it is exacting work requiring a man of very special temperament. There are nineteen rangers employed in British Columbia.

The British Columbia coast does not lend itself to easy survey methods due to the almost total lack of roads. With approximately 7,000 miles of shore line, many parts cannot be reached more frequently than once in two years. It has become evident to many of the larger operators that regular sampling can be achieved only if their personnel in that area assist. Arrangements have been made in several regions whereby the companies concerned conduct periodic sampling throughout the year on plots originally established in co-operation with the Forest Insect Laboratory.

Associated with the field staff of rangers is the professional staff at the laboratory who receive, identify, and rear the living larvae through to the completion of their life cycle from which final records are compiled. Specialized rearings and studies of certain specific groups of insects are undertaken by the laboratory personnel for life-history studies, parasite and disease work, taxonomic data or other related problems.

Directing all survey activities both in the field and in the laboratory is the survey head for the province. He must be a combined forester, entomologist, and ecologist. Through him the work of the ranger staff is organized on a sound scientific basis. Current reports are analyzed for their significance and the work of the survey is co-ordinated with the research staff. Thus the survey not only supplies information on abundance, distribution, etc., but it also yields valuable data for those undertaking special research investigations.

In order to achieve continuity throughout the service, to promote a maximum of efficiency, and to unify procedures and methods, the Canada-wide survey is headed by a divisional survey co-ordinator. The over-all efficient operation of the survey and the development of specialists needed in its operation at the various centres are his responsibilities.

During a typical year the survey in British Columbia handles some 25,000 individual rearings which, in turn, entail a similar number of separate rearing sheets, each record containing the pertinent insectary and field data. A periodic analysis of so large a volume of records, if done manually, would be impossible without a greatly expanded staff. To cope with this a standard punch-card system of recording was established across Canada in 1952.

Henceforth all information, including the identity of the insect, will be coded and punched on the cards. The mechanical sorter can handle 400 cards per minute, sorting for as many as 12 columns simultaneously. Hence it will be possible to draw out information as required with a minimum of effort and time for as many years as one may wish. The installation of this equipment in all main survey centres across Canada and the development of a standard punch card and field record sheet constitute an important step in rounding out an adequate forest insect survey, for unless the information is readily usable its recording would seem futile at the outset.

Almost synonymous with surveys is the problem of population sampling. The development of surveys in Canada and the United States and the application of these data to specific problems and research projects call first for a study of the basic problem of population sampling. Obviously it will be many years before techniques of known value capable of being used by non-specialists can be developed for each important insect. In the meantime methods purely empirical in nature must be employed which in many cases are of doubtful significance. As qualified investigators develop the field of sampling techniques so may we expect advancement in the field of insect surveys.