

FIDS REPORT 84-2  
SURVEYS AND ACTIONS TO COMBAT  
SPREAD AND ESTABLISHMENT OF  
EUROPEAN PINE SHOOT MOTH IN BRITISH COLUMBIA  
1926 - 1982

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## TABLE OF CONTENTS

ABSTRACT	1
INTRODUCTION	2
DESCRIPTION AND HOSTS	2
SURVEYS AND REGULATIONS	2
CONTROL REGULATIONS	5
FIELD STUDIES	5
PARASITES	6
PHEROMONE TRAPPING	8
DISCUSSION	9
REFERENCES	10



INTRODUCTION

The European shoot moth, *Dioryctes abietis* (Schiff.), is native to Europe and was introduced to North America in the early 1900s. The first Canadian report of the shoot moth was in Toronto in 1915 on pine spruce. Further examination by the Ontario Department of Agriculture and Forestry led to

**Abstract**

Surveys conducted to determine the distribution and infestation intensities of European pine shoot moth in British Columbia since its introduction from Europe in 1925 are reviewed. Regulations on the movement of pines within the Province were imposed in 1968 following evidence of increased dispersal. With the apparently low susceptibility of native pines to infestation in the interior climate and the difficulty in monitoring movement of ornamental stock, the regulations were repealed in 1981.

DESCRIPTION AND HOSTS

Adults are orange-brown with silvery markings on the forewings. Hind wings are grey. Young black-headed brown larvae mine the buds in the fall, where they overwinter. In the spring the dark brown larvae feed within the shoots until late May or June when they pupate and become adults. Affected trees develop stunted, crooked, forked or bushy tops but are seldom killed.

Ornamental two- and three-needle pines, such as Scotch, Mugo, Austrian, and Red pine are most susceptible. The native single-needle lodgepole pine and ponderosa pine with the two-needle western white pine are also susceptible.

SURVEYS AND REGULATIONS

From 1925 to 1950, surveys were conducted in British Columbia and Alberta. In 1925, a survey was conducted in the Kootenai region in southern British Columbia. The general pattern in 1925 was similar to that in 1926, with most infestation in the Kootenai region.

Following this recommendation, the Forest Insect and Disease Survey initiated surveys in 1950 in Vancouver and Victoria. In 1950, surveys in Vancouver and Victoria were extensive and showed that the shoot moth was present in both cities. The survey was expanded to other areas in 1951 and 1952.

## INTRODUCTION

The European pine shoot moth, Rhyacionia buoliana (Schiff.) is native to Europe and was introduced to North America in the early 1900s. The first Canadian authentication of the shoot moth was at Toronto in 1925 on pines imported from Holland. Further examinations by the Ontario Department of Agriculture and a national alert to Agriculture Canada resulted in populations being found at six locations in Ontario and at a nursery in Victoria, British Columbia (McLaine 1925).

In 1938, an outbreak was discovered in Vancouver on native lodgepole pines set out as ornamentals in a newly developed residential section of South Vancouver encompassing several city blocks (Mathers 1938). The Canadian Department of Agriculture undertook an eradication program in 1939, which destroyed 88 infested trees. Infested shoots on the trees were clipped and burned and the trees sprayed with arsenate of lead or nicotine sulphate. The area was re-examined in 1941 and infested shoots found at two locations were destroyed. The subsequent surveys, attempted controls and natural controls factors are reviewed in this report.

## DESCRIPTION AND HOSTS

Adults are orange-brown with silvery markings on the forewings, hind wings are grey. Young blackheaded brown larvae mine the buds in the fall, where they overwinter. In the spring the dark brown larvae feed within the shoots until late May or June when they pupate and become adults. Attacked trees develop spiked, crooked, forked or bushy tops but are seldom killed.

Ornamental two- and three-needle pines, such as Scots, Mugo, Austrian, and red pine are most susceptible. The native pines, lodgepole and ponderosa, along with the five-needle pines, are relatively resistant.

## SURVEYS AND REGULATIONS

Until 1960, known distribution in British Columbia was Vancouver and southern Vancouver Island. In 1960 a strong recommendation was made at a work conference of the Northwest Forest Pest Action Council for prompt action to determine the extent and area of pine shoot moth infestation in the Pacific Northwest (Kolbe 1960).

Following this recommendation, the Forest Insect and Disease Survey initiated surveys in 1960 in Vancouver and Victoria. Exotic and native pines in nurseries and planted situations were examined to determine intensity and distribution of pine shoot moth. From 1963 to 1965, the survey was expanded to towns and cities from Victoria north

to Courtenay on Vancouver Island, from Vancouver to Boston Bar in the Fraser Valley, Osoyoos to Vernon in the Okanagan Valley, Sicamous to Kamloops in the Shuswap area and from Grand Forks to Creston in the Kootenays. In the smaller towns and cities, a door to door examination of all residential properties was made for infested pines. Infested shoots were either clipped and burned or sent to Vernon or Victoria laboratories for research.

From 1960 to 1962 little damage was found on pines examined at nurseries or in planted landscaped locations in Coastal and Interior areas (Table 1). From 1963 to 1966, with increased examinations of residential shrubs and trees, there was evidence of increasing populations in the Coastal areas. In the Interior, 30 infested trees imported in 1963 and supplied by nurseries in the Kelowna-Penticton area, were located and infested shoots were clipped and burned. In 1964 and 1965, surveys detected less than 4 trees each year. A significant record in 1963 was a pine shoot moth female reared from a mature ponderosa pine collection from Summerland Experimental Station.

TABLE 1. Number of locations where infested pines were found from 1960 to 1966 in British Columbia.

Location	1960	1961	1962	1963	1964	1965	1966
Vancouver Island	0	0	0	8	16	26	16
Vancouver	0	0	0	37	36	64	515
Interior	0	2	1	30	1	2	3

In 1965 and 1966, in cooperation with Plant Protection Division, Agriculture Canada, a more intensive survey was undertaken to determine distribution and to appraise the actual potential hazard to natural stands. After 1966, the shoot moth survey on the coast was curtailed, as the insect was already well established. Surveys continued in the Interior, although after 1966 examinations were restricted to nurseries and plantations.

Naturally growing native pines were examined after 1965 in the Vancouver-Fraser Valley and in the Interior, but no evidence of shoot moth was found. By 1966, it was evident in the Coastal areas and particularly in Vancouver that the shoot moth was well established and control was no longer feasible. However in the Interior it was felt that control was possible if surveys of nursery stock and pine plantations were maintained and control efforts continued. In 1968, with the restrictions on the movement of pines imposed by B.C. Ministry



of Agriculture, pines leaving Vancouver areas had to be inspected and certified free of shoot moth before entering southern interior British Columbia.

In 1968, restrictions on the movement of pines out of the Vancouver Forest Region were imposed by the Provincial Department of Agriculture to prevent the shipment of pines from Vancouver to the Interior of British Columbia and the Prairie Provinces; movement of pines was permitted within the Vancouver area.

In 1972, a shipment of infested Austrian and Mugo pines from Vancouver was discovered at a retail outlet in Kelowna by Plant Protection, Agriculture Canada. Some trees had been sold; all but 20 trees were traced and destroyed.

In 1974, Plant Protection officers detected an infestation of shoot moth on 150 Mugo pines planted in 1968 at the Hugh Keenlyside Dam near Castlegar. Infested shoots were clipped and burned. A few infested shoots were found on native ponderosa pine nearby but the vigorous growth of the shoots and heavy sap flow appeared to have drowned out most of the larvae. In 1975, six European pine shoot moth were found in the planted stock and the branches were clipped and burned and the shrubs sprayed with Cygon. Subsequent checks by FIDS from 1976 to 1980 were negative.

In 1976, high populations were found by the Forest Insect and Disease Survey in Kelowna and Vernon areas in city parks, recreation centres, college grounds and at 33 private residences. Following these discoveries, representatives of Agriculture Canada, Canadian Forestry Service, the B.C. Ministry of Agriculture and the B.C. Ministry of Forests formed a subcommittee to the Plant Protection Advisory Council through which a cooperative survey for the detection and control of pine shoot moth could be conducted. Agriculture Canada was responsible for detection of shoot moth in nurseries. Detection, clipping and burning of infested shoots in residential areas was conducted by a B.C. Ministry of Forests crew and the B.C. Ministry of Agriculture was responsible for three spray applications of Dimethoate at two-week intervals at locations where shoot moth had been detected. The Forest Insect and Disease Survey of the Canadian Forestry Service was responsible for pest identification and instruction of the student detection crews on shoot moth recognition, life history, habits and damage. These arrangements continued in annual surveys conducted until 1980.

During the outbreak in the Okanagan, which was monitored from 1976 to 1980 (Table 2), there was a consistent population in Kelowna and sporadic populations in surrounding towns and in Kamloops, even though control action was undertaken.



TABLE 2. Number of locations where infested pines were found, Kamloops Forest Region, 1976-1980.

Location	1976	1977	1978	1979	1980
Summerland	-	-	-	17	3
Kelowna	40	39	30	41	40
Peachland	-	-	3	-	-
Westbank	-	-	3	-	-
Vernon	10	-	-	-	14
Kamloops	-	21	15	2	1
TOTAL	50	60	51	60	58

Many infested shoots remained undetected each year despite two or more examinations of infested areas. The clipping and burning of infested shoots and spraying of infested trees failed to control the population.

#### Control regulations

The introduction and distribution of European pine shoot moth has not been halted, despite regulations imposed on importation of seedlings into Canada and from other provinces into British Columbia (Agriculture Canada Plant Quarantine Act, 1976) and within areas of British Columbia (B.C. Dept. of Agriculture Plant Protection Act, 1968, 1972, 1974, 1975, 1977). The history of outbreaks and regulations in British Columbia was reviewed and on June 18, 1981 the regulations limiting movement of pines were repealed.

#### Field studies

In 1966 and 1967, two experiments were carried out in Vernon by the Forest Insect and Disease Survey. In the first, mated shoot moths, from pupae collected in Vancouver, were placed in sleeve cages on mature ponderosa pine branches. Some larvae became established in the twigs and the sleeves were removed for the winter hibernating period. Twenty-one larvae overwintered successfully on the caged trees and branches.

In the second experiment, five Coddling moth traps, each baited with five living virgin female shoot moths, were set up in two natural

ponderosa pine stands near Kelowna. The traps were examined at five- to seven-day intervals and replenished with sugar solution and newly emerged moths. No male moths were attracted to the traps (Ross 1967).

After monitoring the outbreak of the Hugh Keenlyside Dam site where shoot moth had been found on native and exotic pine, it was concluded that because of the heavy exudation of pitch in attacked shoots, there was little danger of the pine shoot moth becoming established on ponderosa pine (Evans 1975).

Experiments with caged female shoot moths to determine the susceptibility of 1-0 lodgepole pine to attack, revealed that caged females would oviposit on 1-0 seedlings and showed no preference for coast or interior varieties grown under similar circumstances (Evans 1973).

An experiment to determine if pine shoot moth larvae could overwinter in cut Christmas trees concluded that larvae could overwinter in coastal or southern Interior conditions (Evans 1973).

### Parasites

A review of pine shoot moth collections in British Columbia shows numerous parasites (Table 3). Frequency of parasitism from a 14-larvae collection from Vancouver in 1956 shows 14% parasitism; 227 and 355 larvae collections from Vancouver in 1971 shows 6 and 35% parasitism, respectively.

There are no records of introduced parasites in British Columbia; however, in Ontario the "effects of native and introduced parasites generally have been negligible" (Pree 1971).

"Other natural control agents attacking or capable of attacking shoot moth are: Bacillus thuringiensis (Berliner) Pointing and the fungus Paecilomyces farinosus (Dix. ex Fr.)". (Pree 1971).

TABLE 3. Parasites of European pine shoot moth recovered from rearings at PFRC, 1956-1976.

Parasite	Location	Years	No. of larvae	% Affected
<u>Exeristes comstockii</u>	Vancouver	1971, 1976	227	6
	Chilliwack	1975	-	-
<u>Itoplectis conquistor</u>	Chilliwack	1975	-	-
<u>I. evetriae</u>	Kelowna	1975	-	-
<u>I. quadracinquilata</u>	Vancouver	1971	355	35
<u>Orgilus obscurator</u>	Victoria	1963, 1964, 1965	-	-
	Vancouver	1976	-	-
<u>Perilampus tristis</u>	Vancouver	1956	14	14
<u>Scambus</u> sp.	Penticton	1971	-	-
<u>S. hispae</u>	Vancouver	1971	-	-
<u>S. transgressus</u>	Vancouver	1970	-	-

Pheromone Trapping

Pheromone-baited traps, used to monitor adult male shoot moths, were unsuccessful in attracting the insects in the Interior and at the coast (Table 4), where known populations were present. The synthetic pheromone were supplied by Dr. G.E. Daterman, Farchan Chemical Company, and the National Research Council.

TABLE 4. Pheromone trap locations and results, 1974-1979.

Pheromone	Location	Years	Supplier	Results
Trans-9 dodecenyl acetate	Vancouver Fraser Valley	1974	Daterman	Negative
Trans-9 dodecenyl acetate, 98% pure	Vancouver Fraser valley Okanagan Valley	1975	Farchan	Negative
Trans-9 dodecenyl acetate, 99% pure	Vancouver Okanagan Valley	1976	Farchan	Negative
Trans-9 dodecenyl acetate, 99.9% pure	Vancouver Okanagan Valley Nelson Kamloops Victoria	1977, 1978, 1979 1977, 1979 1977, 1979 1978 1979	Farchan	Negative
Trans-9 dodecenyl acetate +Cis-9 dodecenyl acetate	Kelowna	1980	National Research Council	Negative



### DISCUSSION

McGugan's analysis (1965) of the western situation in regard to the European pine shoot moth still holds true: "The European pine shoot moth is a serious pest of pines in many parts of the world, where it is either native or has been introduced. But in all cases known to me, severe damage is confined to planted stock or highly managed situations. The intensity or severity of damage varies considerably and is apparently indirectly related to "vigor" and stocking. In well-stocked stands on good sites, damage is usually minimal. European pine shoot moth does not cause mortality but rather deformation or growth loss during the early stages of stand development. Thus, except for severe attacks extending over prolonged periods, we can expect only varying degrees of degrade and growth loss".

After 12 years of restriction on the movement of pines, intensive annual surveys, clipping and burning of infested shoots and 5 years of control spraying with Cygon after clipping, the status of the shoot moth in the Okanagan area has changed little.

A review of unpublished data (Evans, unpublished, 1975) indicates a recurring introduction of the shoot moth in the Interior and that low temperature, parasites, poor suitability of ponderosa pine as a host and a continuing research program for control will limit change. Evans notes that the U.S. Forest Service no longer considers the shoot moth a serious forest pest and has adopted a wait-and-see approach. It is apparent from the past five years surveys that the shoot moth is established in the Okanagan Valley on ornamental managed trees, and will probably increase in intensity unless abnormally low winter temperatures cause a population reduction. Such a reduction will likely be of short duration followed by a gradually increasing population again. Until the insect attains severe infestation proportions on pines in urban centres far in excess of what has been noted to date, there appears to be little hazard to native pine stands in British Columbia.

## References

- Agriculture Canada, Plant Quarantine Act, Plant Quarantine Regulations, Nov. 19, 1976., Can. Gazette Part II, Vol. 110. No. 23.
- Annual Reports - Forest Insect and Disease Survey 1960-1980, Vancouver, Kamloops and Nelson regions.
- B.C. Dept. of Agriculture Plant Protection Act, 1972, European Pine Shoot Moth Reg. Order in Council 633. Approved and ordered Oct. 19, 1972. Superseding B.C. Reg. 81768.
- B.C. Dept. of Agriculture Plant Protection Act, 1974. European Pine Shoot Moth Reg. Order in Council 633. Approved and ordered Feb. 20, 1974.
- B.C. Dept. of Agriculture Plant Protection Act, 1975 European Pine Shoot Moth Reg. Order in Council 876, Approved and Ordered, Mar. 6, 1975.
- B.C. Dept. of Agriculture Plant Protection Act, 1977. European Pine Shoot Moth Reg. Order in Council 45. Approved and Ordered Jan. 7, 1977.
- Evans, D., 1971. Survival of Pine Shoot Moth on Cut Christmas Trees, Bimonthly Research Notes.
- Evans, D., 1973. Establishment and Survival of European Pine Shoot Moth on Container Grown 1-0 Lodgepole Pine, Information Report BC-X-79.
- Evans, D., 1975. European Pine Shoot Moth on Ponderosa Pine in British Columbia, Bimonthly Research Notes Vol. 31, No. 2 Mar-Apr 1975.
- Evans, D., 1975. Potential Impact of the European Pine Shoot Moth on the Forests of British Columbia. Unpublished Information Report, Canadian Forestry Service, Dept. of Environment, Victoria, B.C.
- Harris, J.W.E. and R.O. Wood, 1967. The European Pine Shoot Moth, Rhyacionia buoliana (Lepidoptera:Olethreutidae) Another Introduced Pest. Jour. of Ent. Soc. of B.C. Vol. 64:14-17.
- Harris, J.W.E. and D.A. Ross, 1975. European Pine Shoot Moth, Forest Pest Leaflet No. 18. Canadian Forestry Service, Dept. of Environment Victoria, B.C.
- Holms, J.C., C.A. Gibson, G.W. Miller and J.W.E. Harris, 1966. European Pine Shoot Moth Survey, Information Report BC-X-6. Dept. of For. and Rural Dev. British Columbia.
- Kolbe, E.L., 1960. Invasion Proceedings of the 51st Western Forestry Conference, Western Forestry and Conservation Association, Victoria, B.C., Dec. 7-9.



- Mathers, W.G., 1938. Can. Dept. Agric., Ann. Rept. of the Vancouver Forest Insect Lab, pp. 58-63.
- McLaine, L.S., 1926. A preliminary announcement of the outbreak of the European pine shoot moth. 56th Ann. Rept. Ent. Soc. Ont. (1925) pp. 71-72.
- McGugan, B.M., 1964. What will it take to Eradicate the European Pine Shoot Moth from Western North America. Annual meeting of Western Forest Pest committee, Western Forestry and Conservation Association, Spokane, Wash., Dec. 1, 1964.
- Pree, D.J., 1971. Control of European Pine Shoot Moth: Chemistry and bioactivity of carbofuron in mugho pines. Ph.D. Thesis, Wash. State Univ., Dept. Ent., Pullman. 89 pp.
- Ross, D.A. 1967. The European Pine Shoot Moth in British Columbia. Information Report BC-X-13, Dept. of For. and Rural Dev., Vernon, B.C.

