

1981
ANNUAL REPORT
OF THE COOPERATIVE
FORESTRY RESEARCH UNIT

Cooperative Forestry Research Unit Information Report 10

April, 1982

TABLE OF CONTENTS

	PAGE
ANNUAL REPORT OF THE DIRECTOR	1
ANNUAL REPORT OF THE CHAIRMAN	1
SILVICULTURE PROGRAM - Dr. Maxwell L. McCormack, Jr	3
Intensive Forest Harvesting, Residue Management Practices and Nutrient Cycling in the Spruce-Fir Type of Northern Maine	3
Thinning Spruce and Spruce-Fir Stands	5
Aerial Application of Herbicides for Management of Undesirable Vegetation in Maine Forests	6
FOREST PROTECTION - Dr. Mark VI. Houseweart	9
I. White Pine Weevil Studies:	
Life Tables	9
Spring Activity Patterns	9
II. Spruce Budworm Projects:	
A. Lab Studies: Host-Age Acceptability	10
<i>Triahogramma</i> Size Differences	10
<i>Triahogramma</i> Fecundity	10
B. Field Studies:	10
III. Regeneration Insects:	13
MARKETING, UTILIZATION, AND ECONOMICS - Dr. David B. Field	14
TIMBER MANAGEMENT AND HARVESTING - Dr. Robert S. Seymour	14
Proposed cable-yarder evaluation in thinning study	14
New Research Associate	15
FOREST FERTILIZATION - Dr. Robert K. Shepard	15
Spruce	15
White Pine	15
TREE IMPROVEMENT - Dr. Katherine K. Carter	16
Black Spruce Progeny Test	16
Black Spruce Provenance Test	16
Larch Plus-Tree Selection and Rooting Tests	16
White Spruce Provenance-Progeny Test	16
Exotic Larch Species Tests	17

TABLE OF CONTENTS (Cont'd.)

	PAGE
GROWTH IMPACT STUDY - Dr. Thomas B. Brann	18
Conclusions	20
PUBLICATIONS RESULTING FROM RESEARCH SUPPORTED BY THE	
CFRU IN 1981	21
COOPERATIVE FORESTRY RESEARCH UNIT ADVISORY COMMITTEE	24
STAFF OF THE CFRU	24
COOPERATORS OF THE FORESTRY RESEARCH UNIT	25
OTHER ORGANIZATIONS PROVIDING SUPPORT FOR CFRU PROJECTS ,	25

COOPERATIVE FORESTRY RESEARCH UNIT
ANNUAL REPORT - 1981

DIRECTOR'S REPORT

Nineteen hundred and eighty-one (1981) represents a special year in the history of the Cooperative Forestry Research Unit. This is the year in which all members expressed their confidence in the work of the Unit by signing up for an additional five years of work. Our losses in membership were near zero; one individual and one company. The company was ITT Rayonier which sold its land in Maine. The land was purchased by another member and that pledge was increased by the appropriate figure. Three of our members increased their pledges significantly because of added land holdings purchased from non-members. The productivity and enthusiasm of our researchers has been recognized by you.

The proposal for 1981-1985 called for new initiatives in white pine and hardwood research, if funds could be obtained for the purpose. The amount of work on white pine in the Unit was already a significant part of the program in 1981 and some work was in progress on hardwoods; especially on genetics. Mr. Henry Saunders, President of Saunders Brothers (a Unit member), volunteered to work with me to obtain support from members of the hardwood manufacturing industry. The amount of additional funds from this source was not expected to be large because the acres of land owned is small. Pledges were obtained from 29 new members interested in a hardwood research program. These new members agreed that research on growing trees needed to supply the industry was of more importance to them at the present than research on wood products.

The staff of the Cooperative Unit met monthly during 1981. These staff meetings were beneficial to all of us in the Unit as well as the Advisory Committee. We have been able to solve problems before they have become serious and have communicated our needs to one another.

We thank all of the members for support during 1981 and especially Dr. Charles Webb and the other members of the Advisory Committee for their help which was given so willingly. The CFRU is a cooperative and its accomplishments are derived from a dedicated staff plus cooperators who have been willing to give time to assure its success.

Fred B. Knight
Director March
1982

CHAIRMAN'S REPORT

The overall goal of the Cooperative Forestry Research Unit is to conduct research to provide the foundation for increasing forest productivity in Maine and to disseminate the results to the membership of the Cooperative. Toward this end, one of the major themes in 1981 was technology transfer emphasizing research results from the first five years of the Cooperative.

In May a one-day technology transfer symposium was conducted and attended by a total of 112 people (90 percent members, 10 percent non-members). Numerous topics were covered: white pine management, taxation, fertilization, herbicides and thinning studies, budworm growth impact, genetics, marketing and utilization, budworm research, and hardwood research priorities. Evaluation sheets completed by attendees indicated general satisfaction with the symposium and the need for follow-up symposia in the future.

In addition, CFRU scientists published some 12 articles as CFRU publications, and 21 in other external media. Technology transfer was enhanced further by numerous contacts during the year between CFRU scientists and CFRU members asking for assistance on specific problems.

The year 1981 has been special in the life of the Cooperative for a number of reasons. It was the beginning of the second 5-year increment of the Cooperative. Although the annual membership fee was increased to account for the effects of inflation, interest of the membership remained strong. The number of contributors grew from 46 in 1980 to 63 in 1981, due to the addition of members having special interests in hardwood silviculture. During the year ending June 30, 1981, contributions to the Cooperative totaled \$251,566, compared to \$223,743 for the year ending June 30, 1980.

There were two significant personnel changes within the Unit this year. The first, Dr. Katherine Carter, assumed the position of Geneticist in January. Her activity has been intense, and several CFRU publications have already come out based on her analysis of some of the work started by Dr. David Canavera.

The second change occurred when Dr. David Field assumed the Giddings Chair of Forest Policy within the School of Forest Resources. Dr. Robert Seymour was selected to fill Dr. Field's position and to continue with the economic analysis of intensive forest management and of various small-tree harvesting systems. Dr. Seymour, a graduate of Yale University, has worked for several years in Maine as part of the Greenwoods Project.

The pages to follow summarize research accomplishments during 1981. The research varies from highly applied studies, e.g., comparing herbicides for vegetation management or economic comparisons of logging systems, to fundamental studies, such as definition of the life cycle of the white pine weevil.

Looking forward to 1982, the most immediate, new objectives to be accomplished are:

1. Development of a plan of research for the economic comparison of small-tree logging systems.
2. Recruitment of a hardwood silviculture technologist.
3. Development, of a plan of research for hardwood silviculture.

Charles D. Webb, Chairman
CFRU Advisory Committee

PROJECTS BY CFRU SCIENTISTS

SILVICULTURE PROGRAM - Dr. Maxwell L. McCormack, Jr.

Intensive Forest Harvesting, Residue Management Practices, and Nutrient Cycling in the Spruce-Fir Type of Northern Maine

This research is in cooperation with the U.S. Forest Service and Great Northern Paper Company on a pair of watersheds on Weymouth Point, east side of Chesuncook Lake. C. Tattersall Smith, Jr., Ph.D. student, initiated this study in 1979; he continued his field work through 1981.

This project continued on schedule. During May 1981 Smith sampled 40 additional spruce and fir trees for nutrient analyses. These samples were oven dried and will be chemically analyzed during the winter. The data will be combined with the 1980 biomass data to estimate the quantity of nutrients removed from the site during harvesting.

Mechanical harvesting of the treatment watershed (118 acres), incorporating two full-tree systems, was initiated in June and completed on 13 July 1981. Hand crews and cable skidders worked on the site until 12 August to harvest large saw-timber trees and to fell unmerchantable material in order to complete the clear-cutting.

Twelve plots (20 m x 20 m plus a 10 m buffer zone) on the treatment watershed were harvested with a Koehring feller-forwarder during June and July. Three treatments were applied to these plots as follows:

- (1) 4 plots - residues completely removed,
- (2) 4 plots - residues chipped and spread over plots, and
- (3) 4 plots - residues scattered intact.

Treatment (1) represents a typical, full-tree mechanized harvest. Treatment (3) simulates a traditional topping-and-delimiting-in-the-woods operation. The chipping treatment represents a residue management system for which information is needed. For treatments (2) and (3) the merchantable trees were removed and piled adjacent to the plots for delimiting in that location. Tree-length boles were forwarded to the roadside by skidder. Green weights of the harvesting residues were measured within one to five days after the delimiting process. Residues were then placed over the plots according to the assigned treatments.

Samples of the residues were taken from the eight treatment plots to provide basic weight and nutrient content data. Laboratory processing of this material is progressing. These data will help complete the picture of biomass, residues, organic matter, and nutrients as it relates to harvesting systems management and possible interactions with site conditions.

Soil organic pad characteristics are an important reflection of site quality in spruce-fir stands. In order to evaluate existing conditions and changes after harvesting, a preharvest evaluation of the organic pad was made at the 12 plot

locations. These data are typical of the information being collected to characterize the study site. They indicate the importance of drainage condition interactions which appear to exist in northern Maine forests. The organic pad dry weights, as they relate to drainage class, are summarized in the following table:

MEAN OVEN-DRY WEIGHTS OF THE ORGANIC PAD FOR
THE TREATMENT WATERSHED PLOTS
SEGREGATED BY SOIL DRAINAGE CLASS

Soil Drainage Class	Organic Pad Dry Weight (Tons/acre)
Moderately well -well (N=4)	23.80 + 2.44 ⁻¹ -/
Somewhat poorly (N=4)	23.23 + 3.76
Poorly (N=4)	33.30 + 9.23
Mean, all plots (N=12)	28.45 + 6.72

- One standard deviation

Two pairs of porous, ceramic cup, tension lysimeters were installed at depths of 25 and 50 cm on each study plot during November 1979. Soil solution samples have been taken on a monthly basis from May to November in 1980 and 1981. Analyses, to date, show increases in nitrate and calcium concentrations following harvest. Nutrient concentrations differ by soil drainage class. Values for October samples before (1980) and after (1981) harvest are illustrated in the following table.

TREATMENT WATERSHED SOIL SOLUTION CHEMISTRY FOR NITRATE AND
CALCIUM SAMPLED OCTOBER 1980 (PREHARVEST) AND OCTOBER 1981
(POSTHARVEST) GROUPED BY SOIL DRAINAGE CLASS

Soil Drainage Class	Sample Depth (cm)	NO ₃ (mg/l)		Ca (mg/l)	
		Oct. 80	Oct. 81	Oct. 80	Oct. 81
Moderately well (N=4)	25	0.60	18.36	3.65	4.42
	50	0.34	12.13	2.19	3.74
Poorly - somewhat poorly (N=8)	25	0.01	0.18	1.53	1.18
	50	0.06	0.12	2.03	1.83
Average, all plots (N=12)	25	0.20	7.76	1.90	2.53
	50	0.16	5.12	2.09	2.63

These preliminary results indicate the importance of soil drainage to vertical ionic movement following clearcutting. This sampling will continue and more complete evaluations are planned.

Soil disturbance is another aspect of post harvest conditions which has received consideration. In August 1981 a survey was conducted to characterize soil disturbance conditions on the treatment watershed. Using the previously established grid system, 100 random starting points were located with road, brush pile, and stream channel areas excluded. Line transects, 2500 cm long, were evaluated on random azimuths from each starting point. The length of each of ten types of surface condition was recorded. These estimates indicate most of the area was disturbed. Further evaluations of these data and conditions are planned, but a preliminary indication of percentages of the sample transects in a selection of the condition categories is shown in the following table.

SUMMARY OF SOIL DISTURBANCE
ON THE TREATMENT WATERSHED

Selected Categories of Disturbance Type	Range of Sample , , Transect Lengths - (percent)
Undisturbed	6 6 10 10
Compaction, no scarification	18 24 28 32
Scarification of organic mat Equipment ruts, lined with organic soil Mineral soil ruts	10 16

- Range indicates 95% confidence interval

Additional studies of ground conditions and forest regeneration dynamics will be initiated in 1982. The fate of vegetation which remained after harvest, and the establishment of new growth will be monitored. Three permanent transects, based on the original grid system, have been located across the watershed. A series of preharvest and postharvest photographs taken along the transects is on file; this will assist in documenting conditions and changes.

This intensive field effort will continue through the coming field season. This effort is facilitated through the cooperation of Great Northern Paper Company by their providing a site for the CFRU trailer which functions effectively as a base of operations.

Thinning Spruce and Spruce-Fir Stands

The long-term phase of this research continued through 1981. The four study sites previously reported were maintained and all individual study trees were checked. The permanent tree records were updated and reflected some changes which included loss of some fir study trees due to spruce budworm-caused mortality.

Further plans have been made for the additional study site in Nashville Plantation. It is now expected that a comprehensive study will be conducted on this site through the administration of a harvesting system evaluation to be conducted by Dr. Seymour in cooperation with Seven Islands Land Company.

Individual tree data are being utilized to evaluate tree characteristics in order to develop information for simulation of stand conditions. Crown diameter is one measurement which is being appraised. A more intensive effort is planned as five-year responses become available on the treated areas.

Aerial Application of Herbicides for Management of Undesirable Vegetation in Maine Forests

During 1981 presentations at the 36th Annual Meeting of the Northeastern Weed Science Society several invited papers reported results from this project. One paper summarized one- and three-year responses of vegetation in clearcut strips following aerial application of herbicides (May, May, and McCormack, 1982). This is of special interest because it relates implications of herbicide-induced vegetation changes to wildlife use.

Through the cooperation of Georgia-Pacific Corporation and Northeast Helicopter, an aerial application of liquid hexazinone (Velpar^R) was tested (McCormack, Sprague, and Grau, 1982). In general, efficacy improved with increasing rates of application (up to 2 Ibs active ingredient per acre) and addition of simazine (Princep^R) provided some enhancement. Though satisfactory control of red maple was not achieved, there was excellent suppression of beech, aspen, raspberry and grasses.

First-year results of a study, incorporating considerations of rates and timing of applications, triclopyr (GarlonR) formulation, and triclopyr combinations with glyphosate (Roundup*) were reported (McCormack, Sprague, Saviello, and Hendler, 1982). The conclusions of this report were:

1. Triclopyr and glyphosate treatments provided silvicultural advantages over a range of rates, site conditions, and timing of application.
2. A range of conditions through the growing seasons and between sites had an influence on efficacy.
3. Higher rates of application and use of the ester formulation for triclopyr treatments can help to compensate for some negative environmental influences.
4. Site preparation objectives tend to be more readily accomplished with early season applications. Release treatments are more secure later in the season within the limits of the onset of autumn conditions which vary greatly among sites.
5. Combinations of glyphosate and triclopyr show excellent potential for silvicultural effectiveness using reduced quantities of herbicide.

Relative effectiveness of the combination treatments is illustrated in the following table of selected data which were extracted from the complete paper. The low ratings from the September applications are attributed to rainfall shortly after the treatments were completed.

I/
SELECTED ONE-YEAR SILVICULTURAL EFFECTIVENESS-'
RATINGS FOR CONTROL OF FOREST BRUSH ON A
STUDY SITE IN HOWLAND, MAINE

Herbicide	Rate?/ lb/a	Time of application			
		June	July	Aug.	Sept.
triclopyr amine	3	9	8	9	9
triclopyr ester	3	8	9	9	8
glyphosate	3	9	9	10	5
triclopyr amine + glyphosate	.38 + .5	8	8	9	3
triclopyr ester + glyphosate	.5 + .5	6	8	9	8

- Zero to 4 represents inadequate silviculture! advantage; 5 is the threshold of benefit; 6 to 10 indicate increasing silvicultural effectiveness up to complete control. These values represent averages of four independent appraisals on replicated plots.

21

- All rates are active ingredient per acre treated.

During 1981, four-year height growth of released conifers was measured across the treatment blocks at the Austin Pond study site. The data collected are being processed. As an example, summary data from the triclopyr treatments and one control block are shown in the following table.

AVERAGE TREE HEIGHTS, REFLECTING FOUR-YEAR GROWTH FOLLOWING TRICLOPYR TREATMENTS, AT THE AUSTIN POND STUDY SITE

	Control (No herbicide)	Triclopyr 2 Tbs/a/	Triclopyr 4 lbs/a	Triclopyr + 2,4-D 2 + 2 lbs/a
RED SPRUCE				
	36	41	44	45
Height at treatment (1977)	77.5	88.5	92.0	92.0
Total height (1981)	142.3	189.2	171.7	175.7
4-yr. height growth	64.8	100.7	89.7	99.5
BALSAM FIR				
N	80	63	55	74
Height at treatment (1977)	146.0	178.2	189.2	199.8
Total height (1981)	146.0	201.0	189.2	199.8
4-yr. height growth	53.3	122.8	108.1	123.1

- Averages represent measured trees (N) sampled from two separate 2.4 acre treatment blocks.

21

Rates expressed as active ingredient per acre treated

FOREST PROTECTION - Dr. Mark W. Houseweart

I. White Pine Weevil Studies:

Research efforts on the white pine weevil, *Pissodes strobi* (Peck), over the past 3-4 years have resulted in three major journal articles. The first, on fall temporal behavior, was published in Annals of the Entomological Society of America in 1979. All CFRU members should have received a copy of that manuscript. Two other articles have been accepted by the same journal, and although only the abstracts are presented here, all members will receive reprints of these two manuscripts as well.

Life Tables

Life tables were constructed for 3 generations (1977-80) of the white pine weevil, a pest insect of eastern white pine, *Pinus strobus* L. Typically, female weevils oviposited ca. 140 eggs/terminal leader of a host tree in the spring; however only one progeny adult survived to the following spring. Average generation survival (SG = 0.008) and total generation mortality (K = 2.08) reflected observed small increases in weevil infestation each year. Key factor analysis suggested that larval, pupal, and winter submortalities were influences on population change. Submortality factors were (1) egg infertility, (2) pitch-drowning, (3) larval intraspecific competition, (4) natural enemy predation and parasitism, (5) non-emergent brood adults, (6) unknown cause(s) of death, and (7) effect of climatic conditions on overwintering adults.

Spring Activity Patterns

f

Spring activities (emergence, feeding, mating and oviposition) of adult white pine weevils were monitored from late April to early July 1979. Weevils emerged from overwintering sites in late April, peaked in numbers/tree by mid-May, and none were found on host trees by early July. Adult activity peaked in early May and appeared to be thermo-photoperiodic. Greatest activity during the 4-hour interval checktimes occurred in the late afternoon-early evening (1300, 1700 h) and decreased to low levels until the following morning (2100, 0100, 0500 h). Adults occupied upper-branch new growth during scotophase, but moved to branch stems during photophase. Weevils are negatively phototactic, and response time to different wave-lengths of light varied during scotophase. The weevils occupied the leaders of host trees the first two weeks of monitoring, but toward season's end were found more often on first whorl lateral branches.

Length of current-year growth of leaders was influenced by magnitude of weevil damage. Highest levels of immature weevil damage resulted in leader mortality. Leaders that sustained an intermediate level of weevil damage remained alive; however, length of new growth was significantly less than leaders with almost no weevil damage.

II. Spruce Budworm Projects:

Both laboratory and field studies using *Triehogramma minutum* Riley have been continued in this year's research efforts on the spruce budworm *Choristoneura fumiferana* (Clem.). Laboratory studies (cooperatively with Dan Jennings, USFS) emphasizing *T. minutum* fecundity, longevity, development, size differences and host-age acceptability have resulted, thus far, in three manuscripts in press (abstracts follow). Analyses and writeups are still proceeding on the two other laboratory studies.

A. Lab Studies:

Host-Age Acceptability

Spruce budworm egg deposition spanned 27 days during both 1979 and 1980. The egg deposition curve is essentially a normal bell-shaped distribution with a slight skew to the right. Spruce budworm eggs are most acceptable to *T. minutum* for successful parasitism during the earlier stages of host egg development. Parasitism rates at two different temperatures (21°C and 27°C) were significantly greater for 1- to 3-day-old eggs than for 6- to 8-day-old spruce budworm eggs. Major reduction in host egg acceptability occurred after the 5th day at 21°C and after the 4th day at 27°C.

Triohogramma Size Differences

Three body dimensions (body length, head width, and abdomen width) were used to determine size differences between laboratory-reared and wild populations of *T. minutum*. Six separate groups of *T. minutum* were measured: three groups reared from *Sitotroga aerealella* (Olivier) eggs, two from laboratory-reared spruce budworm eggs, and one from wild populations of spruce budworm.

Both female and male *T. minutum* from spruce budworm (large host) eggs were significantly larger for all measured parameters than *T. minutum* from *S. cerealella* (small host) eggs.

A significant reduction in parasitoid size was observed during the initial generations of *T. minutum* reared in the smaller host (*S. cerealella*). However, this size reduction was not permanent. Following numerous generations in the *S. aerealella* host eggs, a significant increase in parasitoid size was noted within the first generation of *T. minutum* reared in the spruce budworm host eggs.

Triohogramma Fecundity

Mean daily fecundity of the Maine strain of *T. minutum* in two laboratory-reared hosts (*C. fumiferana* and *S. cerealella*) was significantly different. The mean emerged fecundity/female/day was 15.2 using *C. fumiferana* as a host, while a mean fecundity value of 10.9 was obtained when *S. aerealella* was used. Although not significantly different, the total production of progeny was numerically superior using the *S. aerealella* hosts. Significantly more eggs were deposited the first day than in subsequent days, regardless of the host eggs utilized. We found no significant reduction in progeny produced by females in relation to day of male death as previously reported. We did find a significant decrease in the sex ratio (i.e., fewer females) as the daily egg production proceeded. We found that 69.7 percent of the life of the females was spent ovipositing when *S. cerealella* eggs were the host, while significantly less time (only 59.8%) was spent ovipositing in the *C. fumiferana* (spruce budworm) eggs.

B. Field Studies:

Field studies this year involving the aerial release of *T. minutum* were handled solely by the CFRU crews, since CANUSA funds were no longer available. During the release operations we hosted a group of research scientists from Ontario Ministry of Natural Resources and Guelph University, who will be conducting their own field releases of *T. minutum* in 1982.

Our 1981 field tests were conducted on five 10-acre blocks, established last year on land owned by Georgia-Pacific Corp. Each of the five study areas consisted of a 10-acre block which contained five 0.2-acre circular plots. Each block was a minimum of 5 miles from all other blocks and received no insecticide applications during 1979, 1980 or 1981. Baseline data on native *T. minutum* populations were obtained in 1980 by methods described in the CFRU 1980 Annual Report.

On 2, 8 and 15 July of 1981 "Maine-strain" *T. minutum* were released by helicopter on King Brook (KB), Lambert Lake (LL) and Wesley (WS) 10-acre blocks. The Clifford Stream (CS) and Tomah River (TR) blocks served as controls. The Georgia-Pacific helicopter, piloted by John Nichols, was used on all release operations. An electric insect egg dispenser mounted inside the helicopter cabin was connected via plastic tubing to a Venturi-type dispensing funnel attached to the helicopter skid plate. The estimated numbers of *T. minutum* released on the three dates were 164,000, 140,000 and 243,000 females per acre respectively (total release = 547,000 females per acre).

The 1981 branch sampling procedure used to evaluate parasitism rates was modified from that used in 1980. Because of a concern about the possible effects of wind during releases over these small study areas, a greater proportion of the branch sampling in 1981 was conducted in the center of each 10-acre block. On 27-30 July, 60 balsam fir and 10 spruce trees were pole-pruned from each center plot, which was enlarged this year to 1.0 acre. Ten balsam fir were sampled from each of the four corner plots (0.2 acre). Where possible, 1981 branch samples were taken from the same trees sampled in 1980. In the analysis of parasitism rates, both the percentage of budworm eggs parasitized (PERCENT) and the percentage of budworm egg masses parasitized (EMPERC) were examined.

Preliminary analyses of the 1981 data showed no significant differences ($P < 0.05$) between the parasitism rates observed on balsam fir and those on spruce. Also, plot location within the release blocks did not significantly affect the observed parasitism rates. Because of these results, and because of the larger sample sizes available from balsam fir in the center plots, only data collected from those trees were used in further analyses.

Although the levels of parasitism were disappointingly low, we did find significant differences between the release blocks and control blocks (Table 1). The values of PERCENT at Wesley and of EMPERC at Wesley and Lambert Lake were significantly greater than the values for either of the control blocks. At the other release area, King Brook, these parasitism rates were significantly greater than only the Tomah River site.

Although parasitism rates can be legitimately compared between release and control blocks, a certain amount of variation is present simply because of the differences related to separate locations. Because of this factor and because of the low parasitism rates in 1981, the baseline data we obtained in 1980 became very important. With these data we compared parasitism rates between years (i.e., pre- and post-release) within treatments (Table 2). Although the parasitism rates in the release treatment are higher in 1981 (post-release), the differences are not statistically significant. In the control areas, the percentage parasitism of budworm eggs (PERCENT) was not significantly different between years, and the percentage parasitism of egg masses (EMPERC) was significantly less in 1981.

To examine more closely the change in parasitism rates between years, this change was computed as a percentage of the first-year parasitism rate. When this 1980-81 percent change in parasitism was analyzed, all study blocks except King Brook had a reduction in parasitism rates from 1980 to 1981. No significant differences ($P < 0.05$) were found, however, between any of the blocks.

Table 1. Mean percentage parasitism in center-plot balsam fir in 1981 by study block

TREATMENT	BLOCK		PERCENT	EMPERC
RELEASE	KB	45	5.94 ^{ab}	6.76 ^{ab}
	LL	54	4.24 ^{abc}	9.74 ^a
	WS	54	8.84 ^a	12.72 ^a
CONTROL	CS	52	2.79 ^{bc}	3.43 ^{bc}
	TR	47	0.00 ^c	0.00 ^c
F Value			3.25	5.61
F Prob.			0.0127	0.0002
Signif .			*	*

Means within a column followed by different letters are significantly different using Duncan's multiple range test at $< * 0.05$.

Table 2. Mean percentage parasitism in center-plot balsam fir by sample year and treatment.

SAMPLE	RELEASE BLOCKS			CONTROL BLOCKS		
	YEAR	n	PERCENT	EMPERC	n	PERCENT
1980	71	4.75	8.52	46	1.40	4.11
1981	153	6.36	9.92	99	1.47	1.80
F Value		0.62	0.34	0.01		4.55
F Prob.		0.4337	0.5627	0.9349		0.0346
Signif.		NS	NS	NS		*

Forest conditions in most of the study areas were visibly worse in 1981 than in 1980. Increased spruce budworm-caused defoliation and mortality were evident. The most severe conditions were observed at the Tomah River site. Because of our concern about what effects these changing conditions might have on parasitism rates, we examined the quantity of spruce budworm egg masses which were available for parasitization. In 1980, 95.2 percent of the sampled balsam fir branches and 90.7 percent of the spruce branches contained current-year budworm egg masses. In 1981, only 83.1 percent and 72.0 percent of the fir and spruce samples, respectively, held new egg masses.

This decrease is also illustrated by the reductions in egg mass density. Density (CUNIT) was calculated on the basis of a standardized unit of branch size (i.e., 600 cm²). The equation used was:

$$\text{rijMTj} = \frac{\text{Number of current-year budworm egg masses} \times 600}{\text{Total foliage area of sample branch in cm}}$$

In all three release blocks and in the Tomah River control block, there were significant decreases in egg mass density. Over all the release blocks the density of egg masses available for parasitization dropped from 10.97 to 5.30 cunits. The density at Tomah River decreased by over 75 percent, from 11.38 to 2.50 cunits. The Clifford Stream control block was the only area which did not have a significant decrease in egg mass density (3.76 in 1980 and 4.84 in 1981). It is also interesting to note that the Clifford Stream site, a control block, had 1981 parasitism rates that were not significantly different from those at King Brook, a release area (Table 1). The above implies that a delicate balance exists between levels of egg mass densities and levels of *T. minutum* parasitism.

Overall in these tests of aerial releases of *T. minutum*, parasitism rates were at low levels. This was evident even in the release blocks, although parasitism rates there were significantly greater than those in the control areas. The reduced levels of current-year spruce budworm egg masses appear to have played a large role in the low parasitism rates observed. We also believe that the actual number of female parasitoids available for release (547,000 females/acre) was much too low (reductions due to decreases in sex ratio, sting and emergence rates). The original goal was to release 1.5 million females/acre; but that quantity was not available to us on the required dates. Because the spruce budworm egg mass deposition period in 1981 ended a bit earlier than in 1980, it is also possible that the timing of the third release date was somewhat late for those parasitoids to be effective. Such a situation would reduce the effective release rate even further to approximately 300,000 females/acre.

If further testing of *T. minutum* aerial releases is to be undertaken, some changes in the operation would be necessary. Primary among these would be the establishment locally of a facility for mass rearing several million parasitoids. With this capability we would have much greater control over production of the required numbers of *T. minutum*. Sufficient parasitoids must be available when needed to provide for greater flexibility in timing of releases.

Other field studies of *T. minutum* involved alternate hosts and stand measurements. Since the actual field work was completed this fall, a significant amount of time has been devoted to the alternate host-stand measurement report. Although incomplete at this time (due to delayed taxonomic identifications) the report should be finished before next summer.

III. Regeneration Insects:

A new area of focus for the CFRU protection research has been approved by the Advisory Committee. In general, this is the study of the entomological impacts of both artificial and natural regeneration.

Both Robert K. Lawrence, Assistant Research Scientist, and Celeste Welty, an entomology graduate student, are developing specific proposals along these lines. Celeste's research will be concerned with a relatively new pest (debarking weevils) affecting plantation establishment. Her studies will be conducted cooperatively with International Paper Company research entomologist, Sue Goldman.

MARKETING, UTILIZATION, AND ECONOMICS - Dr. David B. Field
(January 1 - August 30)

Work continued through August 1981 on two major projects:

1. Public benefits from private forest land ownership and management in Maine.
2. An introduction to the financial analysis of forestry investments.

The first of these is a long-term project that has produced several publications on various aspects of Maine's forest-based economy, but none during calendar year 1981. The second project also produced no publications during 1981, but a report bearing the same title as the project will be published in the summer of 1982. The report will present a comprehensive view of forestry investment analysis, incorporating discounted cash flow procedures that include the effects of inflation and taxation and using several case studies from small woodlands in Maine for illustration.

Dr. Field's responsibilities changed on September 1, 1981 from primarily research to primarily teaching. Research on these projects will continue, outside the CFRU, but at a slower pace.

TIMBER MANAGEMENT AND HARVESTING - Dr. Robert S. Seymour
(November 1 - December 31)

Dr. Seymour began work as Dr. Field's replacement on November 1, 1981. The appointment of Dr. Field to the Giddings Chair made possible a revised direction for this branch of CFRU research. Although the program is still in early stages of development, it will likely involve work in two general subject areas: (1) analysis of timber management strategies for Maine's forests, and (2) development and field testing of alternative harvesting systems designed to expand foresters' stand-treatment capabilities and extend wood supplies. The new title of "Timber Management and Harvesting" more accurately describes the work which will be done.

Because this is essentially a new position, Dr. Seymour was given a mandate by the CFRU Advisory Committee to develop a problem analysis for these general subject areas, as was done for each position in 1976-77 shortly after CFRU was established. Once approved, this document will provide the basis for specific research projects (to be proposed later) which address the problems outlined. To this end, contacts have been made with several landowners, with many more field visits being planned for 1982.

Proposed cable-yarder evaluation in thinning study

In November, Drs. Seymour and McCormack visited a proposed thinning-study site near Ashland (in Nashville Pit.) on Seven Islands land. Tentative plans were made with Seven Islands' foresters to expand the study into a large-scale evaluation of the Smith Timbermaster (a small cable-yarding machine rigged as a skyline system, now in operation on Seven Islands land near Rangeley). In the process of harvesting the thinning sites, we hope to test various systems for prebunching small-diameter wood to the Timbermaster or conventional skidders. Theoretical advantages of prebunching for thinning dense spruce-fir stands include (1) less residual-stand damage and (2) substantially improved production of the more expensive yarding machines, but these need to be demonstrated in the field.

New Research Associate

The resignation of Ellis Sprague (to take effect March 1, 1982) provided an opportunity to recruit an individual with specific skills and hands-on experience with innovative harvesting methods and machines. The idea is to have the new person work as a team with Paul Messier, now Dr. Seymour's research associate. Both individuals would then work under the collective direction of Dr. McCormack and Dr. Seymour. At year's end, the position description had been prepared, to be filled at the Research Associate level, and the advertising process was initiated. The new person should be on staff by April, 1982, in time to begin field work in June.

FOREST FERTILIZATION - Dr. Robert K. Shepard

Work during 1981 was divided between spruce (approximately 60 percent of the total effort) and white pine (approximately 40 percent of the total effort).

Spruce

Establishment of plots in north-central Maine as part of the study to determine response to fertilization on soils that differ primarily in drainage (poorly drained, somewhat poorly drained, and moderately well to well drained) was continued. By the end of the 1981 field season, approximately 150 plots had been established. On poorly drained soils, which support stands of both red and black spruce, plots are nearly evenly distributed between the two species. Plots on the remaining better drained soils are comprised predominantly of red spruce.

In early June one plot in each of 15 plot pairs that had been established in 1980 was fertilized with nitrogen at a rate of 200 pounds per acre. The remaining plot of each pair will serve as the control. These plot pairs were equally distributed among stands on soils of each drainage classification.

Specific gravity determinations on cores taken from dominant red spruce growing on the different soils were completed. These suggest that specific gravity is highest in trees growing on the poorly drained soils. Extractive and lignin contents of the wood are also being determined, but these determinations have not yet been completed.

Measurements were made in plots in unthinned stands near Ashland and Monticello that were fertilized in 1977 and that had grown for 5 years since fertilization, and in thinned and unthinned stands near Rangeley that were fertilized in 1979 and that had grown for 3 years since fertilization. Analyses of these measurements are not yet complete. Cores were taken from the Ashland and Monticello stands for specific gravity determinations.

White Pine

Plots were established in six stands in western Maine and in two stands in south-central Maine. Plots that had been established in four stands in western Maine in 1980 and those in the two stands in south-central Maine were fertilized. This brings to 12 the number of stands in which plots have been fertilized.

Diameter measurements were made in four stands in western Maine that were fertilized in May, 1980. Results of these measurements indicate that 100 pounds of nitrogen per acre was by far the best treatment. Trees that received that treatment grew 40 percent more in diameter than the control trees during the 2 years since fertilization. These early results suggest that considerable emphasis should be placed on developing a response curve for nitrogen fertilization and that the testing of other nutrients should be reduced, except where obvious deficiencies exist. The possible interaction of fertilization with understory control on growth of the pine overstory should also be investigated.

TREE IMPROVEMENT - Dr. (Catherine K. Carter

Black Spruce Progeny Test

Kevin Kenlan completed his M.S. thesis, an analysis of differences among 79 seedling families of black spruce from 16 stands in Maine (Kenlan, 1980). At age 3, seedlings from stands originating in the central part of the state were taller, on the average, than those originating in northern Maine. However, some above-average families were found in nearly every stand. Seedling growth rate was not well correlated with parental growth rate, indicating that the selection of superior black spruce should be based on progeny tests rather than on the growth rate of individual trees. The seedlings from this study have been out-planted at 3 sites in the state and their future growth will be monitored to provide more information about optimum selection strategies in black spruce.

Black Spruce Provenance Test

A range-wide black spruce provenance test was planted in 1976 at two locations and was re-measured during the summer of 1981. Data analysis is in progress and results should be available by mid-1982. Preliminary indications are that, in central Maine, the fastest-growing black spruce provenance (from Valcartier, Quebec) is nearly 4 times as tall as the shortest provenance (from Steamboat Mtn., British Columbia). Trees from the St. Lawrence River Valley and the Great Lakes Region were most frequently above-average in height.

Larch Plus-Tree Selection and Rooting Tests

During the autumn of 1981 a selection program was initiated to locate native tamarack trees having above-average form and growth rates. The goal is to select approximately 30 such trees throughout the state. Cuttings will be taken from the trees next year and subjected to rooting trials in the greenhouse to determine the best rooting method.

White Spruce Provenance-Progeny Test

Ron Tebbetts is nearing completion of his M.S. thesis on white spruce. Height and diameter of 119 seedling families from 31 stands in Ontario, Quebec, and Maine were measured after two years in the nursery. Nine of the top ten stands were from the Beachburg, Ontario area and averaged 15 percent taller

than the study mean and 37 percent taller than the local Maine sources. The seedlings from this study have been outplanted at 2 sites and will continue to provide information about comparative growth rates.

Exotic Larch Species Tests

Three plantations of exotic larches were established in 1977, including provenances of European larch (*Larix deauidua* Mill.), Japanese larch (*Larix leptolepis* (Sieb. et. Zucc.) Gord.), Siberian larch (*Larix siberica* Ledeb.), and European x Japanese hybrids. After 5 growing seasons, survival and growth rates are excellent for many provenances (Table 1). European, Siberian, and hybrid larches are generally taller than the Japanese larch. In the Orneville Twp. plantation, the average height for all trees was 7.3 ft, with individual trees reaching over 11 ft in height. The large variation in growth rate among species and among provenances indicates that significant gains can be made by selection of the seed sources which are best adapted to growth in Maine.

Table 1. Summary of exotic larch species and provenance tests.
Trees in all plantations were contained erized seedlings
planted in 1977.

Plantation Location	Heights, in feet		Comments
	1981	1979	
<u>T5 R14</u>			
Overall mean:	5.2	2.0	European, hybrid, and Siberian larches were generally taller than Japanese.
Provenance mean range:	7.0 - 3.0	3.0 - 1.2	
European Av.	5.9	2.3	Provenance survival values ranged from 92% to 33%, with an average of 56%.
Eur. range:	7.0 - 5.1	3.0 - 1.7	
Japanese Av. :	4.8	1.9	This is a northern site which was clearcut and planted with no site -----
Jap. range:	6.4 - 3.0	2.6 - 1.2	
Hybrid Av. :	5.6	2.2	
Hybrid range:	6.1 - 4.3	2.6 - 1.6	
Siberian:	6.6	2.4	
<u>Orneville</u>			
Overall mean:	7.3	3.1	European, hybrid, and some Japanese proven- ances grew fastest. Survival ranged from 100% to 56%, with an average of 85%.
Provenance mean range:	9.3 - 6.0	4.1 - 2.3	
European Av. :	7.7	3.1	
Eur. range:	9.0 - 6.4	3.0 - 1.7	
Japanese Av. :	6.6	3.0	
Jap. range:	7.9 - 6.0	3.4 - 2.4	
Hybrid Av.:	8.6	3.6	
Hybrid range:	9.3 - 7.8	4.1 - 3.1	
Siberian:	8.1	2.7	
<u>Dover-Foxcroft</u>			
Japanese Av. :	6.7 7.9 -	3.4 4.2 -	Survival ranged from 100% to 39%, with an average of 56%.
Jap. range:	4.9	2.5	

GROWTH IMPACT STUDY - Dr. Thomas B. Brann

The Maine Spruce Budworm Growth Impact Study was initiated in 1975 to monitor the effect of spruce budworm on the forests of northern Maine. Approximately 400 - 1/20 acre permanent plots are established throughout the state. Approximately 66 percent of the plots are located in spruce-fir type stands and 33 percent are located in mixedwood stands.

Each plot is visited annually and data are collected. The following is a preliminary analysis of tree mortality on those plots during the years 1975-1981. Mortality is divided into classes by probable cause, including budworm-caused blowdown, cutting, logging damage, other known causes, and unknown cause.

In the presentation to follow, mortality due to logging damage and cutting has been removed for simplification.

Examination of mortality on these sample plots indicates a sharp rise in mortality since 1975. The most rapid increase occurred in 1980-1981 six years into the project (Figure 1).

Mortality in spruce-fir stands has increased more rapidly than in mixed wood stands (Figure 2). This is due to a higher proportion of fir in softwood stands than in mixed wood stands. This is evidenced by comparing Figure 3 with Figure 2 and noting the similarity between the fir only mortality lines in Figure 3 and the total mortality lines in Figure 2.

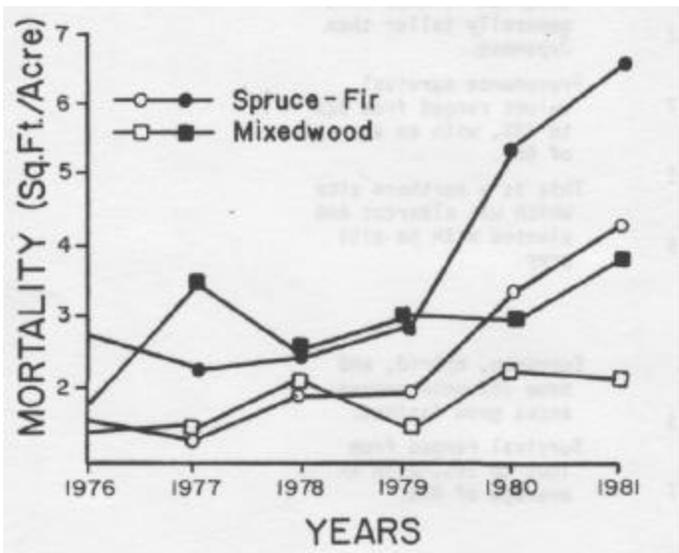


Figure 1. Mortality in square feet per acre by forest type and year. Closed symbols indicate total mortality; open symbols indicate mortality with blowdown removed.

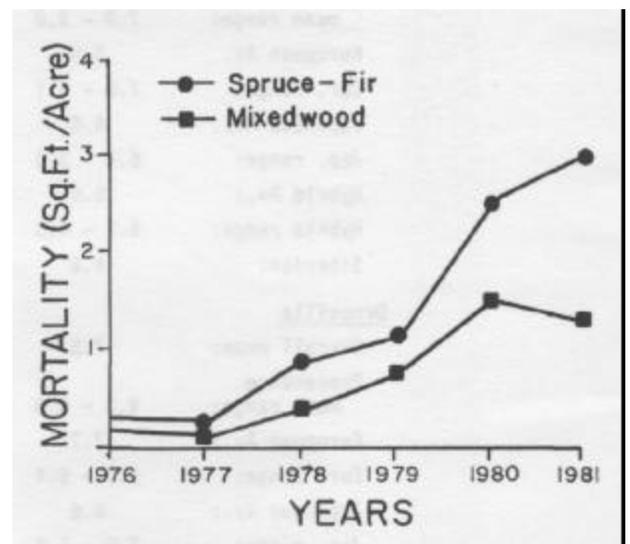


Figure 2. Budworm caused mortality in square feet per acre by forest type and year.

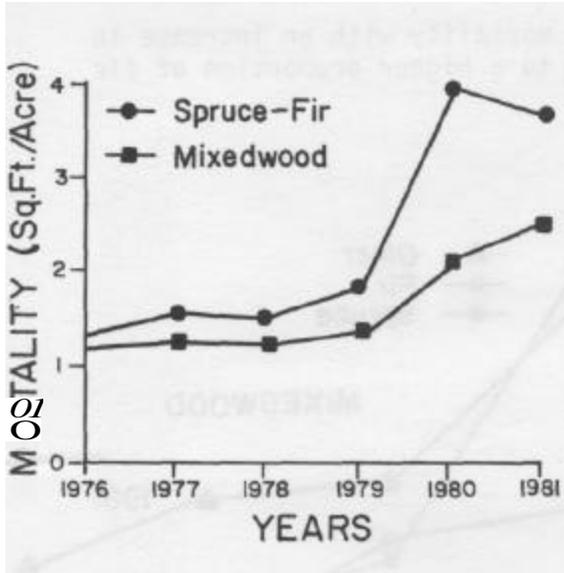


Figure 3. Fir mortality in square feet per acre by forest type and year.

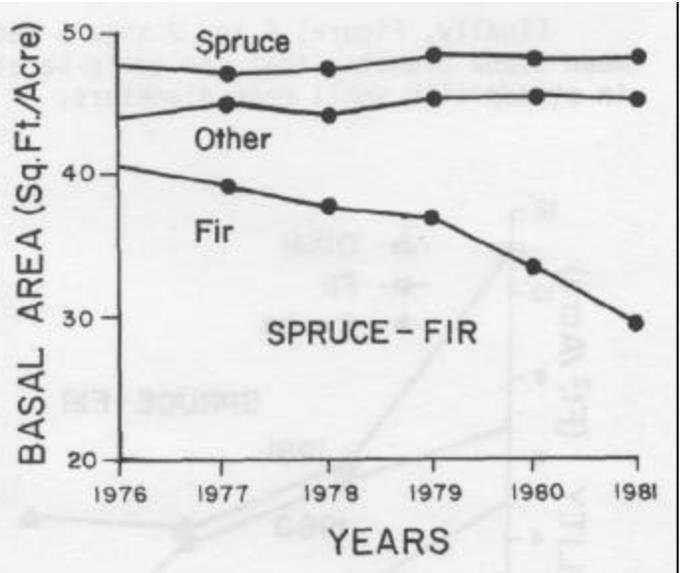


Figure 4. Species composition in square feet per acre by year for the spruce-fir forest type.

Figures 4 and 5 provide information relative to the changes in stand composition brought about by the spruce budworm. In both the spruce-fir (Figure 4) and the mixed wood types, there has been a significant reduction in the fir component while the spruce and other species' components have remained relatively constant. Total basal area of fir in both types is amazingly similar after five years. It will be interesting to see if this similarity persists.

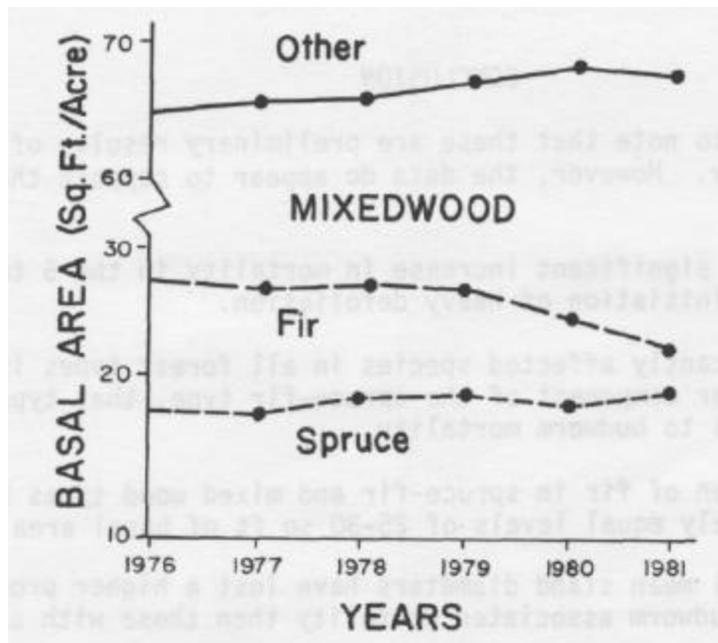


Figure 5. Species composition in square feet per acre by year for the mixed wood forest type.

Finally, Figures 6 and 7 show a decrease in mortality with an increase in mean stand diameter that can again be attributed to a higher proportion of fir in stands with small mean diameters.

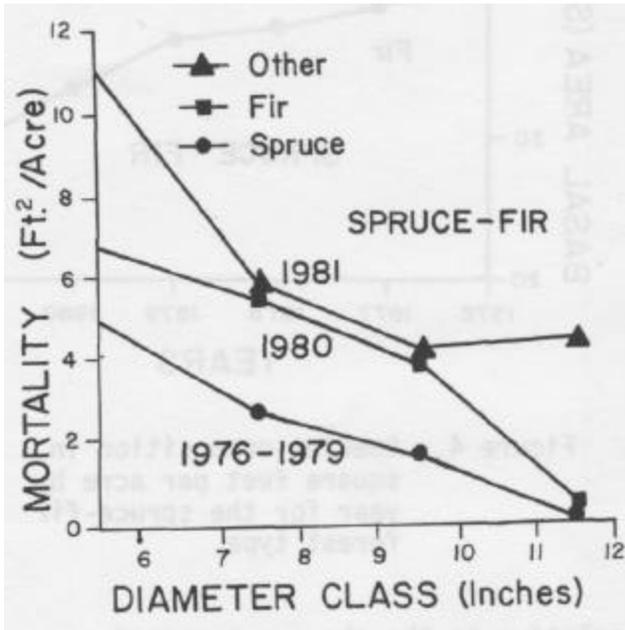


Figure 6. Mortality in square feet per acre by diameter class and year for the spruce-fir forest type.

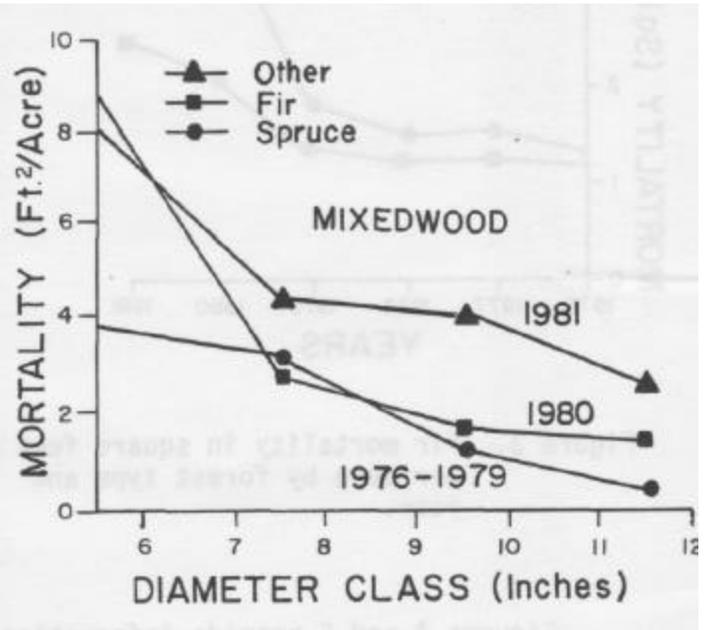


Figure 7. Mortality in square feet per acre by diameter class and year for the mixedwood type.

CONCLUSION

It is important to note that these are preliminary results of the first six years of the study. However, the data do appear to support the following conclusions.

There has been a significant increase in mortality in the 5 to 6 year period following the initiation of heavy defoliation.

The most significantly affected species in all forest types is balsam fir and, as fir is a larger component of the spruce-fir type, that type has suffered the most severe losses to budworm mortality.

The representation of fir in spruce-fir and mixed wood types has been steadily reduced to approximately equal levels of 25-30 sq ft of basal area per acre.

Stands with small mean stand diameters have lost a higher proportion of their basal area to budworm associated mortality than those with a larger mean stand diameter.

PUBLICATIONS RESULTING FROM RESEARCH

SUPPORTED BY THE CFRU IN 1981

- Brann, Thomas, Dale S. Solomon and Peter H. Triandafillou. 1981. Spruce budworm growth impact study 1980 report. CFRU Research Note 10. School of Forest Resources. Misc. Report 257. Life Sciences and Agriculture Experiment Station. University of Maine, Orono. 28 pp.
- Carter, K.K. 1981. Early results from a rangewide green ash provenance test. Proc. 2nd North Central Tree Impr. Conf., Lincoln, NE. In press.
- Carter, K.K., D.S. Canavera. 1981. Early results from containerized plantings of several native and exotic birch species in Maine. CFRU Res. Note 9. School of Forest Resources. Misc. Report 243. Life Sciences and Agriculture Experiment Station. University of Maine, Orono. 5 pp.
- Carter, K.K., D.S. Canavera and P.T. Caron. 1981. Early growth of exotic larches at three locations in Maine. CFRU Res. Note 8. School of Forest Resources. Misc. Report 241. Life Sciences and Agriculture Experiment Station. University of Maine, Orono. 7 pp.
- Field, D.B. 1981. Book review of: California's forest resources, assessment and analysis, by the California Dept. of Forestry. For. Prod. J. 31(9):22,23.
- Field, D.B. 1981. Maine's timber supply--the public's stake. Proceedings: Blaine House Conference on Forestry. Jan. 21,22, 1981. Augusta, ME. pp. 59-64.
- Field, D.B. 1981. Network analysis for project planning and control. Paper presented at New England Section, Society of American Foresters meeting in Portland, ME.
- Field, D.B. 1981. Would Maine miss an acre of commercial forest land? Paper presented at Maine Economic Society meeting in Portland, ME.
- Houseweart, M.W. 1981. Status of *Trichogramma* research at University of Maine. CFRU Technology Transfer Conference, Orono, ME.
- Houseweart, M.W. 1981. Methods of suppressing white pine weevil populations. CFRU Technology Transfer Conference, Orono, ME.
- Houseweart, M.W. 1981. The Cooperative Forestry Research Unit -- Past, present and future. Old Town Rotary Meeting, Old Town, ME.
- Houseweart, M.W. 1981. Potential plantation insect problems in Maine: the yellowheaded spruce sawfly. Northeastern Forest Insect Work Conference, Bangor, ME.
- Houseweart, M.W., D.T. Jennings, and C.J. Sanders. 1981. Variables associated with pheromone traps for monitoring spruce budworm populations. Canadian Entomologist 113:527-537.
- Kenlan, K.W. 1981. Genetic variation in progeny from 16 stands of black spruce (*Picea mariana* (Mill.) B.S.P.) in Maine. M.S. Thesis. Univ. Maine, Orono. 91 pp.

- Lawrence, R.K. and M.W. Houseweart. 1981. Impact of the spruce budworm in the Maine spruce-fir region: 1975-1979. CFRU Res. Bull. 3. School of Forest Resources. Misc. Report 250. Life Sciences and Agriculture Experiment Station. University of Maine, Orono. 106 pp.
- McCormack, Maxwell L., Jr. 1981. A case study of an environmental confrontation involving forestry use of herbicides in Maine. Proceedings, 1981 John S. Wright Forestry Conference, Purdue University, Lafayette, Indiana, pp. 264-271.
- McCormack, Maxwell L., Jr. 1981. Balsam fir genetics for Christmas tree production. *IH^* Balsam Fir Update: A review of the latest research findings pertinent to Christmas tree culture. Proceedings of a Seminar, April 25, 1981, Faculty of Forestry, University of New Brunswick, Fredericton. pp. 15-19.
- McCormack, Maxwell L., Jr. 1981. Chemical weed control in northeastern forests. Proceedings, 1981 John S. Wright Forestry Conference, Purdue University Lafayette, Indiana, pp. 108-115.
- McCormack, Maxwell L., Jr. 1981. Herbicides for vegetation management in balsam fir Christmas tree production. *IH_* Balsam Fir Update: A review of the latest research findings pertinent to Christmas tree culture. Proceedings of a Seminar, April 25, 1981, Faculty of Forestry, University of New Brunswick, Fredericton. pp. 30-32.
- McCormack, Maxwell L., Jr. 1981. Response: The forest and Maine's future. Proceedings of the Blaine House Conference on Forestry. Department of Conservation, Augusta, ME pp. 97-99.
- McCormack, Maxwell L., Jr. 1981 The role of herbicides in silviculture. Work shop on the Impact of Herbicides on the Eastern Boreal Forest Ecosystem. The Centre for Research on Environmental Quality, York University, Downsview, Ontario, p. 10.
- Mott, D.G., R.S. Seymour and J.B. Dimond. 1981. Integrated protection management for Maine Forests. CANUSA Newsletter 18.
- Seymour, Robert S. 1981. The future of Maine's spruce-fir forest: some preliminary projections. Paper presented at the Eastern Spruce Budworm Research Work Conference, Jan. 7, 1981.
- Seymour, Robert S. 1981. Decision-making tools for budworm forestry. Paper presented at the Eastern Spruce Budworm Research Work Conference, Jan. 7, 1981.
- Shepard, Robert K. 1981. Growth and specific gravity of fertilized Norway spruce (*Picea dbies* (L.) Karst.) CFRU Prog. Rep. 13. School of Forest Resources. Misc. Report 240. Life Sciences and Agriculture Experiment Station. University of Maine, Orono. 9 pp.

- Shepard, Robert K. 1981. Specific gravity of red spruce (*Picea rubens* Sarg.) in north central Maine as related to soil series. CFRU Prog. Rep. 14. School of Forest Resources, Misc. Report 245. Life Sciences and Agriculture Experiment Station. University of Maine, Orono. 5 pp.
- Shepard, Robert K. 1981. Two-year results from fertilized white pine (*Pinus strobus* L.) stands. CFRU Prog. Rep. 15. School of Forest Resources. Misc. Rep. 246. Life Sciences and Agriculture Experiment Station. University of Maine, Orono. 6 pp.
- Shepard, Robert K. 1981. Early results from thinned, fertilized red spruce (*Picea rubens* Sarg.) stands near Rangeley, CFRU Prog. Rep. 16. School of Forest Resources. Misc. Report 254. Life Sciences and Agriculture Experiment Station, University of Maine, Orono. 6 pp.
- Shepard, Robert K. 1981. Response of row thinned white spruce (*Picea glauca* (Moench) Voss) plantations to fertilization with nitrogen. CFRU Prog. Rep. 17. School of Forest Resources. Misc. Report 251. Life Sciences and Agriculture Experiment Station. University of Maine, Orono. 6 pp.
- Shepard, Robert K. 1981. Two-year results from fertilized white pine (*Pinus strobus* L.) stands in western Maine. CFRU Prog. Rep. 18. School of Forest Resources. Misc. Report 259. Life Sciences and Agriculture Experiment Station. University of Maine, Orono. 9 pp.
- Shepard, Robert K., and R.A. Struchtemeyer. 1981. Foliage nitrogen concentration and basal area growth of red spruce (*Picea rubens* Sarg.) fertilized with urea. CFRU Res. Note 6. School of Forest Resources. Misc. Report 252. Life Sciences and Agriculture Experiment Station. University of Maine, Orono. 12 pp.
- Shottafer, James E., R.K. Shepard, and R.D. Kerr. 1981. Effect of specific gravity variation on the strength properties of wood. CFRU Info. Rep. 9. School of Forest Resources. Misc. Report 249. Life Sciences and Agriculture Experiment Station. University of Maine, Orono. 9 pp.
- Tebbetts, R. 1981. Early results of an Ottawa Valley white spruce progeny test planted in Maine. Proc. 2nd North Central Tree Impr. Conf., Lincoln, NE. In press.

COOPERATIVE FORESTRY RESEARCH UNIT ADVISORY COMMITTEE
1981 MEMBERSHIP

The members of the CFRU Advisory Committee appointed to set priorities and review proposals for the Cooperative Forestry Research Unit are as follows:

Dr. Charles Webb, Northern Forest Research Center, Int'l. Paper Co. (Chairman)
Mr. Richard Griffith, St. Regis Paper Co. (Secretary)
Mr. E. Bart Harvey, Jr., Woodlands, Great Northern Paper Co.
Mr. George W. Weiland, Vice President, Dead River Co.
Dr. Barton Blum, Project Leader, U.S. Forest Service
Dr. Fred B. Knight, Director, School of Forest Resources
Mr. Clifford L. Swenson, President, Seven Islands Land Co.
Mr. Harold M. Klaiber, Chief Forester, Scott Paper Co.
Mr. James L. Robbins, Robbins Lumber Co.
Mr. Dwight E. Newman, President, Christmas Tree Acres
Mr. Oscar Selin, Georgia-Pacific Corporation

LIASION TO FOREST RESOURCES RESEARCH ADVISORY COMMITTEE:

John Hartranft, General Manager, Boise Cascade Corporation
Temple Bowen, Bureau of Forestry, Department of Conservation

STAFF OF THE CFRU
(December 31, 1981)

Fred B. Knight, Director & Dwight B. Demeritt Professor of Forest Resources;
Associate Director of Maine Life Sciences & Agriculture Experiment Station
Maxwell L. McCormack, Jr., Research Professor of Forest Resources David B. Field,
Associate Research Professor of Forest Resources (Jan. 1-Aug. 30) Mark W.
Houseweart, Associate Research Professor of Forest Resources Robert K. Shepard,
Jr., Associate Professor of Forest Resources Robert S. Seymour, Assistant Research
Professor of Forest Resources(Nov. 1-Dec. 31) Katherine K. Carter, Assistant
Professor of Forest Resources Thomas B. Brann, Assistant Professor of Forest
Resources Robert K. Lawrence, Assistant Scientist in Forestry Paul R. Messier,
Research Associate in Forestry Ellis B. Sprague, Research Associate in Forestry Amy
R. Morin, Unit Secretary Peter Caron, Research Technician

COOPERATORS OF THE FORESTRY RESEARCH UNIT
ON DECEMBER 31, 1981

Allen Rogers Company	Kearsage Peg Co.
Anson Stick Company	Kennebec Equipment Co.
Banton, Inc.	Kingfield Wood Products
Baskahegan Co.	Knight's Tree Farm
J.H. Beardsley	James R. LaCasce
Earl Bessey	Abbott Ladd
Bethel Furniture Stock, Inc.	Lumber Exchange of No. America
Charles Blood	Maine Christmas Tree Association
Marvin Blumenstock	Maine Wood Turning Co.
Boise-Cascade Corp.	Beaton Marsh
Bruce Brockway	Ray McDonald
P.H. Chadbourne	Monsanto Chemical Co.
Edward E. Chase	Moosehead Mfg. Co.
Ralph Clifford	NELMA
Columbia Plywood Corp.	Dwight E. Newman
Crooked River Dowel Co.	Newton & Tebbetts, Inc.
C.B. Cummings & Son. Co.	Paris Manufacturing Co.
Dead River Co.	Peavey Manufacturing Co.
Dirigo Dowel, Inc.	Penley Corp.
Dow Chemical Corp.	Pierce Farms
Dunn Timberlands	Henry Plummer
Ekco Wood Products Co.	Prentiss & Carlisle Co.
E.I. duPont de Nemours & Co.	Pride Manufacturing Co.
Evergreen Energy	Pierre Redmond, Inc.
Field Timberlands	Robbins Lumber Co.
Forster Mfg. Co.	St. Regis Paper Co.
Fredrickson's Tree Farm	Fred P. Saunders Co.
Georgia-Pacific Corp.	Saunders Brothers
Great Northern Paper Co.	Scott Paper Co.
Hannington Brothers	Seven Islands Land Co.
Hanover Dowel! Co.	James W. Sewall Co.
Hardwood Products	Douglas & Dennis Smith
Louis Hilton	Smith Timberlands
Houlton International	Sprowl Brothers, Inc.
Huber Corp.	Stowell Wood Products
International Paper Co.	J.A. Thurston Co., Inc.
Irving Pulp & Paper Co.	Clayton Totman
Isaacson Lumber Co.	Western Maine Forest Nursery
J.J. Tree Farm	Leon Williams
	H.G. Winter & Sons, Inc.

OTHER ORGANIZATIONS PROVIDING SUPPORT FOR CFRU PROJECTS

Maine Forest Service	Diamond International
USFS, Northeastern For. Expt. Sta.	Pejepscot Paper Co. McIntire-
USFS, State & Private Forestry	Stennis Formula Funds