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LARVAL

A Computer Programme for Summarizing
Data from Spruce Budworm Population
Assessments

by

Aubrey Moore

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vice, Environment Canada, 25 Pickering
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This report provides documentation for the Fortran programme LARVAL, the purpose of which is the summarization of data from spruce budworm population assessments. Due to the large amounts of data generated by spruce budworm population assessments associated with field trials of insecticides; the computer can be used to advantage in eliminating many hours of tiresome calculations. Processing of data by computer also provides secure and economical storage of raw data so that further analysis can be performed expediently.

LARVAL has been used by the Integrated Control Section since 1974 and has been proved efficient in summarizing the results of spruce budworm sampling as recorded on the tally sheets designed by Morgan Hildebrand (Appendix A). The programme is set up to process data from a two branch per tree sampling scheme. However, it could easily be modified for other designs.

Output Of The Programme

Appendix B is the output from a test run of LARVAL. There are two pages of output for each plot. The first page is a listing of tree code numbers, their species, and the total number of live budworm found on each tree. If any branch sample data is missing, this is indicated. Page two outputs the following information:

- 1) Number and percentage of budworm at each instar.
- 2) Number of dead budworm.
- 3) Number of larvae of associated species.
- 4) Number of budworm parasites.
- 5) Population densities in terms of SBW per bud, SBW per square metre, SBW per 100 square feet, SBW per branch.
- 6) Tree vigor as indicated by the number of buds per square metre.
- 7) Budworm populations on white spruce and balsam fir are analysed separately.

Preparation of Data

Data to be summarised by LARVAL may be entered from punch cards, tape cassette, disk file, or directly from a time-sharing terminal. Data must be transcribed from tally sheets using the format outlined on the following page. Refer to Appendix C for an example of a batch of data ready for processing. This is the data which was used for the output in Appendix B.

Input Data Format

- 1 Plot no. and location
- 2 No. of collection (Post-spray or pre-spray)
- 3 Date of collection
- 4 Tree no. (2 characters) and tree species (WS, BF, etc.)
- 5 Data from lower branch: no. of buds, br. length,
br. width, L2, L3, L4, L5, L6, pupae, emerged pupae,
dead budworm, associated species, parasites
- 6 Data from upper branch (as in line 5)
- 7 Tree no.
- 8 Data from lower branch
- 9 Data from upper branch
- .
- .
- .
- .
- .
- .
- .
- .
- .
- .
- 20 Data from upper branch
- 21 The word "END"
- 22
- .
- .
- .
- .
- Data from another plot (as in lines 1-20)
- .
- 40
- 41 The word "END"
- 42 The words "END OF DATA"

Notes

- 1 Lines 1-3 may contain up to 40 alphanumeric characters each
- 2 Branch data may be separated by commas or blanks
- 3 If less than 13 numbers are entered in a branch data
line, the remaining numbers will be interpreted as
being 0's by the computer
- 4 Two lines of branch data must follow each tree number.
If only one branch is sampled from a tree, the line
which would contain the data from the missing branch
must be kept blank.

Appendices

- A Spruce Budworm population assessment tally sheet
- B Output from a Test run of LARVAL
- C Test Data
- D Programme listing

SPRUCE BUDWORM

TREATMENT _____

TREE NO. _____

TREE SPECIES _____ DATE COLLECTED _____ DATE EXAMINED _____

NO. OF BUDS 1 _____ 2 _____

BRANCH LENGTH (ins.) 1 _____ 2 _____ BRANCH WIDTH (ins.) 1 _____ 2 _____ TOTAL FOLIAGE AREA _____ (sq. ft.)

SAMPLED BY _____ (initials)

CHECKED BY _____ (initials)

Stage	Living	Dead	%
L ₂			
L ₃			
L ₄			
L ₅			
L ₆			
P			

STAGE	DEAD BUDWORM	ORIGINAL EXAMINATION (living)							CHECK EXAMINATION				GRAND TOTAL	
		BRANCH 1	SUB Total	BRANCH 2	SUB Total	Total 1&2	Assoc. species	Parasites	DEAD Budworm	BRANCH 1	BRANCH 2	TOTAL		
L ₂														
L ₃														
L ₄														
L ₅														
L ₆														
P														
P (E)														

Appendix A

NOTE - Branch 1 -- Lower Branch 2 -- Upper / Use reverse side for observations & comments

CHECK if any mjh 8-4-74

* PLOT 1 ZONE 3, MARS *
* PRE-SPRAY *
* MAY 23, 1999. *

TREE NO	SPECIES	NO OF LIVE LARVAE AND PUPAE
1	WS	43
13	WS	49
1	BF	110
20	WS	66

 * PLOT 2 LILLIPUT *
 * PRE-SPRAY *
 * MAY 26,1774. *

TREE NO	SPECIES	NO OF LIVE LARVAE AND PUPAE	
1	WS	46	
3	WS	37	* 1WS -BRANCH 1 MISSING
12	RS	25	* 3WS -BRANCH 2 MISSING

 * PLOT 2 LILLIPUT *
 * PRE-SPRAY *
 * MAY 26, 1974. *

NO OF TREES *****	II INSTAR *****	III INSTAR *****	IV INSTAR *****	V INSTAR *****	VI INSTAR *****	PUPAE *****	EMERGED PUPAE *****	DEAD SBW ****	PARA-SITES *****	ASSOC SP *****	LIVE SBW *****
ALL SPECIES											
3	30 (27.8%)	34 (31.5%)	29 (26.9%)	13 (12.0%)	2 (1.9%)	0 (.0%)	0 (.0%)	1	0	0	108
WS ONLY											
2	24 (28.9%)	26 (31.3%)	20 (24.1%)	11 (13.3%)	2 (2.4%)	0 (.0%)	0 (.0%)	0	0	0	83

SBW POPULATION DENSITY

	ALL SPECIES	WS	BF
PER BUD	.4320	.5253	.0000
PER SQ M	454.9	714.7	.0
PER 100 SQ FT	4226.	6640.	0.
PER BRANCH	18.00	20.75	.00

TREE VIGOR

BUDS PER SQ M	1053.0	1360.6	.0
---------------	--------	--------	----

PLOT 1 ZONE 3, MARS

PRE-SPRAY

MAY 23, 1999.

 LWS

51 19 5 1 3 0 0 0 0 0 1 0 1

140 18 5 13 26 0 0 0 0 0 0 0 1

 13WS

102 18 6 14 18 12 5

56 18 4

 LBF

89 18 7 13 26 13

45 14 6 12 26 14 6 0 0 0 2 3

 20WS

98 18 6 6 16 13 12 4 3 2 1

76 18 6 1 2 3 4

END OF PLOT

PLOT 2 LILLIPUT

PRE-SPRAY

MAY 26, 1774.

 LWS

0

79 18 4 12 13 10 9 2

 3WS

79 18 6 12 13 10 2

0

 12RS

64 16 5 6 8 9 2 0 0 0 1

28 18 6

END OF PLOT

END OF DATA

```

C ***** PROGRAMME LARVAL *****
C
C
C   THIS PROGRAMME WAS WRITTEN FOR DR. O. N. MORRIS, CHEMICAL
C CONTROL RESEARCH INST., DEPT. OF THE ENVIRONMENT, OTTAWA.
C ITS PURPOSE IS THE ANALYSIS OF DATA COLLECTED IN SPRUCE
C BUDWORM LARVAL SURVEYS.
C
C   PROGRAMME PREPARED BY AUBREY MOORE, CARLETON UNIVERSITY,
C MARCH , 1974.
C
C   DATE OF THIS VERSION: APRIL 27, 1976.
C
C
C   INTEGER TALLY
C   COMMON L(100,2,14),TALLY(13),TAREA,BRANCH,BUDS,DEN(3,5),ISP
C   DIMENSION TREENO(100),PLOT(3,10)
C   F,SPECIE(100)
C   DATA BF/'BF'//,WS/'WS'//,EN/'EN'//
C   F ,END /'END ' /
C
C INITIALIZATION
99   CONTINUE
    DO 5 I=1,13
5     TALLY(I)=0
    TAREA=0.0
    BUDS=0.0;BRANCH=0.0
    DO 6 I=1,3
    DO 6 J=1,5
6     DEN(I,J)=0.0
C
C INPUT OF PLOT NO, LOCATION, AND SAMPLE DATE
C OUTPUT OF PAGE HEADING
    WRITE(108,1012)
1012  FORMAT('1',30X,43'*')
1011  FORMAT(31X,43'*'//)
    DO 10 I=1,3
    READ(105,1000) (PLOT(I,J),J=1,10)
1000  FORMAT(10A4)
    WRITE(108,1001) (PLOT(I,J),J=1,10)
1001  FORMAT(1X,30X,'*',1X,10A4,'*')
    IF (PLOT(1,1) .EQ. END ) STOP
10    CONTINUE
    WRITE(108,1011)
C
C INPUT OF TREE NO & SPECIES FOLLOWED BY UPPER & LOWER
C BRANCH DATA.
    WRITE(108,1010)
1010  FORMAT(1X/1X/1X,'TREE NO',3X,'SPECIES',3X,
C   F'NO OF LIVE LARVAE'/21X,'AND PUPAE')
    DO 35 I=1,100
    READ(105,1002) TREENO(I),SPECIE(I)
1002  FORMAT(2A2)
    IF(TREENO(I) .EQ. EN) GO TO 40
    LIVE=0
    DO 30 J=1,2
    READ(105,1003) (L(I,J,K),K=0,10),L(I,J,12),L(I,J,11)
1003  FORMAT(13G)
C

```

```

C SUM FINDS TOTAL NO OF LIVE BUDWORMS PER BRANCH.
  L(I,J,13)=L(I,J,3)+L(I,J,4)+L(I,J,5)
  F      +L(I,J,6)+L(I,J,7)+L(I,J,8)+L(I,J,9)
  LIVE=LIVE+L(I,J,13)
30      CONTINUE
      WRITE(108,1004) TREENO(I),SPECIE(I),LIVE
      DO 2021 JJ=1,2
      IF (L(I,JJ,1).EQ. 0) WRITE(108,1021) TREENO(I),SPECIE(I),JJ
1021    FORMAT(30X,'*',2A2,'-BRANCH',I2,'MISSING')
2021    CONTINUE
1004    FORMAT(2X,A2,8X,A2,9X,I4)
35      CONTINUE
40      LAST=I-1
C
C PRINT HEADINGS FOR PLOT SUMMARY
      WRITE(108,1012)
      DO 50 I=1,3
      WRITE(108,1001) (PLOT(I,J),J=1,10)
50      CONTINUE
      WRITE(108,1011)
      WRITE(108,1005)
1005    FORMAT(1X/1X,'NO OF',5X,'II',8X,'III',7X,'IV',8X,'V',
  F9X,'VI',16X,'EMERGED',4X,
  F'DEAD PARA- ASSOC LIVE'/
  F1X,'TREES',5(4X,'INSTAR'),5X,'PUPAE',
  F' PUPAE SBW SITES SP SBW '/
  F1X,5'*',7(4X,6'*'),
  F4X,4'*',2X,5'*',2X,5'*',2X,6'*')
      WRITE(108,1006)
1006    FORMAT(1X'ALL SPECIES')
C
C COMPUTE & PRINT LINE FOR ALL SPECIES.
      DO 55 I=1, LAST
      CALL PTALLY(I)
55      CONTINUE
      ISP=1
      CALL SUMARY(LAST)
C
C COMPUTE & PRINT LINE FOR WS ONLY.
      WRITE(108,1007)
1007    FORMAT('0','WS ONLY')
      NUM=0
      DO 57 I=1,13
57      TALLY(I)=0
      BUDS=0.0;BRANCH=0.0
      TAREA=0.0
      DO 60 I=1, LAST
      IF (SPECIE(I). NE .WS) GO TO 60
      NUM=NUM+1
      ISP=2
      CALL PTALLY(I)
60      CONTINUE
      IF (NUM.EQ. 0) GO TO 62
      CALL SUMARY(NUM)
C

```

C COMPUTE & PRINT A LINE FOR BF ONLY.

```

62  CONTINUE
    NUM=0
    DO 65 I=1,13
65  TALLY(I)=0
    BUDS=0.0;BRANCH=0.0
    TAREA=0.0
    DO 70 I=1, LAST
    IF (SPECIE(I). NE .BF) GO TO 70
    NUM=NUM+1
    ISP=3
    CALL PTALLY(I)
70  CONTINUE
    IF (NUM.EQ.0) GO TO 98
    WRITE(108,1008)
1008 FORMAT(1X,'BF ONLY')
    CALL SUMARY (NUM)

```

C
C PRINT LARVAL DENSITY ETC.

```

98  CONTINUE
    WRITE(108,3000) DEN
3000 FORMAT(/39X,'SBW POPULATION DENSITY'/39X,22'*'
F//32X,'ALL SPECIES',23X,'WS',23X,'BF'
F//5X,'PER BUD',6X,3F25.4
F//5X,'PER SQ M',5X,3F25.1
F//5X,'PER 100 SQ FT',3F25.0
F//5X,'PER BRANCH',3X,3F25.2
F//45X,'TREE VIGOR'/45X,10'*'
F//5X,'BUDS PER SQ M',3F25.1)
    GO TO 99
    END

```

C
C
C SUBROUTINE PTALLY (I)

```

COMMON L(100,2,14),TALLY(13),TAREA,BRANCH,BUDS,DEN(3,5),ISP
DO 10 J=1,2
    BRANCH=BRANCH+1
    BUDS=BUDS+L(I,J,0)
    AREA=L(I,J,1)*L(I,J,2)/14400.0
    TAREA=TAREA+AREA
    DO 10 K=3,13
    TALLY(K)=TALLY(K)+L(I,J,K)
10  CONTINUE
    RETURN
    END

```

C

-

```
C
SUBROUTINE SUMARY (NUM)
C
COMMON L(100,2,14),TALLY(13),TAREA,BRANCH,BUDS,DEN(3,5),ISP
DIMENSION PRCNT(9)
DO 10 M=3,9
10  PRCNT(M)=TALLY(M)/(TALLY(13))*100.0
    TDENS=TALLY(13)/TAREA
C
C PRINT A LINE OF PLOT SUMMARY.
    WRITE (108,1005) NUM,(TALLY(M),M=3,9),
    F(TALLY(M1),M1=10,13),(PRCNT(M2),M2=3,9)
1005  FORMAT(1X,I4,1X,7(I10),4I7
    F/6X,7(2X,'( ',F5.1,'% '))
C
    DEN(ISP,1)=TALLY(13)/BUDS
    DEN(ISP,2)=TDENS/9.290304
    DEN(ISP,3)=TDENS
    DEN(ISP,4)=TALLY(13)/BRANCH
    DEN(ISP,5)=(BUDS/TAREA)/9.290304
RETURN
END
```