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ENTENTE DE
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COOPERATION

FOREST RESEARCH REPORT

No. 64: March, 1996

"Product Cruise 1.0"
Forest Inventory Cruise Program

Introduction

The **"Forest Inventory Cruise Program"**, developed by the Nova Scotia Department of Natural Resources (Forestry Division), is a DOS based microcomputer program for compiling forest inventory data. It accepts point sample or fixed plot cruise data in either metric or imperial units. The program generates comprehensive species and product specific output at the stand and block level, and provides efficient data editing, storage, and management. It allows compilations for up to 13 different products per stand.

Features

Data Input

- Choice of metric or imperial units
- Diameter class tally, by product type and species
- Tree heights, by product
- Product definition, including value ($)

- Stand operability (percent accessible for harvest)
- Merchantability parameters including stump height, top diameter limit, cull & waste (%), and weight conversions (e.g. tonnes/m^3 stacked)
- Treatment recommendations

Canadä

Nova Scotia

Data Output

- Block and stand level summary tables in metric or imperial
- Total and merchantable volume estimates (m^3, m^3 stacked, ft^3, cords)
- Lumber yields (m^3, Mfbm)
- Merchantable weight (metric tonnes)
- Subtotals by species and product type
- Operable harvest estimates, by maturity class
- Basal area, diameter, height, operability (%), stem density, value ($)
- Stand index (# trees/m^3) to assist in productivity estimates (volume harvested/hr) and calculation of silviculture rates (commercial thinning, shelterwood, etc.)
- Tally sheet and code list for field cruising

Editing/Data Management

- Direct entry ensures immediate data storage
- Data storage options include local (C:) or network (F:) drives, and floppy disks (A:)
- Independent edit screens fully access the database
- Data editing during input and upon retrieval

Development Environment

This is a DOS based program developed using FOXPRO 2.5B on an IBM compatible 486 DX33 microcomputer running under DOS 5.0. It performs well with 4 mb of RAM, and initially requires 4 mb of free disk space. It will print to an Epson compatible dot matrix printer, or an HP compatible laser printer.

Ordering Procedure

To obtain a copy send a formatted high density disk (3.5 in. [1.4 mb]; or 5.25 in. [1.2 mb]) with return address to:

Nova Scotia Department of Natural Resources
Forest Planning and Research
P.O. Box 68 Truro, NS   B2N 5B8
ATTN: PRODUCT CRUISE

Waiver

The Nova Scotia Department of Natural Resources makes no warranties, expressed or implied, and shall not be liable for direct or indirect damages arising from the use of the Product Cruise software program. Mention of any product, in this report, should not be construed as an endorsement of that product.

USER INSTRUCTIONS

Installation & Startup

To install on a local hard drive (C) or network drive (F):

1. Remove or rename any existing directory called "CRUISE"
2. Insert program disk in Drive A
3. From the DOS prompt, go to the root directory (e.g. C:) of the drive on which the program will be installed. This can be accomplished by typing CD\ and pressing [Enter]
4. Type **A:SETUP**, and press [Enter]

To start the program:

From the C:\CRUISE directory, type **CRUISE**, and press [Enter]

The setup routine creates a directory called CRUISE to store and run the program, and a subdirectory, CRUISE\TEMP, to store data (.dbf files). Do not rename or delete these files. It is recommended that additional data storage directories be created for permanent data storage, reserving the TEMP directory for use as a temporary work area. Refer to the Setup/Maintenance section below for instructions on how to create data directories.

Menus & Features

The **CRUISE MENU** displays 6 submenus and **QUIT** (Figure 1). Menu items can be selected either by number, by highlighting with the arrow keys and pressing [Enter] or by pointing and clicking the left mouse button.
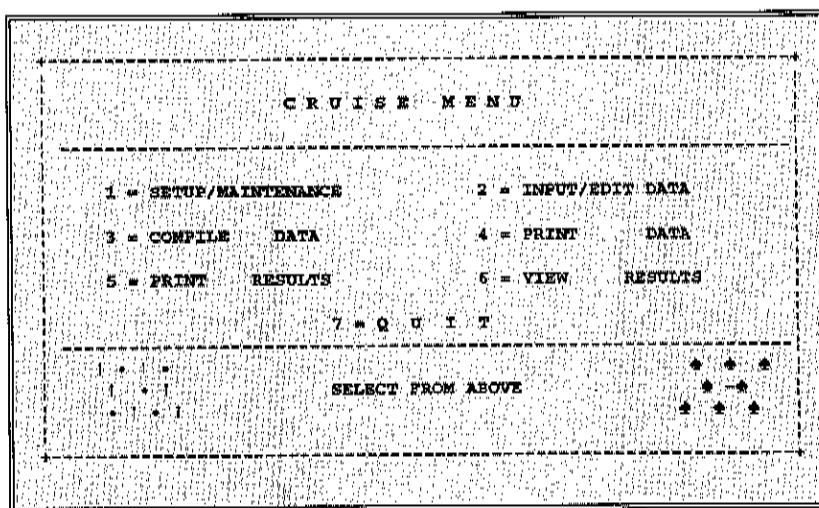

Figure 1. Example of the CRUISE MENU.

Data Management:

1 = Setup/Maintenance (Figure 2)

Options include:
- DIRECTORY→MAKE DIRECTORY Creates directories for data storage . This operation copies blank data structures from TEMP to the new directory.
- DIRECTORY→CHANGE DIRECTORY Select a working directory.
- COPY DATA. Copy data, from one directory to another existing directory. BLOCK/STAND's that already exist in the target directory will not be copied. This will be noted in a verification message.
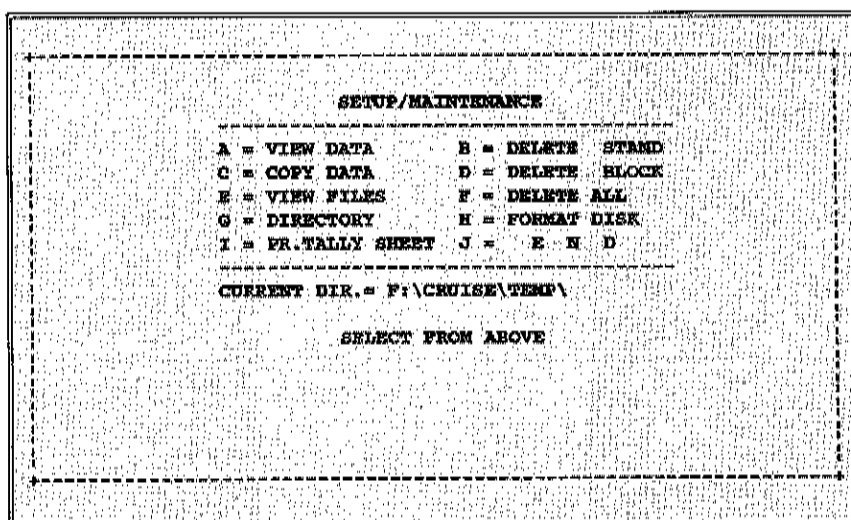- PR.TALLY SHEET. Print a tally sheet (metric or imperial) and code list for cruising.


```
                    SETUP/MAINTENANCE

        A = VIEW DATA          B = DELETE  STAND
        C = COPY DATA          D = DELETE  BLOCK
        E = VIEW FILES         F = DELETE  ALL
        G = DIRECTORY          H = FORMAT DISK
        I = PR.TALLY SHEET     J =     E  N  D

        CURRENT DIR. = F:\CRUISE\TEMP\

                    SELECT FROM ABOVE
```

Figure 2.   Example of SETUP/MAINTENANCE menu.

Data Entry:

2 = Input/Edit (Figure 3)

The desired units, metric or imperial, are selected prior to each input session. All STANDS in a BLOCK should be entered using the same units (metric or imperial).

   The INPUT screen contains 6 sections (data files) 1) HEADER, 2) PRODUCT, 3) SPECIES, 4) DIAMETER, 5) HEIGHT, and 6) PRODUCT DESCRIPTION. Movement between each section is accomplished with [Page Up] [Page Down] . The program identifies and links each section with the "keyfields", BLOCK and STAND.

   When preparing to enter new data, BLOCK and STAND should initially read "0" (if necessary, reset screen by positioning cursor in Header section and pressing [F2]). If entering a series of stands from the same BLOCK, [F1] will reset the screen carrying forward the common BLOCK information.

Figure 3. Example of a metric INPUT SCREEN, which is composed of 6 sections (files). The Header, Product, and Species sections are contained in the upper box, while the Diameter, Height, and Product Description sections appear in their own boxes below.

When an existing BLOCK/STAND is entered it will appear in the INPUT screen. Full data editing is possible at this point, and **users are cautioned** that changes are immediate and permanent. The 6 data files can be accessed separately using the "EDIT" menu selections.

Enter cruise data in the following fields (see Appendix I for cursor movement). Fields which require data appear in UPPER CASE, optional fields are in lower case.

Header File

BLOCK	A unique number used to identify the parcel of land being inventoried (e.g. Woodlot#). Used in conjunction with STAND to identify the forest units and link the data files. Can only be input from the Header section. Must not be duplicated for other parcels.
STAND	Used to identify the forest stands within each block, and link data files. Can only be input from the Header section. Must be kept unique within each BLOCK.
map #	User defined
AREA (HA)	Stand Area
B.A. FACTOR	Prism Factor - enter for point samples.
PLOTAREA(HA)	Plot Size - enter for fixed plot samples
NO.PLOTS	Number of plots/points measured
date -dmy	Day/Month/Year
location	User defined
county	Name of county
lc	Land Capability Class
COV.	Covertype Code. Only codes 1, 2, and 3 represent stands with merchantable

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volume. Data compilation will not be performed on stands with other codes. Press $\boxed{\text{F7}}$ for pick list.

owner	Name of landowner
cruiser	Name of cruiser
OPR(%)	Operability. Enter percentage of the stand considered operable. This value will be used to calculate operable volume.
memo	Memo field used for storing notes. Enter "Y" to access notepad. Press $\boxed{\text{Ctrl}}$ + $\boxed{\text{W}}$ to exit.
trt.	Treatment recommendation code. Press $\boxed{\text{F8}}$ for pick list. This value will be used to produce a sorted table.

> Press $\boxed{\text{Page Down}}$ to enter Product information

Product File

<-PROD.   Enter a product code for each product type defined by the cruiser (e.g. R1=pulp, R2=stud, S1=sawlog). Enter UM for unmerchantable products, R1 to R6 for roundwood products (e.g. pulp, firewood), and S1 to S6 for sawlog products (New Brunswick log rule). Each product code can be repeated and assigned different species codes. A maximum of 13 fields exist for product codes. These columns are labelled "UM", "<-ROUNDWOOD->"and "<—SAWLOGS—>" to help organize work, however any valid product code can be used in any of the 13 columns. Product assignment (definition) must remain the same for all stands in a BLOCK.

> Press $\boxed{\text{Page Down}}$ to enter Species information

Species File

<-SPEC.   A species code must be assigned to each product code. Press $\boxed{\text{F5}}$ for pick list Volume calculations use species specific form factors (Appendix II).

> Press $\boxed{\text{Page Down}}$ to enter Diameter information

Diameter File

DBH	Enter the Diameter Classes (Breast Height, outside bark) for which tallies are to be entered.
UM to 6->	Enter tally for each DBH Class under the appropriate product column. Entries are not permitted for roundwood codes (R) at DBH's less than 8 cm, and for sawlog codes (S) at DBH's less than 12 cm. To prevent loss of last value entered, press $\boxed{\text{Enter}}$ before exiting this file.

> Press $\boxed{\text{F1}}$ to Insert another DBH record
> Press $\boxed{\text{Page Down}}$ to enter Height information

Height File

PROD   Enter product code. At least one height entry must be made for each assigned product code.

spec   Enter species code, or press ⌷F5⌷ for pick list. This field is used solely for information purposes, since average heights are only calculated to the product level.

HEIGHT   Enter the measured heights of the "trees of average basal area" for each product type (in a stand of all one product type the height of the "tree of average basal area" would normally be equivalent to the average height of the co-dominants). A default value of 6.1 m (20 ft) is used for UM product height, if not entered.

age   Years

> Press ⌷F1⌷ to Insert another Height record
> Press ⌷Page Down⌷ to enter Product Description File

Product Description File

This section is optional, however it is important for keeping work organized. Product assignment (definition) must remain the same for all stands in a BLOCK!

prod.   Product Code

$value$ Enter a value for each product. Roundwood products (R) are entered in $/m³stacked or $/cord, and Sawlog products (S) in $/m³solid or $/Mfbm.

description   Enter a description for each product (e.g. R1 = pulpwood).

> Press ⌷F1⌷ to Insert another Product Description
> Press ⌷F4⌷ to quit Input Screen

Output:

3 = Compile Data

Data compilation must be performed prior to requesting cruise summary reports. Compilations remain resident in the program until another compilation is performed. At this time the previous compilations are overwritten.

  Factors to compute merchantable wood yields are displayed, and can be accepted by pressing ⌷Enter⌷ or changed as desired:

Stump Height = 15 cm (6 in.)
Top Diameter inside bark = 7.62 cm (3 in.)
Cull Factor = 8 %, average losses for manual shortwood harvesting (Eddy and Snow, 1982)

Weight Conversion (stacked wood to green weight including bark)*.

 softwood = 0.53 metric tonnes/m3 (stacked)
     = 1.91 metric tonnes/cord
 hardwood = 0.57 metric tonnes/m3 (stacked)
     = 2.08 metric tonnes/cord

4 = *Print Data*

Raw cruise data is printed in a format similar to the cruise sheet.

5 = *Print Results (Figures 4 & 5)*

Print a variety of summary tables in either metric or imperial. Total and merchantable wood yields, as well as "operable harvest estimates", are presented in various units (m3stacked, cords, Mfbm, tonnes, etc.) with subtotals by product, species, and maturity. Summaries include: AGE, AREA, BASAL AREA, DBH, HEIGHT, OPERABILITY, STAND INDEX, STEM FREQUENCY, TREATMENT, VALUE ($), and VOLUME.

6 = *View Results*

View the summary tables described in section 5 above.

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* Based on sampled mill deliveries in Nova Scotia. Pers. comm. Alton Sutherland, Supervisor of Scaling, NSDNR JR

Figure 4. Example of imperial output - BLOCK SUMMARY OF ACCESSIBLE VOLUME BY MATURITY AND PRODUCT.

VIEW.PRG [Read Only]

==
.... S T A N D   S U M M A R Y   BY   P R O D U C T (metric) ......
==

BLOCK #. =6   STAND #.   = 1   MAP # =11F15   AREA=2.5   ha/6.2
BA.FACTOR=2 (m)   PLOT AREA(HA)= 0.00000 PLOT # =2   DATE(DMY)= / /
LOCATION =MACKINNON HARBOUR   COUNTY =VICTORIA   LC =5   COVER =
OWNER   =M. MACNEIL   CRUISER=MICHAEL   OPR.%=100 TREAT.=

```
                        === COVER TYPE=  OVERMATURE      ===
```

P	S	DBH	HT.	FREQ.	B.A.	V O L U M E per H E C T A R E						
R	P			/ha.	/ha.	TOTAL	MERCHANTABLE		ROUNDWOOD		LOG	CHIP
O	E											
D	C											
.	.	cm	m	#	m2	m3	m3	m3(st)	m3	m3(st)	m3	M.ton

R1	WS	14.5	12.0	1045	17.0	95.0	74.4	119.0	74.4	119.0		63.1
tot.=		14.5	12.0	1045	17.0	95.0	74.4	119.0	74.4	119.0		63.1
TOT.=		14.5	12.0	1045	17.0	95.0	74.4	119.0	74.4	119.0		63.1
R2	RM	13.5	12.0	484	7.0	35.7	27.1	43.4	27.1	43.4		24.7
tot.=		13.5	12.0	484	7.0	35.7	27.1	43.4	27.1	43.4		24.7
TOT.=		13.5	12.0	484	7.0	35.7	27.1	43.4	27.1	43.4		24.7
S1	WS	17.0	14.0	526	12.0	75.2	61.9	99.0			57.63	52.5
tot.=		17.0	14.0	526	12.0	75.2	61.9	99.0			57.63	52.5
TOT.=		17.0	14.0	526	12.0	75.2	61.9	99.0			57.63	52.5
G.T.=		16.9	12.7	2055	36.0	205.9	163.4	261.4	101.5	162.4	57.63	140.3

```
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
+ STAND INDEX(manual)= 8   TREES / M3(st) (mechanical)= 8   TREES / M3(st) +
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

MEMO:


VOLUME FACTORS: Stump Ht = 0.15 m   Top Dib = 7.62 cm  Cull & Waste (%)= 8
                Tonnes(sw) =0.53 per m3(stk)  Tonnes(hw) = 0.57 per m3(stk)
DATE= 29/02/96                                              PAGE= 1
```

Figure 5.   Example of metric output - STAND SUMMARY BY PRODUCTS.

Literature Cited

Eddy, A. and K. Snow, 1982. *Logging residue survey.* N.S. Dept. of Lands and Forests, For. Tech. Note #2. 4 pp.

Honer, T.G., 1967. *Standard volume tables and merchantable conversion factors for the commercial tree species of central and east-* *ern Canada.* Canada Dept. of Forestry and Rural Development, Forestry Branch, Information Report FMR-X-5. 153 pp.

Husch, B., C.I. Miller, and T.W. Beers, 1972. *Forest mensuration.* Second Edition Toronto: John Wiley and Sons, p.182.

Within a Data File:

Key	Description
→ ←	One space in indicated direction
↑ ↓	Movement to an adjacent record or file (change lines).
Ctrl + ↑ ↓	In BLOCK position (Header File), movement to a new stand.
Enter	• Movement to the next field, replacing the old entry with a new one, or • Movement to the next file, when cursor is positioned in the last field (Header, Product or Species files), or • Insert a new record when cursor is positioned in the last field (Diameter, Height, Product Description files)
End	Go to last record (bottom of file)
Home	Go to first record (top of file)
F1	Insert a new record (line) for data entry, with much of the information from the previous record carried forward.
F2	In Header File, add a new "empty" record (blank and/or "0" filled), in preparation for data entry on a new stand.
F5	Display species pick list
F6	Display product pick list
F7	Display covertype pick list
F8	Display treatment pick list
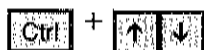
F9	Delete Record. If used in the Header file section of the INPUT screen, the entire stand (all data in all files) is prompted for deletion. If used in the Diameter, Height, or Product Description files, the specified record is marked for deletion and will be removed later.
F10	Find. Locate specific data by the block and stand number, record number, or sorted list.
F12	With cursor in Header section, this function checks all sections of Input screen for errors or missing data. A good practice after completing entry for each new stand, however users should still manually check data to validate entry.

Between Data Files:

Page Up Page Down	Movement to adjacent data file

Quit:

F4	Exit screen, and return to Main Menu.
Esc	Exit screen, and return to Main Menu

Volume Calculation

Volume estimates are calculated in the program using a variation of the "Stand Volume from Tree of Mean Volume" method described in Husch, Miller, and Beers (1972). In this method, stand volume is obtained by multiplying the volume of the "tree of average volume" by the number of trees in the stand.

The volume of the "tree of average volume" is determined from the diameter and height of the "tree of average basal area" and Honer's volume equations (Honer, 1967). Separate calculations are made for each product/species combination. These volumes are summed to determine stand volume.

An expansion factor of 1.6 is used to convert solid volumes (wood only) to stacked measures (wood, bark and air).

Total Volume

The solid volume of all trees tallied, including the stump and top.

Merchantable Volume

The volume of the merchantable bole of all trees classified as roundwood products (R-code) or sawlog products (S-code) expressed in solid and stacked measures (excluding stump and top). Default stump height is 15 cm (6 in) and top diameter limit is 7.62 cm (3 in) inside bark. These values can be adjusted before compilation.

Roundwood Volume ("R" Code)

The merchantable volume of the roundwood products (R-code) are expressed in solid and stacked measure. This excludes the stump and top according to the same limits applied to the merchantable volume calculation.

Sawlog Volume ("S" Code)

A measure of the merchantable bole of all trees classified as sawlog products (S-code). In metric this is presented as solid volume (m³). In imperial it is an estimate of yield, presented as thousands of board feet (Mfbm, N.B. Log Rule; Honer, 1967).

Sawlog volume excludes the stump and top and is based on 16.5 foot logs. Top diameter limit is set at 10.16 cm (4 inches) and cannot be adjusted. Stump height is set according to the same limits applied to the merchantable volume calculation.

Chip Volume

An estimate of the "green" weight of the merchantable wood (including bark). This is presented in metric tonnes for both metric and imperial output summaries. Default conversion factors can be changed prior to compilation.

Frequency

The number of trees per unit area.

Basal Area

The cross-sectional area, at breast height per unit area.

Tree of Average Basal Area

Total Basal Area divided by Total Frequency.

Average Diameter

The diameter of the tree of average basal area.

Average Height

The average of the measured heights. These should be representative of the tree of average basal area for the specified product type.

Stand Index (manual)

The frequency of merchantable trees divided by the merchantable volume (trees/m^3 stacked or trees/cord).

Stand Index (mechanical)

The frequency of all trees divided by the merchantable volume (trees/m^3 stacked or trees/cord).

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HEIGHTS (Minimum of 1 per product)										PRODUCT DESCRIPTION		
#	Prod	Spec	Ht	Age	#	Prod	Spec	Ht	Age	Prod	Value	Description
1					14							
2					15							
3					16							
4					17							
5					18							
6					19							
7					20							
8					21							
9					22							
10					23							
11					24							
12					25							
13					26							

COMMENTS:

CRUISE TALLY SHEET

BLOCK #_____ STAND #_____ MAP #_____ STAND AREA (ha/ac) _____

BA FACTOR_____ PLOT AREA (ha/ac) _____ NO. PLOTS_____ DATE (D/M/Y) _____/_/_

LOCATION_____ COUNTY_____ LC_____ COVER ____

OWNER _____ CRUISER_____ ACCESS (%) _____ TREATMENT _____

DIAMETER CLASS	UM	ROUNDWOOD							SAWLOGS						
Prod →															
Spec →															
"QUICK" TALLY															
DBH= →															
DBH-= →															