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INCA Users' Guide:The INventory to CACTOS Conversion Program

by

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Abstract

INCA is designed to produce stand description files for the CACTOS system using data collected in the U.S.F.S. Region 5 inventories. The program runs on PC-compatible micro-computers and the Forest Service Data General series mini-computers. The necessary coefficients and conversion factors are provided, though they may change with experience.

INCA is an interface between the standard USFS Region 5 inventory analysis system and the CACTOS system (Wensel, et. al., 1986). The function of INCA is to reformat the inventory data, estimate the average CACTOS site index, and construct the necessary tree records to form CACTOS stand description files. Site index is averaged over either cluster plots or stands, as selected by the user at runtime. Tree records are processed the same way regardless of the method of site index averaging. More detail on the processing of site index and tree records follows.

The sequential process for producing CACTOS stand description files from standard USFS Region 5 inventory files is illustrated in Figure 1. Field data recorded on inventory form R5-2400-207 (see appendix) is run through either FIA-EDIT (in development), or CONVERT (step 5) in order to validate and sort the data. The output files are then run through INCA to produce data files suitable for running through STAG, the STAnd Generator for CACTOS (Biging and Meerschaert, 1987). STAG will fill in any missing data and produce stand description files suitable for running through CACTOS.

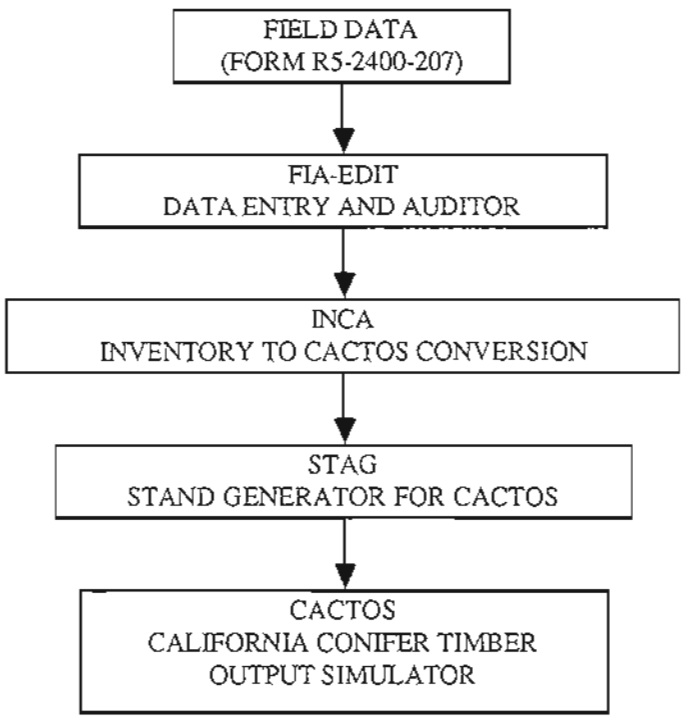

Figure 1. Inventory to CACTOS conversion path.

Site index

CACTOS requires a separate site index for each species in the stand, to account for different productivity levels (Biging and Wensel, 1987). INCA determines site index for each species from either (1) the average calculated site index of site trees (trees less than 100 years old with crown ratios greater than 0.30 for dominant trees and greater than 0.40 for codominant trees) for that species; (2) referenced from the calculated average site index of one or more of the 5 major species (ponderosa pine, Jeffery pine, white fir, red fir, and Douglas-fir) using the adjustment factors in Table 1; or (3) referenced from R5 site class default CACTOS site given below.

Table 1. Species adjustment factors for site index conversions.

CACTOS	SPECIES CODE	ADJUSTMENT FACTOR
1	Ponderosa Pine	1.00
2	Sugar Pine[1]	0.90
3	Incense Cedar[2]	0.76
4	Douglas-fir	1.00
5	White Fir	1.00
6	Red Fir	1.00
7	Lodgepole Pine[2]	0.82
8	Western White Pine[2]	0.90
9	Jeffery Pine	1.00
10	Misc. Conifers	1.00
11	Chinquapin[3]	0.54
12	Black Oak[4]	0.57
13	Tan Oak[5]	0.54
14	Other Hardwoods[6]	0.52

1 Dunning and Reineke, 1933
2 Calculated from California National Forest inventory data
3 Assumed to be the same as Tanoak
4 Powers, 1972
5 MacDonald, 1983
6 Madrone factor from MacDonald, 1983

The R5 site classes are given in The R-5 Timber Management Plan Inventory Handbook (R-5 FSH 2409.21b). The conversion between the R5 site classes and the CACTOS site indicies is based upon ages (adjusted to breast height) and total heights found in the Inventory Handbook. These conversions are shown in Table 2.

Table 2. Site Index Conversion Table

R5 site class	CACTOS site index
0	110
1	95
2	80
3	60
4	50
5	40

There are two alternate methods by which INCA process the site index data: by cluster plot within a stratum or by stand. The cluster plot option summarizes the site information for all site trees of each species and computes the average for each cluster plot. The stand option does the same for each stand. The format for the input data is the same for the two methods as shown in Table 3.

Table 3. INCA input data format.

COLUMNS	FORMAT	DATA IN COLUMNS
1	A1	Tree ID
19	I1	Site Class
23-26	A4	Stratum
33-34	I2	Elevation+100
35-38	I4	Stand Number
39-41	I3	Plot Number
42-43	I2	Point Number
46-50	F5.0	Basal Area Factor/Plot Size Class
51-52	I2	R5 Species Code
53-54	I2	DBH GROUP
55	A1	Crown Position
56	I1	Crown Ratio Percent÷10
64-67	F4.1	DBH (inches)
68-70	F3.0	Height (feet)
71-73	F3.0	Total Age

The user has the option of manually checking the results of the site averaging process. If this option is chosen, INCA will print out the species codes and their calculated site indices, along with a one letter code corresponding to how the site was determined ("c" if calculated average of that species site trees, "a" if referenced from average of major species site trees, "d" if referenced from R5 default CACTOS site class, or "u" if given by the user). The user can then change any of the site indicies that seem unreasonable. The program will also prompt the user for the elevation of the plot or stand if it is missing, the elevation being required in STAG.

Tree records

INCA processes individual tree records from the input file the same way regardless of the method of site index averaging. Individual tree dimensions of diameter, height, and crown ratio are either used directly or converted from the class data, if available.

Species codes are converted directly from the R5 species codes as shown in Table 4. Diameters for individual trees are used directly, if avaliable, or are obtained for the DBH group using the midpoint DBH shown in Table 5.

Total height is only placed in the output if it was available in the input file; if missing, a zero is placed in that field. STAG will fill in any missing total heights. Crown ratio is always present in R5 inventory data so it is used directly.

Table 4. R5 to CACTOS species code conversions.

USFS Region 5		CACTOS	
Code	Species	Code	Species
1	Douglas-fir	4	Douglas-fir
2	Bigcone Douglas-fir	10	Misc. Conifer
5	Redwood	10	Misc. Conifer
6	Giant Sequoia	10	Misc. Conifer
11	Ponderosa Pine	1	Ponderosa Pine
12	Jeffery Pine	9	Jeffery Pine
13	Sugar Pine	2	Sugar Pine
14	W.White Pine	8	White Pine
15	Lodgepole Pine	7	Lodgepole Pine
21	Coulter Pine	10	Misc. Conifer
23	Digger Pine	10	Misc. Conifer
24	Knobcone Pine	10	Misc. Conifer
25	Bishop Pine	10	Misc. Conifer
26	Whitebark Pine	10	Misc. Conifer
27	Singleleaf Pinyon Pine	10	Misc. Conifer
21	White Fir	5	White Fir
32	Red Fir	6	Red Fir
33	Grand Fir	10	Misc. Conifer
46	Brewer Spruce	10	Misc. Conifer
47	Mountain Hemlock	10	Misc. Conifer
48	Western Hemlock	10	Misc. Conifer
51	Incense Cedar	3	Incense Cedar
53	Port-Orford-cedar	10	Misc. Conifer
54	Western Redcedar	10	Misc. Conifer
61	California-nutmeg	10	Misc. Conifer
62	Pacific Yew	10	Misc. Conifer
63	Western Juniper	10	Misc. Conifer
64	Cypress	10	Misc. Conifer
71	Red Alder	14	Misc. Hardwood
72	Ash	14	Misc. Hardwood
73	Aspen	14	Misc. Hardwood
75	Black Cottonwood	14	Misc. Hardwood
76	Bigleaf Maple	14	Misc. Hardwood
81	California Black Oak	12	Black Oak
82-86, 88	Other Oak	14	Misc. Hardwood
87	Tanoak	13	Tan Oak
91	California Laurel	14	Misc. Hardwood
93	Giant Chinquapin	11	Chinquapin
94-96,98	Other Hardwoods	14	Misc. Hardwood

Table 5. Midpoint DBH's from R5 DBH group

DBH group	Midpoint DBH
2	4.2
8	8.8
14	14.9
21	21.2
27	27.1
35	35.2
40	45.0

The tree expansion factor (number of trees per acre) is calculated as follows:

Plot type	Expansion factor
fixed area	43,560 ÷ plot size
variable radius	BAF ÷ basal area of tree

where BAF is the Basal Area Factor of the prism. (Note: seedling tree records are ignored in INCA) Species codes are converted from Region 5 codes to CACTOS codes as shown in Table 2.

The requirements given for selecting a tree to apply Dunning's site index classification system are as follwos:

(1) Tree position must be predominant or dominant and have grown freely all of it's life.

(2) The tree must be at least 50 years old.

(3) Tree species must be either Douglas-fir; white or red fir; or ponderosa, Jeffrey, or sugar pine

(4) The tree must be of a suitable form class so that it is representative. (For example, a rough cull does not qualify as a site tree.)

(5) The tree must have its orignial top.

Tree heights by age are show in table 6 for each of the R5 site classes.

Organization of the Output

There are two options for organization of the output, by stratum or by stand. The output from INCA will be in as many different CACTOS stand description files as there are distinct strata or stands in the input data. These files will be named using the identifier from the input file (stratum label or stand number) followd by the ending ".sd" (for "stand description"). INCA will also produce the CACTOS batch mode filename files that are necessary to run multiple stands through CACTOS. Operation of INCA is illustrated in the annotated sample runstream in the Appendix.

Literature Cited

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TABLE 6. REGION FIVE SITE CLASSES
(HEIGHT BY AGE AND SITE CLASS CODE)

	Site Class					
Age	0	1	2	3	4	5
40	95	81	66	49	43	35
50	106	90	75	56	49	39
60	115	98	82	63	53	43
70	122	105	88	68	58	45
80	129	111	93	73	61	48
90	135	116	98	77	64	50
100	140	121	102	81	67	54
110	145	125	106	84	70	54
120	149	129	109	87	72	55
130	153	133	112	90	74	57
140	157	136	115	93	76	58
150	160	139	118	95	78	60
160	163	142	120	98	80	61
170	166	144	123	100	81	62
180	169	147	125	102	83	63
190	172	149	127	104	84	64
200	175	152	129	106	86	65
220	179	156	133	109	88	67
240	184	160	136	112	90	68
260	188	163	139	115	93	70
280	191	166	142	117	95	71
300	195	169	145	120	96	73
320	198	172	147	122	98	74
340	201	175	150	124	100	75
360	204	177	152	126	101	76
380	206	180	154	128	103	77
400	209	182	156	130	104	78

Note: Based on ponderosa pine, Jeffrey pine, sugar pine, Douglas-fir, red fir, and white fir. Age is in years. Total height is in feet of average dominant and predominant trees with tree age of at least 50 years. Adapted from Dunning's site index curves for height at 300 years. Bulletin #28 Forest Research Notes 12/1/42 rerun 11/58.

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90	135	116	98	77	64	50
100	140	121	102	81	67	54
110	145	125	106	84	70	54
120	149	129	109	87	72	55
130	153	133	112	90	74	57
140	157	136	115	93	76	58
150	160	139	118	95	78	60
160	163	142	120	98	80	61
170	166	144	123	100	81	62
180	169	147	125	102	83	63
190	172	149	127	104	84	64
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Appendix A. Sample Runstream

The following runstream illustrates how the user would go about running INCA. The user entries are in boldface.

```
INCA


                    Welcome to INCA

          The INventory to CActos conversion program

 Open the CONVERT input file
 Enter a file name here: STAND.DATA


 How should the output be organized:
        [1] by stratum
        [2] by stand

 Enter here: 2


Do you want to enable manual site checking? y


Manual site check, stratum = M3N stand =  201

 species    1    2    3    4    5    6    7    8    9   10   11   12   13   14
    site  101.  91.  77. 101. 101. 101.  83.  91. 101. 101.  55.  58.  55.  53.
  source    a    a    a    c    a    a    a    a    a    a    a    a    a    a

any changes (y/n): y


enter species code, new site index (xx,xxx.): 02,98.


Manual site check, stratum = M3N stand =  201

 species    1    2    3    4    5    6    7    8    9   10   11   12   13   14
    site  101.  98.  77. 101. 101. 101.  83.  91. 101. 101.  55.  58.  55.  53.
  source    a    u    a    c    a    a    a    a    a    a    a    a    a    a

any changes (y/n): n


Manual site check, stratum = M4N stand =  218

 species    1    2    3    4    5    6    7    8    9   10   11   12   13   14
    site  102.  92.  77. 102. 102. 102.  84.  92. 102. 102.  55.  58.  55.  53.
  source    d    d    d    d    d    d    d    d    d    d    d    d    d    d

any changes (y/n): y


enter species code, new site index (xx,xxx.): 02,98.
```

```
Manual site check, stratum = M4N stand =  218

 species    1    2    3    4    5    6    7    8    9   10   11   12   13   14
    site  102.  98.  77. 102. 102. 102.  84.  92. 102. 102.  55.  58.  55.  53.
  source    d    u    d    d    d    d    d    d    d    d    d    d    d    d

any changes (y/n): n


  File name file     # nonstocked   File name file     # nonstocked
  201.FN         ....         0      218.FN         ....         0
STOP  NORMAL PROGRAM COMPLETION
```

USDA - FOREST SERVICE — R5-TIMBER MANAGEMENT

CLUSTER PLOT RECORD

CREW:

COMMENTS:

PLOT DIAGRAM
NORTH
100 Ft.
EAST

PLOT IDENTIFICATION AND LOCATION

1. RECORD TYPE	2. NATIONAL FOREST	3. WORKING CIRCLE	4. DISTRICT	5. COMPARTMENT	6. STRATUM	7. PLOT NO.	8. DATE MM YY	9. SITE CLASS	10. MAP SHEET	11. STAND NO.	12. ASPECT	13. SLOPE	14. ELEVATION	15. ECOLOGICAL TYPE
X	XX	X	X	XXX	XXXX	XXX	MM YY	X	XXXXXX	XXXX	X	X	XX	XXXXXX
A														

TREE RECORD

16. RECORD TYPE	17. POINT NO.	18. PLOT FACTOR	19. TREE NO.	20. SPECIES	21. POSITION	22. CROWN RATIO	23. MISTLETOE RATING	24. DEATH/DEFECT	25. OPTIONAL CLASSIFICATION	26. DBH 0.1 INCH	27. HEIGHT FEET TO TIP	28. AGE YEARS	GROWTH 29. PAST 10 Yr. 1/20" OR PAST 5 Yr. HT. (Ft.)	GROWTH 30. ACCUMLATED PAST 20 Yr. 1/20"
X	XX	XXXXX	XX	XX	X	X	XX	XX	X	XXXX	XXX	XXX	XXX	XX

ABCDEFGHIJKLMNOPQRSTUVWXYZ 1234567890

Appendix B. U.S.F.S Field Form R5-2400-207 (page 2)

TREE RECORD

16. RECORD TYPE	17. POINT NO.	18. PLOT FACTOR	19. TREE NO.	20. SPECIES	21. POSITION	22. CROWN RATIO	23. MISTLETOE RATING	24. DEATH/DEFECT	25. OPTIONAL CLASSIFICATION	26. DBH 0.1 INCH	27. HEIGHT FEET TO TIP	28. AGE YEARS	GROWTH 29. PAST 10 Yr. 1/20" OR PAST 5 Yr. HT. (ft.)	GROWTH 30. ACCUMLATED PAST 20 Yr. 1/20"
X	X X	X X X	X X	X X	X	X	X X	X X	X	X X X X	X X X	X X X	X X X	X