CFI OVERVIEW

The Continuous Forest Inventory plots were installed in 1959. Forest managers recognized the need for a "system of frequent repeated inventories designed to keep a current record of changing forest conditions … to assure stability and continuity of management. [To achieve this] it is necessary to know the total merchantable volume of timber, its rate of growth, and the structure of the stand." 143 plots were installed on a systematic grid with an interval of sixty chains. This would result in an accuracy estimate for gross board foot volume of ± 12% with a 5% confidence interval. Subsequent measurements were made in 1964, 1969, 1974, 1979, 1984, 1989, 1999, and 2005. Generally the plots are re-measured every five years. However, the 1994 measurement was missed, and 6 years elapsed between 1999 and 2005.

In 1989 the field procedure underwent major changes. Most significantly, the plot size changed from a ½ acre rectangular plot to a 1/5 acre circular plot. This presents significant challenges for the continuity of growth estimates from 1984 and previous to 1989 and later. Some of these challenges are addressed in Appendix I. Additionally, there were many minor changes in the types of attributes and their allowed values collected for each tree. These changes are described in table 1 below.

PLOT HISTORY

Below is a table showing the number of potential plots for each year and the number of actual plots installed each year. The *missing plots* column names plots that should have been installed, but no plot sheet was found.

Table 1.

Cycle	# of possible plots	# of actual plots	Missing plots	Remarks
1959	144	144	-	
1964	144	143	03-06	
1969	144	144	-	
1974	142	142	-	16-08 & 17-07 were dropped when a parcel was given up by State due to Mendocino Headlands SP purchase
1979	141	141	-	07-09 dropped when parcel was transferred to Parks and Recreation
1984	141	141		
1989	141	139	02-06, 03-08	Plot size change from ½ acre to $^1/_5$ acre
1999	141	141	-	11-03 not found. 11-03b installed
2005	141	141	-	11-03 again in place of 11-03

PLOT LAYOUT

1959 to 1984

The ½ acre main plot is used to record trees 11.0" diameter breast height (DBH) and greater. The $^1/_4$ acre subplot was only used in 1959. Heights were measured for all conifer trees which were used to develop height-diameter relationships. The $^1/_{25}$ acre subplot is used to record pole size trees from 3.0" DBH to 10.9" DBH. The 40 1-

milacre (6.6 ft^2) subplots are used to record presence of (stems are not counted) coniferous reproduction less than 3.0" DBH.

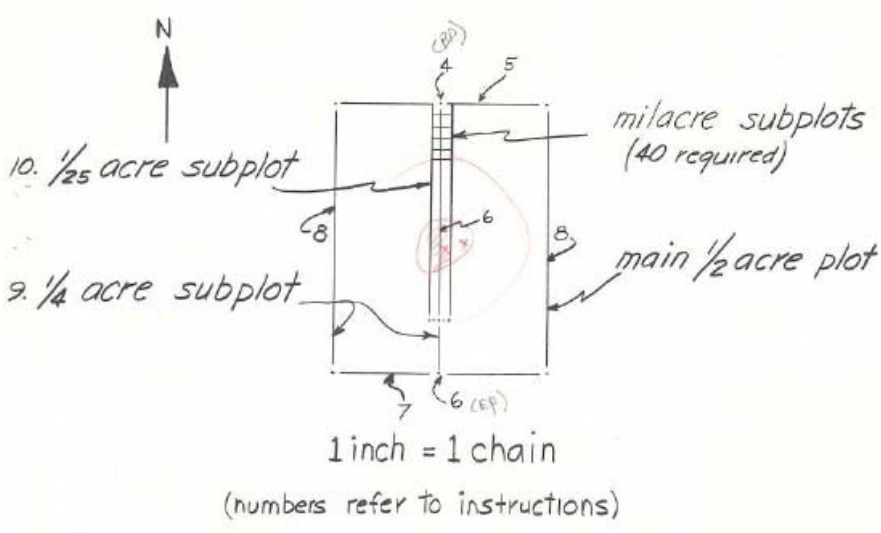

Figure 1. 1959 plot layout.

1989 to 2005

In 1989 the plot size was changed from a ½ acre rectangular plot to a $^1/_5$ acre circular plot. The subplot measurement was changed to $^1/_{20}$ acre and is now used to measure trees from 7.0" DBH to 10.9" DBH. The $^1/_{100}$ acre regeneration plot is used to tally number of trees greater than 4.5 feet and less than 7.0" DBH by species and 2" DBH class.

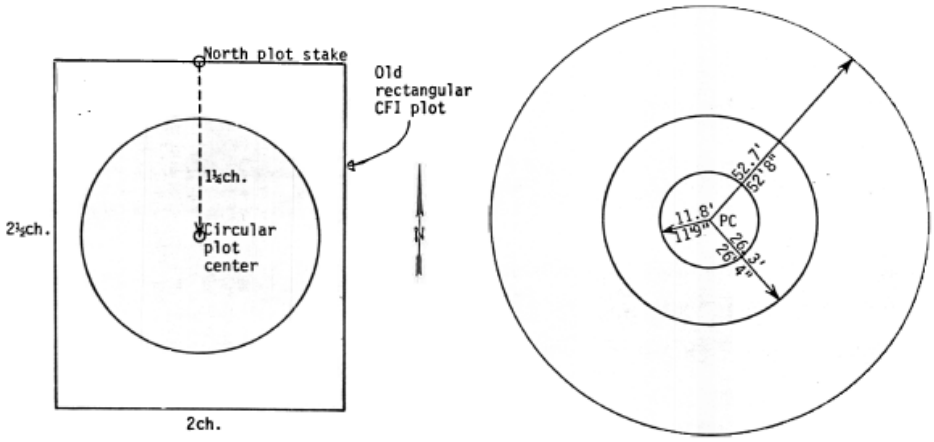

Figure 2. 1989 Plot layout

TREE DATA

The tree data collected for trees on the main and subplot is stored in the *Trees* table in the database. Data for all the measurement cycles appear in this table, so many of the fields will be populated only for trees measured 1984 and previous, and other fields will be populated only for trees measure 1989 and later. All the possible codes

for each field are not included in the table below. See the appropriate field procedures manual for a complete description of allowable codes and their descriptions.

Table 2. *Trees* Database Table

Field	1959-1984	1989-2005	Comment
Tree#	X	X	See discussion in Appendix I.
Species	X	X	Numeric codes changed in 1989. In 2005 alpha codes were added.
Status		X	Numeric code for Survivor, ingrowh, mortality, harvest, etc. Alpha codes added in 2005.
Disposition	X		Similar to status, but slightly different codes.
DBH	X	X	Recorded to 0.1" at DBH (4.5 feet). For 59-84 recorded as $^{1}/_{10}$ inch (divide by 10 to arrive at inches)
LCR	x	X	Live Crown Ratio. % of total height of tree occupied by live crown. Previous to 1989, it was measured in 1979 only.
Defect		X	Subplot only. Defect code such as catface, fire scar, fork, etc.
%defect			% deduction for loss of board foot volume from merchantable portion of tree.
Defect pre89	X		Defect codes by species.
Merch Class	X		Merchantability class. Examples include Live merch, live cull, etc.
Crown Class	X		Dominant, Codominant, Intermediate, Oppressed, Suppressed.
Vigor Class	X		Codes which describe crown length, density, width, foliage, position.
Abnormality	X		Defect codes such as scarred, dead top, leaning, crook, sweep.
height	X	X	Measured on subplot in 1959. Then remeasured in 79, 98, 99 and 2005.
10 yr RG		X	Measured for ingrowth trees
5 yr RG	X		Measured for ingrowth trees in 1959 only
Tag #		X	The tag # found at breast height. This may differ from the Tree#. See discussion in Appendix I.
Plot ID	X	X	The unique ID which relates each tree to the plot# and measurement period.
Sub Plot		X	An indication of whether the tree falls on the subplot.

Tree Numbering and Plot Re-Configuration Issues

There are two major issues that arise when attempting to track inventory growth and individual trees through the 1959 to 2005 measurement cycles. The first has to do

with tree numbering inconsistencies, and the second with the plot size and configuration change in1989. These are addressed below.

Tree Numbering Inconsistencies

In 1959 trees were numbered on the plot sheet, and a corresponding metal tag was placed on the tree at breast height. In subsequent years, many problems cropped up. A thorough description is given below in the section titled *Use of Tree Numbers in the Field and in the Database.*

The entire database was reviewed and every effort was made to give trees a consistent tree # through all the measurement periods. If a tree still exists on the plot in 2005, the database tree# and the metal tag at stump level coincide. Many tree numbers for trees that no longer exist on the plot were changed to avoid conflicts. The original tree # as entered originally in the left most column of the plot sheet can now be found in the *tracking_ID* field in the database. For a list of common changes that were made see the bulleted list below.

Often a tree number was duplicated on the plot. This doesn't mean there are 2 tree #2 in the field in 2005, but that #2 was used for a tree that died in 1984 and then the #2 was used again for a new ingrowth tree in 1989. This causes problems when trying to track trees through the entire database. In the future, the cruiser should have a list of all numbers previously used on the plot to ensure that once a tree number is used, it is retired indefinitely.

Plot Size Reconfiguration

As discussed earlier in this text, the plot size was reconfigured in 1989 from a ½ acre rectangular plot to a $^1/_5$ acre circular plot. The subplot and regeneration plot size also changed. In 1989 all trees were assigned new numbers in the field and the database. For the most part we were able to link surviving trees with their corresponding tree on the 1984 plot. However, this was not possible for virtually all the mortality and harvest trees. Also, there is a suspicious spike in trees coded as missed survivor for 1989 (348 trees compared to about 50 trees in a usual year) for which zero growth is assumed in the growth routine. For these reasons, the growth, harvest and mortality volume estimated from 1984 to 1999 is flawed and all three should be considered a very conservative (low) estimate.

List of Common Changes made to Correct Tree Tracking Issues

- Plot 08-04 the cruisers were not able to match any of the 1989 trees to the 1984 trees.
- If a tree was missed and then found the following measurement period, a tree was added in the missed period with a DBH ½ way between the two existing measurements. The remarks field contains a comment stating "Added with estimated DBH"
- If a tree was recorded, but they failed to enter a DBH, then an estimate dbh was entered, and a remark in the remarks field of "estimated DBH added in office"
- Trees that were determined to be out of plot were deleted.

- If a tree was shown as harvested the previous period and is entered on the plot sheet a second time as harvested , it was deleted from the second period.
- For the 2005 inventory effort, Marc Jameson has asked that fused trees be treated as 2 trees. Originally, in 1999 if trees were fused, one tree was dropped, and one tree given a DBH of the sum of both. This was changed in the following manner: For 1999, both trees were reassigned the DBH they had in 1989. Then in 2005 they were measured with a ½ diameter. This occurred on plot 09-05, 10-07, 11-04, 13-03, 13-04, and 23-01
- For pre-1989 plots, a duplicate tree record existed for some trees, one with a merchantability class of 7 (mortality tree) and the second with 8 (salvable dead tree). The tree record with merchantability class 8 was deleted.
- When a tree number is duplicated, the dead or harvested tree (which no longer exists on the plot) is given a new arbitrary # in the database. This arbitrary number is guaranteed not to be a duplicate tree number with any tree that existed at any time on that plot. However, it may be a tree number that was previously used for an already renumbered tree. This is very confusing, but here is an illustration. First, it should be pointed out that in 1989, when the plot size was reduced, that all trees got a new number in the field (and thus the database). Lets say tree #2 which existed from 1959 to present was renumbered in 1989 to tree #30, and still exists as tree #30 in the field. Then all tree #2s for 1984 and previous in the database will be given the new tree #30. Now, on the same plot there is another tree number conflict, and a tree that no longer exists in the field in 2005 needs to be assigned some arbitrary #. Well, the #2 might be assigned to this tree from 1959 to 1984 when it was harvested.

History of Tree Numbers as used in the field and in the database.

Below, *physical*# refers to the physical number printed on the metal tag out in the field. *Tree# field* refers to the tree number written on the left most column of the plot sheet. *Tag* field refers a field in the database which was added to hold the physical number in the field at DBH if it differed from the *tree*# field.

1959

The tree number is placed at DBH.

1964 and 1969

If a physical# changed, most often the *Tree#* field is updated, and a remark such as “was #xxx” or “previously #xxx” is given. However, there are some cases where the surveyor put a new physical# on the tree, but left the *tree*# field as is, and the only record of the change is a comment in the remarks field such as “new tag#xxx”. Then, in the following measurement cycle the *tree*# field is changed to match the “new tag#xxx” which also corresponds to the physical #.

1974

There are 90 trees that have a value in the *tag* field of the database. These are trees whose physical# and the number in the *tree*# field has changed. If the remark on the

paper plot sheet said “tag# xxx” then the data entry person put the previous physical# (*tree*# field) of the tree in the *tag*# field. However, there are also many trees with a remark with the same intent, but worded slightly differently such as “was #xxx” or “previously #xxx” and in this case the old physical# was not placed in the *tag*# field.

1979

In 1979 it was decided to retain the original # in the *tree*# field as a tracking# and not to update it to any new physical# in the field. The intent was to have a permanent tracking number in the *tree*# field. 337 trees had their physical# change and this value is entered into the *tag*# field.

1984

As before, the original # is retained in *tree*# field, and *tag*# field has actual # on tree.

1989

½ acre rectangular plots were changed to 1/5 acre circular plots. For most plots, the trees are given an entirely new number which is entered into tree# in the database and is also placed at stump height in field. In the remarks column can be found the reference to the physical dbh tag out in the field. This is the only number that will allow you to trace the tree back to 1984.

1999

As in 1989, the *tree*# field continues to correspond to the physical metal tag at **stump** height. The DBH tag# is now placed into the *tag*# field. With new ingrowth, a tree is given identical physical metal tags at stump and DBH height.

2005

As in 1999, except that if a physical DBH tag is missing or grown over, it is replaced with the number that corresponds to the *tree*# field and the physical stump #.