

# The Forest Inventory and Analysis Database: Population Estimation User Guide (Edition: March, 2017)

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# Preface

## Preface Contents:

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## Abstract

This document is based on previous documentation of the nationally standardized Forest Inventory and Analysis database (Hansen and others 1992; Woudenberg and Farrenkopf 1995; Miles and others 2001; Woudenberg and others 2010). Examples for producing population-level estimates are presented. This database provides a consistent framework for storing forest inventory data across all ownerships for the entire United States. These data are available to the public.

### Keywords:

Forest Inventory and Analysis, inventory database, user manual, user guide, monitoring

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## Authors

**Barbara M. O'Connell** is a Forester with the Forest Inventory and Analysis Program, USDA Forest Service, Northern Research Station, Newtown Square, Pennsylvania.

**Barbara L. Conkling** is a Research Assistant Professor in the Department of Forestry and Environmental Resources, North Carolina State University, Raleigh, North Carolina.

**Andrea M. Wilson** is a Forester with the Interior West Forest Inventory and Analysis Program, USDA Forest Service, Rocky Mountain Research Station, Ogden, Utah.

**Elizabeth A. Burrill** is a Forester with the Natural Resources Inventory, Monitoring and Assessment Program, Northern Research Station, Durham, New Hampshire.

**Jeffery A. Turner** is a Forester with the Forest Inventory and Analysis Program, USDA Forest Service, Southern Research Station, Knoxville, Tennessee.

**Scott A. Pugh** is a Forester with the Forest Inventory and Analysis Program, USDA Forest Service, Northern Research Station, Houghton, Michigan.

**Glenn Christensen** is a forester with the Forest Inventory and Analysis Program, USDA Forest Service, Pacific Northwest Research Station, Portland, Oregon.

**Ted Ridley** is an IT Specialist with the Forest Inventory and Analysis Program, USDA Forest Service, Southern Research Station, Knoxville, Tennessee.

**James Menlove** is an Ecologist with the Forest Inventory and Analysis Program, USDA Forest Service, Rocky Mountain Research Station, Ogden, Utah.

## Background

The Forest Inventory and Analysis (FIA) research program has been in existence since mandated by Congress in 1928. FIA's primary objective is to determine the extent, condition, volume, growth, and use of trees on the Nation's forest land. Before 1999, all inventories were conducted on a periodic basis. The passage of the 1998 Farm Bill requires FIA to collect data annually on plots within each State. This kind of up-to-date information is essential to frame realistic forest policies and programs. USDA Forest Service regional research stations are responsible for conducting these inventories and publishing summary reports for individual States.

In addition to published reports, the Forest Service provides data collected in each inventory to those interested in further analysis. This report describes a standard format in which data can be obtained. This standard format, referred to as the Forest Inventory and Analysis Database (FIADB) structure, was developed to provide users with as much data as possible in a consistent manner among States. A number of inventories conducted prior to the implementation of the annual inventory are available in the FIADB. However, various data attributes may be empty or the items may have been collected or computed differently. Annual inventories use a common plot design and common data collection procedures nationwide, resulting in greater consistency among FIA work units than earlier inventories. Data field definitions note inconsistencies caused by different sampling designs and processing methods.

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# Chapter 1: Introduction

This guide presents procedures written in Oracle SQL script that can be used to obtain population estimates (and associated sampling errors) for standard FIA attributes from the measurement data stored in the FIADB. These estimates follow the equations presented in Bechtold and Patterson (2005, chapter 4). Population estimates for many attributes can be generated using FIA web-based tools. The tools: [EVALIDator](#), [Design and Analysis Toolkit for Inventory and Monitoring \(DATIM\)](#), and [Forest Inventory Data Online \(FIDO\)](#), allow any user (who may or may not understand the underlying structure of the FIADB) to produce their own estimates. Another tool, FIADB SQL, allows advanced users to produce estimates by either creating their own SQL scripts, or copy/paste (along with any desired modifications) the SQL script examples in this volume. These tools can be found at <http://fia.fs.fed.us/tools-data>.

Users also have the option of downloading the data as either comma delimited files or Microsoft (MS) Access databases, allowing users to work offline. Due to size limitations, data are stored in individual State databases. MS Access SQL scripts differ slightly from the Oracle SQL scripts described in this guide, and are provided in the MS Access databases. These scripts can be used as a starting point to create customized queries suitable for local or regional analyses.

The FIADB can be used to estimate many attributes (e.g., forest area, timberland area, number of trees, net volume, biomass) from many different samples (typically State-wide inventories for a specific year or set of years). Therefore, the number of estimates that can be made from the FIADB is very large, and continues to increase as more data are added to the FIADB. This guide provides examples of a few estimation procedures that can be modified by the user. **The FIADB is continually updated. Therefore, the resulting estimates shown as output are examples only and are not necessarily the exact numbers a user will obtain using current data.**

In addition to the naming conventions used in the FIADB, reference is made to the notation and terminology used in Bechtold and Patterson (2005). To fully understand the statistical basis of the estimation, readers may find it useful to refer to that publication as they review this guide

This guide is divided into chapters that describe the basic steps required for traditional population-level estimates with sampling error (chapters 2-5). Additional steps are presented for those interested in custom-level and change over time analyses (chapters 6-8). Chapter 9 explains how users who have the ability to directly query the FIADB can incorporate expansion views in their scripts. The chapters in this guide describe the following steps:

- Chapter 2: Selecting the attribute of interest (the quantity that is to be estimated).
- Chapter 3: Selecting an appropriate sample (the area of interest).
- Chapter 4: Linking the appropriate tables in the FIADB to produce estimates for attributes of interest for a population.
- Chapter 5: Producing estimates with sampling errors for attributes of interest for a population.

- Chapter 6: Restricting the attribute of interest to a smaller subset of the population (e.g., filtering the data to include only sawtimber stands on publicly owned timberland, versus all stands in all ownerships).
- Chapter 7: Changing the attribute of interest with user-defined criteria.
- Chapter 8: Estimating change over time on the standard 4-subplot fixed-area plot.
- Chapter 9: Selecting an appropriate sample using population-by-evaluation-type views.



## Chapter 2: Selecting the Attribute of Interest

The most common attributes of interest in FIADB estimation are described in the REF\_POP\_ATTRIBUTE table. Attributes are defined at three levels (1) condition-level attributes for area estimates; (2) tree-level attributes for numbers of trees, volume, growth, removals, and mortality estimates; and (3) seedling-level attributes for number of seedlings estimates. Estimation of condition-level attributes requires accessing data on the PLOT and COND tables. Estimation of tree-level attributes requires accessing data on the PLOT, COND, and TREE tables. Estimation of seedling-level attributes requires accessing data on the PLOT, COND, and SEEDLING tables. Appendix A lists the attributes currently defined in the REF\_POP\_ATTRIBUTE table.

In this chapter we present examples that estimate:

- Area of timberland (REF\_POP\_ATTRIBUTE.ATTRIBUTE\_NBR = 3),
- Number of live trees on forest land (REF\_POP\_ATTRIBUTE.ATTRIBUTE\_NBR = 4),
- Net volume of growing-stock trees on timberland (REF\_POP\_ATTRIBUTE.ATTRIBUTE\_NBR = 18, and
- Number of live seedlings on timberland (REF\_POP\_ATTRIBUTE.ATTRIBUTE\_NBR = 46).

These are examples of condition-, tree-, and seedling-level attributes that can be modified to produce other estimates of attributes at these levels. For each attribute, the REF\_POP\_ATTRIBUTE table contains a unique ATTRIBUTE\_NBR, a description of the attribute (ATTRIBUTE\_DESCR), and the variables EXPRESSION and WHERE\_CLAUSE that are both portions of the SQL statements used to produce the estimates of the attribute. Table 2-1 lists these four variables for the four examples we are presenting. (Note: In EXPRESSION and WHERE\_CLAUSE, 'c' stands for COND table, 't' stands for TREE table, 's' stands for SEEDLING table, and 'pet' stands for POP\_EVAL\_TYP table.)

**Table 2-1:** REF\_POP\_ATTRIBUTE entries for the examples presented in this guide.

ATTRIBUTE NBR	ATTRIBUTE DESCR	EXPRESSION <sup>a</sup>	WHERE CLAUSE
3	Area of timberland, in acres	c.condprop_unadj* decode(c.prop_basis,'MACR', pop_stratum.adj_factor_macr, pop_stratum.adj_factor_subp)	and pet.eval_typ='EXPCURR' and c.cond_status_cd=1 and c.reservcd=0 and c.siteclcd in (1,2,3,4,5,6)
4	Number of live trees (at least 1 inch d.b.h/d.r.c), in trees, on forest land	t.tpa_unadj* decode(dia,null,adj_factor_subp, decode(least(dia,5-0.001),dia,adj_factor_micr, decode(least(dia, nvl(MACRO_BREAKPOINT_DIA,9999)-0.001), dia,adj_factor_subp,adj_factor_macr)))	and pet.eval_typ='EXPVOL' and t.plt_cn=c.plt_cn and t.condid=c.condid and c.cond_status_cd=1 and t.statuscd=1 and t.dia>=1.0
18	Net volume of growing-stock trees (at least 5 inches d.b.h), in cubic feet, on timberland	t.tpa_unadj* t.volcfnet* decode(dia,null,adj_factor_subp, decode(least(dia,5-0.001),dia,adj_factor_micr, decode(least(dia, nvl(MACRO_BREAKPOINT_DIA,9999)-0.001), dia,adj_factor_subp,adj_factor_macr)))	and pet.eval_typ='EXPVOL' and t.plt_cn=c.plt_cn and t.condid=c.condid and c.cond_status_cd=1 and c.reservcd=0 and c.siteclcd in (1,2,3,4,5,6) and t.statuscd=1 and t.treeclcd=2
46	Number of live seedlings (less than 1 inch d.b.h/d.r.c), in seedings, on timberland	s.tpa_unadj*adj_factor_micr	and pet.eval_typ='EXPVOL' and s.plt_cn=c.plt_cn and s.condid=c.condid and c.cond_status_cd=1 and c.reservcd=0 and c.siteclcd in (1,2,3,4,5,6)

<sup>a</sup>Note that for Microsoft Access SQL, the decode function is replaced with the IIF function

EXPRESSION is multiplied by the expansion factor POP\_STRATUM.EXPNS and summed at the condition level in the estimation procedure. In the notation used in Bechtold and Patterson (2005), this sum is  $P_{hid}$  for area estimation (see equation 4.1, page 47) or  $y_{hid}$  for the estimation of tree attributes (see equation 4.8, page 53). In all cases, EXPRESSION consists of the product of two terms, the first term (c.condprop\_unadj, t.tpa\_unadj, and s.tpa\_unadj in our examples) is the unadjusted observation of the attribute of interest (on a per acre basis). The second term is the appropriate stratum adjustment factor. The stratum adjustment factor is the inverse of the mean proportion of the sample plot areas that were within the population. Following the notation of Bechtold and Patterson (2005) this adjustment factor is  $1/\bar{p}_{mh}$  (see equation 4.2, page 49). The decode statement simply selects the appropriate adjustment factor to be used for the specific estimate. Area estimates use either ADJ\_FACTOR\_MACR (in inventories where area estimates are based on the macroplot) or ADJ\_FACTOR\_SUBP (in inventories where area estimates are based on the subplot) for the adjustment. The adjustment of tree- and seedling-level estimates is based on the plot on which the tree or seedling was sampled (seedlings and trees <5 inches diameter are sampled on the microplot, larger trees are sampled on the subplot or macroplot depending on diameter).

Common selection criteria used often with FIA data when creating queries include various classifications of land and groups of trees as shown below:

**Identifying land classes (COND table):**

<b>Classification</b>	<b>Selection criteria</b>
Forest land	COND_STATUS_CD = 1
Timberland	COND_STATUS_CD = 1, SITECLCD <7, RESERVCD = 0
Nonforest land	COND_STATUS_CD = 2
Reserved forest land	COND_STATUS_CD = 1, RESERVCD = 1
Unreserved forest land	COND_STATUS_CD = 1, RESERVCD = 0
Productive forest land	COND_STATUS_CD = 1, SITECLCD <7
Unproductive forest land	COND_STATUS_CD = 1, SITECLCD = 7

**Identifying tree characteristics:**

<b>Classification</b>	<b>Selection criteria</b>
Live trees	TREE.STATUSCD = 1
Standing dead trees	TREE.STATUSCD = 2, TREE.STANDING_DEAD_CD = 1
Growing-stock trees	TREE.STATUSCD = 1, TREE.TREECLCD = 2



# Chapter 3: Selecting an Appropriate Sample

In order to compute a sample-based population estimate<sup>1</sup>, the appropriate sample and stratification must be identified. In FIA estimation, the sample is a set of plots that were selected for the attribute of interest that was observed. The stratification consists of an assignment of plots to strata (non-overlapping areas of a known or estimated size) that in aggregate define the population of interest. There is an assignment of plots to every stratum, and all plots are assigned to one, and only one stratum, for each evaluation. FIA uses the term "evaluation" to reference the relationship that links a set of plots to a set of strata for estimation purposes. Thus, an evaluation is a set of plots defined in the FIADB that can be used to make a statistically valid sample-based estimate for a population (area of land) based on a specific stratification.

Each evaluation used by FIA is identified, named, and stored as a single entry in the POP\_EVAL table. The important data items in the POP\_EVAL table are listed in table 3-1 for all evaluations that are loaded into the FIADB for data collected in Minnesota through 2006. CN is the control number that uniquely identifies the entry and is used in creating links to other tables. RSCD (Region or Station Code) and EVALID (Evaluation Identifier) are the natural identifiers of a specific record. EVAL\_DESCR provides a description of the evaluation. STATECD and LOCATION\_NM describe the geographic extent of the population that was sampled and REPORT\_YEAR\_NM describes the years in which the sample was taken. For older periodic inventories, REPORT\_YEAR\_NM typically reflects a single reporting year (the one used in the FIA publications), even though the plots may have been measured over several years. Annual inventories (taken since 1999) list the years of data measurements used in the estimation. There are usually multiple evaluations for a specific year because not all plots observed have every attribute of interest, and/or different stratifications are used in the estimation of different attributes of interest. For example, volume estimation can be done on plots measured at only one point in time. However, growth estimates require repeat measurements. Thus, evaluations for the estimation of growth only assign those plots that are repeat measurement plots to strata, and do not include one-time measurement plots.

**Table 3-1:** Important POP\_EVAL entries for Minnesota through 2006 from the FIADB.

CN	RSCD	EVALID	EVAL_DESCR	STATECD	LOCATION_NM	REPORT_YEAR_NM
107106457010661	23	277701	MINNESOTA 1977: CURRENT AREA (PERIODIC)	27	Minnesota	1977
107106458010661	23	277702	MINNESOTA 1977: CURRENT VOLUME (PERIODIC)	27	Minnesota	1977
107106459010661	23	277703	MINNESOTA 1977: GROWTH (PERIODIC)	27	Minnesota	1977
107106460010661	23	277704	MINNESOTA 1977: MORTALITY (PERIODIC)	27	Minnesota	1977
107106461010661	23	277705	MINNESOTA 1977: REMOVALS (PERIODIC)	27	Minnesota	1977

1. Beginning with FIADB version 1.6.02, there are population-by-evaluation-type views available to users who query the FIADB within the Forest Service firewall. These views allow users to select the appropriate population more directly. See chapter 9 for more information about using these views.

CN	RSCD	EVALID	EVAL DESCR	STATECD	LOCATION NM	REPORT YEAR NM
107106462010661	23	279001	MINNESOTA 1990: CURRENT AREA (PERIODIC)	27	Minnesota	1990
107106463010661	23	279002	MINNESOTA 1990: CURRENT VOLUME (PERIODIC)	27	Minnesota	1990
107106464010661	23	279003	MINNESOTA 1990: GROWTH (PERIODIC)	27	Minnesota	1990
107106465010661	23	279004	MINNESOTA 1990: MORTALITY (PERIODIC)	27	Minnesota	1990
107106466010661	23	279005	MINNESOTA 1990: REMOVALS (PERIODIC)	27	Minnesota	1990
107106467010661	23	279006	MINNESOTA 1990: CHANGE (PERIODIC)	27	Minnesota	1990
197440375010661	23	270300	MINNESOTA 2003: 1999-2003: ALL AREA	27	Minnesota	1999;2000;2001;2002;2003
197440374010661	23	270301	MINNESOTA 2003: 1999-2003: CURRENT AREA, CURRENT VOLUME	27	Minnesota	1999;2000;2001;2002;2003
197440569010661	23	270302	MINNESOTA 2003: 1990 TO 1999-2003: GROWTH, REMOVALS, MORTALITY	27	Minnesota	1999;2000;2001;2002;2003
197440972010661	23	270400	MINNESOTA 2004: 2000-2004: ALL AREA	27	Minnesota	2000;2001;2002;2003;2004
197440975010661	23	270401	MINNESOTA 2004: 2000-2004: CURRENT AREA, CURRENT VOLUME	27	Minnesota	2000;2001;2002;2003;2004
197441166010661	23	270500	MINNESOTA 2005: 2001-2005: ALL AREA	27	Minnesota	2001;2002;2003;2004;2005
197441167010661	23	270501	MINNESOTA 2005: 2001-2005: CURRENT AREA, CURRENT VOLUME	27	Minnesota	2001;2002;2003;2004;2005
197441358010661	23	270600	MINNESOTA 2006: 2002-2006: ALL AREA	27	Minnesota	2002;2003;2004;2005;2006
197441359010661	23	270601	MINNESOTA 2006: 2002-2006: CURRENT AREA, CURRENT VOLUME	27	Minnesota	2002;2003;2004;2005;2006
192738219010661	23	270700	MINNESOTA 2007: 2003-2007: ALL AREA	27	Minnesota	2003;2004;2005;2006;2007
192738225010661	23	270701	MINNESOTA 2007: 2003-2007: CURRENT AREA, CURRENT VOLUME	27	Minnesota	2003;2004;2005;2006;2007
197440976010661	23	270402	MINNESOTA 2004: 1999 TO 2004: GROWTH, REMOVALS, MORTALITY	27	Minnesota	2004
197441170010661	23	270502	MINNESOTA 2005: 1999-2000 TO 2004-2005: GROWTH, REMOVALS, MORTALITY	27	Minnesota	2004;2005
197441539010661	23	270602	MINNESOTA 2006: 1999-2001 TO 2004-2006: GROWTH, REMOVALS, MORTALITY	27	Minnesota	2004;2005;2006

An evaluation group is the set of evaluations that goes into the contents of a typical FIA report for a State. For example the evaluations that went into the report entitled "Minnesota's forests 1999-2003 (Part A.)" (Miles and others 2007) are identified by EVALIDs 270300, 270301 and 270302, and are collectively identified by a single record in the POP\_EVAL\_GRP table. Table 3-2 lists the important attributes for all evaluation groups that are loaded into FIADB for data collected in Minnesota through 2006.

**Table 3-2:** Important POP\_EVAL\_GRP entries for Minnesota through 2006 from the FIADB.

CN	RSCD	EVAL_GRP	EVAL_DESCR	STATECD
107114016010661	23	271977	MINNESOTA 1977: CURRENT AREA, CURRENT VOLUME, GROWTH, REMOVALS, MORTALITY	27
107114017010661	23	271990	MINNESOTA 1990: CURRENT AREA, CURRENT VOLUME, GROWTH, REMOVALS, MORTALITY, CHANGE	27
197441921010661	23	272003	MINNESOTA 2003: ALL AREA, CURRENT AREA, CURRENT VOLUME, GROWTH, REMOVALS, MORTALITY	27
197442818010661	23	272004	MINNESOTA 2004: ALL AREA, CURRENT AREA, CURRENT VOLUME, GROWTH, REMOVALS, MORTALITY	27
197443272010661	23	272005	MINNESOTA 2005: ALL AREA, CURRENT AREA, CURRENT VOLUME, GROWTH, REMOVALS, MORTALITY	27
197443769010661	23	272006	MINNESOTA 2006: ALL AREA, CURRENT AREA, CURRENT VOLUME, GROWTH, REMOVALS, MORTALITY	27

In the POP\_EVAL\_GRP table the data item EVAL\_GRP identifies the evaluation group by its State code (first 2 digits) and a year (last 4 digits), which is the year commonly associated with estimates (if EVAL\_GRP does not follow this format, see the EVAL\_GRP\_DESCR for the precise identification). In table 3-2 we see evaluation groups for two periodic inventory estimates (1977 and 1990), and four annual estimates (2003, 2004, 2005 and 2006). The EVAL\_GRP\_DESCR describes the groups, and indicates that all of the annual inventory estimates are based on 5 years of measurements taken over the 5-year period ending with that date.

The POP\_EVAL\_TYP table provides a link between the evaluation groups in POP\_EVAL\_GRP and the evaluations in POP\_EVAL. POP\_EVAL\_TYP.EVAL\_TYP identifies the evaluation type - "EXPCURR," "EXPVOL," "EXPDWM," "EXPGROW," "EXPMORT," "EXPREMV," or "EXPALL" - that can be estimated from a specific evaluation. "EXPCURR" identifies the evaluation used in the estimation of most area estimates, such as the area of forest land or the area of timberland, as well as condition-level estimates, such as modeled total carbon. "EXPDWM" identifies the evaluation used in the estimation of down woody material attributes. "EXPVOL" identifies the evaluation used in the estimation of tree-level attributes such as number, volume, and biomass of trees, and seedling-level estimates, such as number of seedlings. "EXPGROW," "EXPMORT," and "EXPREMV" identify the evaluations used in the estimation of growth, mortality, and removals, respectively. The evaluation identified by "EXPALL" is only appropriate for area estimation where the area of hazardous and denied access are of interest. All other evaluations treat hazardous and denied access as non-measured and adjust the estimate to account for these areas.

The POP\_EVAL\_TYP table allows users to query the appropriate evaluation by identifying only the eval\_grp (STATECD\*10000 + INV\_YR) and evaluation type (EVAL\_TYP) and allows for a variety of evaluations to be added in the future. In the example below, the

join selects the appropriate evaluation for the estimation of area and volume attributes for the Minnesota 2003 annual inventory.

```
SELECT pev.cn, pev.eval_descr
FROM fs_fiadb.pop_eval_typ pet,
     fs_fiadb.pop_eval     pev,
     fs_fiadb.pop_eval_grp peg
WHERE peg.eval_grp = 272003
      AND pev.cn = pet.eval_grp_cn
      AND pev.cn = pet.eval_cn
      AND pet.eval_typ = 'EXPCURR'
```

This is a change from previous FIADB versions whereby evaluations were identified by columns in the POP\_EVAL\_GRP table. These columns were dropped starting with FIADB version 5.1. Thus, the following query will no longer work:

```
SELECT pev.cn, pev.eval_descr
FROM fs_fiadb.pop_eval pev, fs_fiadb.pop_eval_grp peg
WHERE peg.eval_grp = 272003
      AND pev.cn = peg.eval_cn_for_expcurr
```



# Chapter 4: Linking the Appropriate Tables

The following Oracle SQL script can be modified to produce an estimate of any condition-, tree-, or seedling-level attribute listed in the REF\_POP\_ATTRIBUTE table. In this standard script (example 4-1), the non-bold text applies to all estimates and the bold text is modified by the user, depending on the desired attribute of interest and evaluation group. The line numbers have been added for reference.

- On line 01, the text in the column EXPRESSION in the REF\_POP\_ATTRIBUTE table associated with the desired attribute of interest should be inserted.
- Lines 05 or 06 include either the TREE table or SEEDLING table, and neither line should be included for condition-level estimates. Line 05 should be included for tree-level estimates and line 06 should be included for seedling-level estimates.
- On line 14, the additions to the SQL where clause from the WHERE\_CLAUSE column of the REF\_POP\_ATTRIBUTE table for the desired attribute of interest should be inserted.
- Finally, on line 21, the desired evaluation group needs to be indicated by replacing the characters SSYYYY with the desired evaluation group, whereby SS = STATECD of the desired State, and YYYY = year of the desired inventory (if EVAL\_GRP does not follow this format, see the EVAL\_GRP\_DESCR for the precise identification).

With these changes, a user can produce the standard estimates for any desired population from the REF\_POP\_ATTRIBUTE table.

Estimation requires linking the attribute values (on the COND, TREE, and SEEDLING tables) to the stratification information (on the POP\_PLOT\_STRATUM\_ASSGN, POP\_STRATUM, and POP\_ESTN\_UNIT) for the selected evaluation that defines the sample. Those links are provided in lines 15 through 20 of the script, and these lines do not change.

- Line 15 links the POP\_PLOT\_STRATUM\_ASSGN record to the plot record.
- Line 16 links the POP\_PLOT\_STRATUM\_ASSGN record to the POP\_STRATUM (which identifies each stratum in the estimation unit and contains EXPNS, the plot expansion factor or acres assigned to the plot,  $PSM.EXPNS = (PEU.AREA_USED * PSM.P1POINTCNT / PEU.P1PNTCNT\_EU / PSM.P2POINTCNT)$ ).
- Line 17 links the POP\_ESTN\_UNIT (which identifies each estimation unit in the evaluation) to the POP\_STRATUM record.
- Line 18 links the POP\_EVAL, which identifies each evaluation, to the specific evaluation that is required for the estimation.
- Lines 19 and 20 link the appropriate evaluation to the attribute and evaluation group for which the estimate is being made.

See figure 4-1 for a schematic of links of some of the FIADB tables.

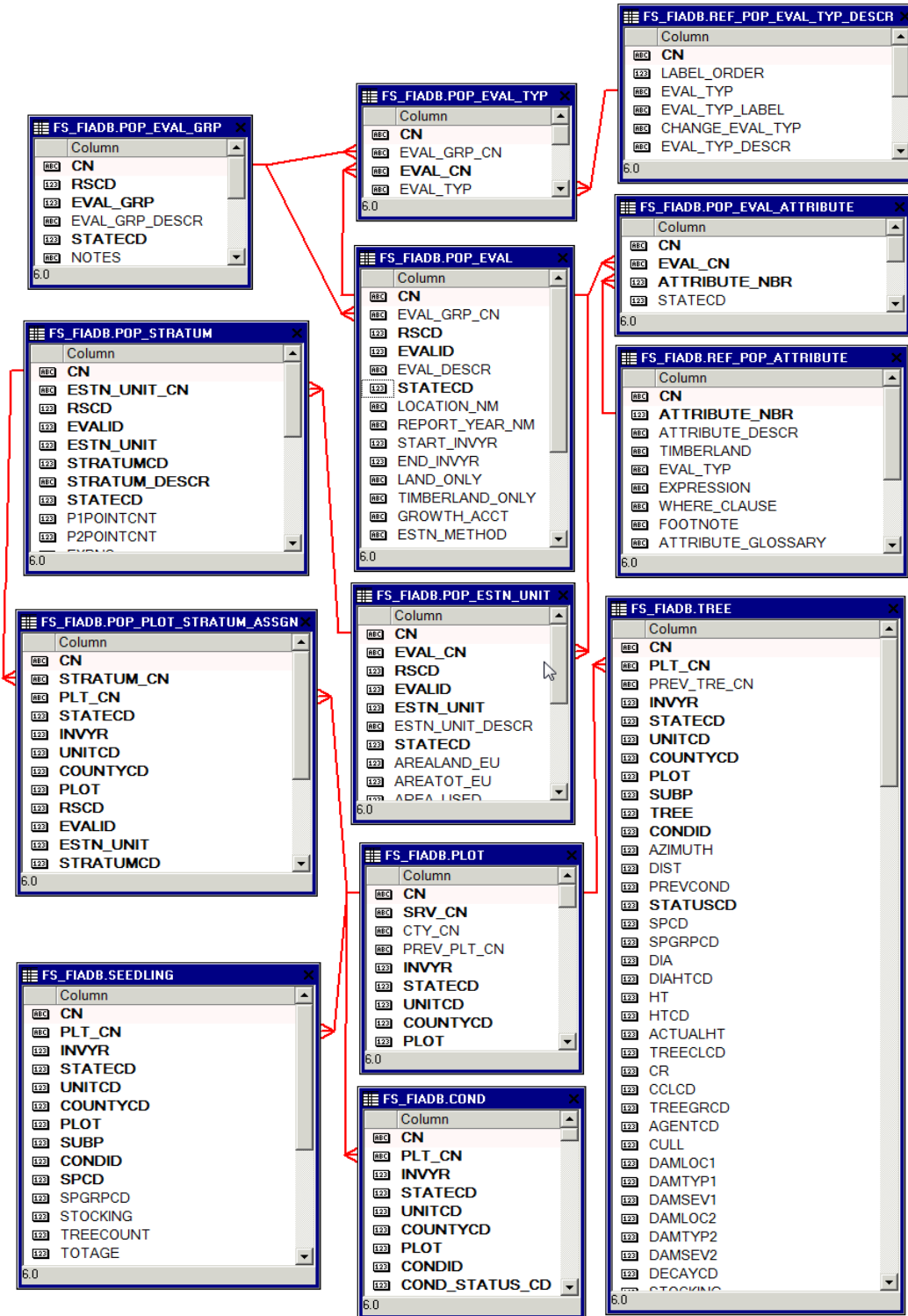
The following table shows some common aliases or abbreviations used within a SQL script to reduce the overall length of the script and improve readability.

**Common aliases for FIADB tables:**

Alias	Table name
p	PLOT
c	COND
t	TREE
s	SEEDLING
ppsa	POP_PLOT_STRATUM_ASSGN
psm	POP_STRATUM
peu	POP_ESTN_UNIT
pet	POP_EVAL_TYP
peg	POP_EVAL_GRP
pev	POP_EVAL
rs	REF_SPECIES

**Example 4-1:** Standard estimation script.

Line	Script
<b>01</b>	SELECT SUM(psm.expns * <b>EXPRESSION</b> -- <i>insert ref_pop_attribute EXPRESSION here</i>
02	) estimate
03	FROM fs_fiadb.cond c,
04	fs_fiadb.plot p,
<b>05</b>	<b>fs_fiadb.tree t</b> , -- <i>tree table must be included for tree-level estimates</i>
<b>06</b>	<b>fs_fiadb.seedling s</b> , -- <i>seedling table must be included for seedling-level estimate</i>
07	fs_fiadb.pop_plot_stratum_assgn ppsa,
08	fs_fiadb.pop_stratum psm,
09	fs_fiadb.pop_estn_unit peu,
10	fs_fiadb.pop_eval pev,
11	fs_fiadb.pop_eval_typ pet,
12	fs_fiadb.pop_eval_grp peg
13	WHERE p.cn = c.plt_cn
<b>14</b>	<b>WHERE_CLAUSE</b> -- <i>insert ref_pop_attribute WHERE_CLAUSE here</i>
15	AND ppsa.plt_cn = p.cn
16	AND ppsa.stratum_cn = psm.cn
17	AND peu.cn = psm.estn_unit_cn
18	AND pev.cn = peu.eval_cn
19	AND pev.cn = pet.eval_cn
20	AND pet.eval_grp_cn = peg.cn
<b>21</b>	AND peg.eval_grp = <b>SSYYYY</b> -- <i>the desired evaluation group must be specified</i>



**Figure 4-1:** An abbreviated diagram of select FIADB tables. Note that there are more columns in each table than are shown.

In the following four examples (4-2, 4-3, 4-4, and 4-5), the scripts are modified from above to produce condition-, tree-, and seedling-level estimates for the Minnesota 2003 inventory. Here the sections in bold are the sections that changed from the standard estimation script, e.g., the REF\_POP\_ATTRIBUTE.EXPRESSION and REF\_POP\_ATTRIBUTE.WHERE\_CLAUSE have been inserted, along with the chosen evaluation number.

Note: The resulting estimates shown as output are examples only and are not necessarily the exact numbers a user will obtain using current data.

**Example 4-2:** Estimate area of timberland (acres).

```
SELECT SUM(psm.expns * c.condprop_unadj *
DECODE(c.prop_basis,
'MACR',
psm.adj_factor_macr,
psm.adj_factor_subp) -- this is the expression from ref_pop_attribute table
) estimate
FROM fs_fiadb.cond          c,
     fs_fiadb.plot          p,
     fs_fiadb.pop_plot_stratum_assgn ppsa,
     fs_fiadb.pop_stratum   psm,
     fs_fiadb.pop_estn_unit  peu,
     fs_fiadb.pop_eval      pev,
     fs_fiadb.pop_eval_typ  pet,
     fs_fiadb.pop_eval_grp  peg
WHERE p.cn = c.plt_cn
AND pet.eval_typ = 'EXPCURR'
AND c.cond_status_cd = 1
AND c.reservcd = 0
AND c.siteclcd IN (1, 2, 3, 4, 5, 6)
-- this is the where clause from ref_pop_attribute table

AND ppsa.plt_cn = p.cn
AND ppsa.stratum_cn = psm.cn
AND peu.cn = psm.estn_unit_cn
AND pev.cn = peu.eval_cn
AND pet.cn = pet.eval_cn
AND pet.eval_grp_cn = peg.cn
AND peg.eval_grp = 272003 -- the desired evaluation group must be specified
```

The example above produces an estimate of acres of timberland:

Item	Value
<b>ESTIMATE</b>	14,491,759

**Example 4-3:** Estimate number of live trees on forest land (trees).

```

SELECT SUM(psm.expns * t.tpa_unadj *
  DECODE(t.dia,
    null,
    psm.adj_factor_subp,
    DECODE(least(t.dia, 5 - 0.001),
      t.dia,
      psm.adj_factor_micr,
      DECODE(least(t.dia,
        nvl(p.macro_breakpoint_dia, 9999) - 0.001),
        t.dia,
        psm.adj_factor_subp,
        psm.adj_factor_macr))) -- this is the expression from ref_pop_attribute table
) estimate
FROM fs_fiadb.cond c,
fs_fiadb.plot p,
fs_fiadb.tree t, -- tree table must be included for tree-level estimates
fs_fiadb.pop_plot_stratum_assgn ppsa,
fs_fiadb.pop_stratum psm,
fs_fiadb.pop_estn_unit peu,
fs_fiadb.pop_eval pev,
fs_fiadb.pop_eval_typ pet,
fs_fiadb.pop_eval_grp peg
WHERE p.cn = c.plt_cn
AND pet.eval_typ = 'EXPVOL'
AND t.plt_cn = c.plt_cn
AND t.condid = c.condid
AND c.cond_status_cd = 1
AND t.statuscd = 1
AND t.dia >= 1.0 -- additional where_clause from ref_pop_attribute table
AND ppsa.plt_cn = p.cn
AND ppsa.stratum_cn = psm.cn
AND peu.cn = psm.estn_unit_cn
AND pev.cn = peu.eval_cn
AND pev.cn = pet.eval_cn
AND pet.eval_grp_cn = peg.cn
AND peg.eval_grp = 272003 -- the desired evaluation group must be specified

```

The example above produces an estimate of total number of live trees on forest land:

Item	Value
<b>ESTIMATE</b>	12,078,196,211

**Example 4-4:** Estimate number of live seedlings on timberland (seedlings).

```

SELECT SUM(psm.expns * s.tpa_unadj * psm.adj_factor_micr
           -- expression from ref_pop_attribute table
) estimate
FROM fs_fiadb.cond          c,
     fs_fiadb.plot         p,
     fs_fiadb.seedling    s,
     -- seedling table must be included for seedling-level estimates
     fs_fiadb.pop_plot_stratum_assgn ppsa,
     fs_fiadb.pop_stratum      psm,
     fs_fiadb.pop_estn_unit    peu,
     fs_fiadb.pop_eval        pev,
     fs_fiadb.pop_eval_typ     pet,
     fs_fiadb.pop_eval_grp     peg
WHERE p.cn = c.plt_cn
     AND pet.eval_typ = 'EXPVOL'
     AND s.plt_cn = c.plt_cn
     AND s.condid = c.condid
     AND c.cond_status_cd = 1
     AND c.reservcd = 0
     AND c.siteclcd IN (1, 2, 3, 4, 5, 6)
           -- additional where_clause from ref_pop_attribute table
     AND ppsa.plt_cn = p.cn
     AND ppsa.stratum_cn = psm.cn
     AND peu.cn = psm.estn_unit_cn
     AND pev.cn = peu.eval_cn
     AND pev.cn = pet.eval_cn
     AND pet.eval_grp_cn = peg.cn
     AND peg.eval_grp = 272003 -- the desired evaluation group must be specified

```

The example above produces an estimate of total number of live seedlings on timberland:

Item	Value
<b>ESTIMATE</b>	36,531,715,033

**Example 4-5:** Estimate volume of growing-stock trees on timberland (cubic feet).

```

SELECT SUM(psm.expns * t.tpa_unadj * t.volcfnet *
  DECODE(t.dia,
    null,
    psm.adj_factor_subp,
    DECODE(least(t.dia, 5 - 0.001),
      t.dia,
      psm.adj_factor_micr,
      DECODE(least(t.dia,
        nvl(p.macro_breakpoint_dia, 9999) - 0.001),
        t.dia,
        psm.adj_factor_subp,
        psm.adj_factor_macr))) -- this is the expression from ref_pop_attribute table
  ) estimate
FROM fs_fiadb.cond c,
  fs_fiadb.plot p,
  fs_fiadb.tree t, -- tree table must be included for tree-level estimates
  fs_fiadb.pop_plot_stratum_assgn ppsa,
  fs_fiadb.pop_stratum psm,
  fs_fiadb.pop_estn_unit peu,
  fs_fiadb.pop_eval pev,
  fs_fiadb.pop_eval_typ pet,
  fs_fiadb.pop_eval_grp peg
WHERE p.cn = c.plt_cn
  AND pet.eval_typ = 'EXPVOL'
  AND t.plt_cn = c.plt_cn
  AND t.condid = c.condid
  AND c.cond_status_cd = 1
  AND c.reservcd = 0
  AND c.siteclcd in (1, 2, 3, 4, 5, 6)
  AND t.statuscd = 1
  AND t.treecld = 2
  AND t.dia >= 5.0 -- additional where_clause from ref_pop_attribute table
  AND ppsa.plt_cn = p.cn
  AND ppsa.stratum_cn = psm.cn
  AND peu.cn = psm.estn_unit_cn
  AND pev.cn = peu.eval_cn
  AND pev.cn = pet.eval_cn
  AND pet.eval_grp_cn = peg.cn
  AND peg.eval_grp = 272003 -- the desired evaluation group must be specified

```

The example above produces the following estimate of total growing-stock volume (cubic feet) on timberland:

Item	Value
ESTIMATE	14,912,684,892

**Important Note:** Users who access data from periodic inventories should restrict the estimation only to the standard timberland estimates. In most cases, for periodic

inventories, the FIADB contains only condition-level information on reserved and unproductive forest lands, and tree-level information on timberland.



# Chapter 5: Producing Estimates with Sampling Errors

Producing population estimates that include error estimates (sampling error or variance of the estimate) along with the estimated total is more complicated. The following Oracle SQL script can be used as a template in producing estimates with sampling errors. The line numbers have been added for reference. This example follows the notation used in Bechtold and Patterson (2005, equation 4.14 on page 55). Again, the portions of the script that should be changed by the user to specify the attribute of interest and population are in bold. Besides returning the estimates and sampling errors, this script also outputs the total number of plots in the sample (TOTAL\_PLOTS), the number of plots where the attribute of interest was observed to occur (NON\_ZERO\_PLOTS), and the total population area (TOTAL\_POPULATION\_ACRES). This procedure produces two intermediate tables: phase\_1\_summary and phase\_2\_summary. Phase\_1\_summary is a stratum-level table that contains the stratification information necessary in the estimation within strata sample sizes ( $n_h$ ), stratum weights ( $W_h$ ), and population area ( $A_T$ ). Phase\_2\_summary is a stratum-level table that contains a summary of the attribute of interest on per-unit-area basis ( $y_{hid}$ ) including the sum and sum of the squared plot-level values and the number of plots where the attribute of interest was observed.

**Example 5-1:** Standard script for estimates with sampling errors.

Line	Script
01	SELECT eval_grp,
02	SUM(estimate_by_estn_unit.estimate) estimate,
03	CASE
04	WHEN SUM(estimate_by_estn_unit.estimate) > 0 THEN
05	ROUND(sqrt(SUM(estimate_by_estn_unit.var_of_estimate)) /
06	SUM(estimate_by_estn_unit.estimate) * 100,
07	3)
08	ELSE
09	0
10	END AS se_of_estimate_pct,
11	SUM(estimate_by_estn_unit.var_of_estimate) var_of_estimate,
12	SUM(estimate_by_estn_unit.total_plots) total_plots,
13	SUM(estimate_by_estn_unit.non_zero_plots) non_zero_plots,
14	SUM(estimate_by_estn_unit.total_population_area_acres) total_population_acres
15	FROM (SELECT pop_eval_grp_cn,
16	eval_grp,
17	estn_unit_cn,
18	SUM(nvl(ysum_hd, 0) * phase_1_summary.expns) estimate,
19	SUM(phase_1_summary.n_h) total_plots,
20	SUM(phase_2_summary.number_plots_in_domain) domain_plots,

Line	Script
21	SUM(phase_2_summary.non_zero_plots) non_zero_plots,
22	total_area * total_area / SUM(phase_1_summary.n_h) *
23	((SUM(w_h * phase_1_summary.n_h *
24	((nvl(ysum_hd_sqr, 0) / phase_1_summary.n_h) -
25	((nvl(ysum_hd, 0) / phase_1_summary.n_h) *
26	(nvl(ysum_hd, 0) / phase_1_summary.n_h))) /
27	(phase_1_summary.n_h - 1)))) +
28	1 / SUM(phase_1_summary.n_h) *
29	(SUM((1 - w_h) * phase_1_summary.n_h *
30	((nvl(ysum_hd_sqr, 0) / phase_1_summary.n_h) -
31	((nvl(ysum_hd, 0) / phase_1_summary.n_h) *
32	(nvl(ysum_hd, 0) / phase_1_summary.n_h))) /
33	(phase_1_summary.n_h - 1)))))) var_of_estimate,
34	total_area total_population_area_acres
35	FROM (SELECT peg.eval_grp,
36	peg.cn pop_eval_grp_cn,
37	psm.estn_unit_cn,
38	psm.expns,
39	psm.cn pop_stratum_cn,
40	p1pointcnt /
41	(SELECT SUM(strs.p1pointcnt)
42	FROM fs_fiadb.pop_stratum strs
43	WHERE strs.estn_unit_cn = psm.estn_unit_cn) w_h,
44	(SELECT SUM(strs.p1pointcnt)
45	FROM fs_fiadb.pop_stratum strs
46	WHERE strs.estn_unit_cn = psm.estn_unit_cn) n_prime,
47	p1pointcnt n_prime_h,
48	(SELECT SUM(eu_s.area_used)
49	FROM fs_fiadb.pop_estn_unit eu_s
50	WHERE eu_s.cn = psm.estn_unit_cn) total_area,
51	psm.p2pointcnt n_h
52	FROM fs_fiadb.pop_estn_unit peu,
53	fs_fiadb.pop_stratum psm,
54	fs_fiadb.pop_eval pev,
55	fs_fiadb.pop_eval_grp peg,
56	fs_fiadb.pop_eval_typ pet
57	WHERE peu.cn = psm.estn_unit_cn
58	AND pev.cn = peu.eval_cn
59	AND pet.eval_cn = pev.cn
60	AND pet.eval_grp_cn = peg.cn

Line	Script
61	AND pet.eval_typ = 'EXPXXX' -- specify the appropriate expansion
62	AND peg.eval_grp = <b>SSYYYY</b> -- the desired evaluation group must be specified
63	) phase_1_summary,
64	(SELECT pop_stratum_cn,
65	SUM(y_hid_adjusted) ysum_hd,
66	SUM(y_hid_adjusted * y_hid_adjusted) ysum_hd_sqr,
67	COUNT(*) number_plots_in_domain,
68	SUM(DECODE(y_hid_adjusted, 0, 0, NULL, 0, 1)) non_zero_plots
69	FROM (SELECT psm.cn pop_stratum_cn,
70	p.cn plt_cn,
71	SUM( <b>EXPRESSION</b> ) y_hid_adjusted -- the appropriate expression from ref_pop_attribute table
72	FROM fs_fiadb.cond c,
73	fs_fiadb.plot p,
74	<b>fs_fiadb.tree t</b> , -- tree table must be included for tree-level estimates
75	<b>fs_fiadb.seedling s</b> , -- seedling table must be included for seedling-level estimates
76	fs_fiadb.pop_plot_stratum_assgn ppsa,
77	fs_fiadb.pop_stratum psm,
78	fs_fiadb.pop_estn_unit peu,
79	fs_fiadb.pop_eval pev,
80	fs_fiadb.pop_eval_grp peg,
81	fs_fiadb.pop_eval_typ pet
82	WHERE p.cn = c.plt_cn
83	<b>WHERE CLAUSE</b> -- additional where_clause from ref_pop_attribute table
84	AND ppsa.plt_cn = p.cn
85	AND ppsa.stratum_cn = psm.cn
86	AND peu.cn = psm.estn_unit_cn
87	AND pev.cn = peu.eval_cn
88	AND pet.eval_cn = pev.cn
89	AND pet.eval_grp_cn = peg.cn
90	AND peg.eval_grp = <b>SSYYYY</b> -- the desired evaluation group must be specified
91	GROUP BY psm.cn, p.cn)
92	GROUP BY pop_stratum_cn) phase_2_summary
93	WHERE phase_1_summary.pop_stratum_cn =
94	phase_2_summary.pop_stratum_cn(+)
95	GROUP BY pop_eval_grp_cn,
96	eval_grp,
97	estn_unit_cn,

Line	Script
98	phase_1_summary.total_area) estimate_by_estn_unit
99	GROUP BY pop_eval_grp_cn, eval_grp

In the following three examples the scripts were modified from above to produce condition-, tree-, and seedling-level estimates for the Minnesota 2003 inventory. Here the sections in bold are the sections that changed from the standard script for estimates with sampling errors.

**Example 5-2:** Estimate area of timberland (acres) with sampling error. (Note the bold sections in this example match the bold sections in example 4-2, which estimates the same area without sampling errors.)

```

SELECT eval_grp,
       SUM(estimate_by_estn_unit.estimate) estimate,
       CASE
         WHEN SUM(estimate_by_estn_unit.estimate) > 0 THEN
           round(sqrt(SUM(estimate_by_estn_unit.var_of_estimate)) /
                SUM(estimate_by_estn_unit.estimate) * 100,
                3)
         ELSE
           0
       END AS se_of_estimate_pct,
       SUM(estimate_by_estn_unit.var_of_estimate) var_of_estimate,
       SUM(estimate_by_estn_unit.total_plots) total_plots,
       SUM(estimate_by_estn_unit.non_zero_plots) non_zero_plots,
       SUM(estimate_by_estn_unit.total_population_area_acres) total_population_acres
FROM (SELECT pop_eval_grp_cn,
            eval_grp,
            estn_unit_cn,
            SUM(nvl(ysum_hd, 0) * phase_1_summary.expns) estimate,
            SUM(phase_1_summary.n_h) total_plots,
            SUM(phase_2_summary.number_plots_in_domain) domain_plots,
            SUM(phase_2_summary.non_zero_plots) non_zero_plots,
            total_area * total_area / SUM(phase_1_summary.n_h) *
            ((SUM(w_h * phase_1_summary.n_h *
                (((nvl(ysum_hd_sqr, 0) / phase_1_summary.n_h) -
                 ((nvl(ysum_hd, 0) / phase_1_summary.n_h) *
                  (nvl(ysum_hd, 0) / phase_1_summary.n_h))) /
                 (phase_1_summary.n_h - 1)))) +
                1 / SUM(phase_1_summary.n_h) *
                (SUM((1 - w_h) * phase_1_summary.n_h *
                    (((nvl(ysum_hd_sqr, 0) / phase_1_summary.n_h) -
                     ((nvl(ysum_hd, 0) / phase_1_summary.n_h) *
                      (nvl(ysum_hd, 0) / phase_1_summary.n_h))) /
                     (phase_1_summary.n_h - 1)))))) var_of_estimate,
            total_area total_population_area_acres
FROM (SELECT peg.eval_grp,
            peg.cn pop_eval_grp_cn,
            psm.estn_unit_cn,
            psm.cn pop_stratum_cn,
            psm.expns,

```

```

p1pointcnt /
(SELECT SUM(strs.p1pointcnt)
 FROM fs_fiadb.pop_stratum strs
 WHERE strs.estn_unit_cn = psm.estn_unit_cn) w_h,
(SELECT SUM(strs.p1pointcnt)
 FROM fs_fiadb.pop_stratum strs
 WHERE strs.estn_unit_cn = psm.estn_unit_cn) n_prime,
p1pointcnt n_prime_h,
(SELECT SUM(eu_s.area_used)
 FROM fs_fiadb.pop_estn_unit eu_s
 WHERE eu_s.cn = psm.estn_unit_cn) total_area,
psm.p2pointcnt n_h
FROM fs_fiadb.pop_estn_unit peu,
fs_fiadb.pop_stratum psm,
fs_fiadb.pop_eval pev,
fs_fiadb.pop_eval_grp peg,
fs_fiadb.pop_eval_typ pet
WHERE peu.cn = psm.estn_unit_cn
AND pev.cn = peu.eval_cn
AND pet.eval_cn = pev.cn
AND pet.eval_grp_cn = peg.cn
AND pet.eval_typ = 'EXPCURR' -- specify the appropriate expansion
AND peg.eval_grp = 272003 -- the desired evaluation group must be specified
) phase_1_summary,
(SELECT pop_stratum_cn,
SUM(y_hid_adjusted) ysum_hd,
SUM(y_hid_adjusted * y_hid_adjusted) ysum_hd_sqr,
COUNT(*) number_plots_in_domain,
SUM(decode(y_hid_adjusted, 0, 0, NULL, 0, 1)) non_zero_plots
FROM (SELECT psm.cn pop_stratum_cn,
p.cn plt_cn,
SUM(c.condprop_unadj *
decode(c.prop_basis,
'MACR',
psm.adj_factor_macr,
psm.adj_factor_subp)
-- the expression from ref_pop_attribute table
) y_hid_adjusted
FROM fs_fiadb.cond c,
fs_fiadb.plot p,
fs_fiadb.pop_plot_stratum_assgn ppsa,
fs_fiadb.pop_stratum psm,
fs_fiadb.pop_estn_unit peu,
fs_fiadb.pop_eval pev,
fs_fiadb.pop_eval_grp peg,
fs_fiadb.pop_eval_typ pet
WHERE p.cn = c.plt_cn
AND pet.eval_typ = 'EXPCURR'
AND c.cond_status_cd = 1
AND c.reservcd = 0
AND c.siteclcd IN (1, 2, 3, 4, 5, 6)
-- additional where_clause from ref_pop_attribute table
AND ppsa.plt_cn = p.cn
AND ppsa.stratum_cn = psm.cn
AND peu.cn = psm.estn_unit_cn

```

```

        AND pev.cn = peu.eval_cn
        AND pet.eval_cn = pev.cn
        AND pet.eval_grp_cn = peg.cn
        AND peg.eval_grp = 272003
        -- the desired evaluation group must be specified
        GROUP BY psm.cn, p.cn)
    GROUP BY pop_stratum_cn) phase_2_summary
WHERE phase_1_summary.pop_stratum_cn =
    phase_2_summary.pop_stratum_cn(+)
GROUP BY pop_eval_grp_cn,
    eval_grp,
    estn_unit_cn,
    phase_1_summary.total_area) estimate_by_estn_unit
GROUP BY pop_eval_grp_cn, eval_grp

```

The example above produces an estimate of acres of timberland with sampling error:

Item	Value
<b>EVAL_GRP</b>	272003
<b>ESTIMATE</b>	14,491,759
<b>SE_OF_ESTIMATE_PCT</b>	0.7
<b>VAR_OF_ESTIMATE</b>	11,033,423,522
<b>TOTAL_PLOTS</b>	16041
<b>NONZERO_PLOTS</b>	4,705
<b>TOTAL_POPULATION_ACRES</b>	54,002,539

**Example 5-3:** Estimate number of live trees on forest land (trees) with sampling error. (Note the bold sections in this example match the bold sections in example 4-3, which estimates the same number of trees without sampling errors.)

```

SELECT eval_grp,
    SUM(estimate_by_estn_unit.estimate) estimate,
    CASE
        WHEN SUM(estimate_by_estn_unit.estimate) > 0 THEN
            round(sqrt(SUM(estimate_by_estn_unit.var_of_estimate)) /
                SUM(estimate_by_estn_unit.estimate) * 100,
                3)
        ELSE
            0
    END AS se_of_estimate_pct,
    SUM(estimate_by_estn_unit.var_of_estimate) var_of_estimate,
    SUM(estimate_by_estn_unit.total_plots) total_plots,
    SUM(estimate_by_estn_unit.non_zero_plots) non_zero_plots,
    SUM(estimate_by_estn_unit.total_population_area_acres) total_population_acres
FROM (SELECT pop_eval_grp_cn,
    eval_grp,
    estn_unit_cn,
    SUM(nvl(ysum_hd, 0) * phase_1_summary.expns) estimate,
    SUM(phase_1_summary.n_h) total_plots,
    SUM(phase_2_summary.number_plots_in_domain) domain_plots,

```

```

SUM(phase_2_summary.non_zero_plots) non_zero_plots,
total_area * total_area / SUM(phase_1_summary.n_h) *
((SUM(w_h * phase_1_summary.n_h *
  (((nvl(ysum_hd_sqr, 0) / phase_1_summary.n_h) -
  ((nvl(ysum_hd, 0) / phase_1_summary.n_h) *
  (nvl(ysum_hd, 0) / phase_1_summary.n_h))) /
  (phase_1_summary.n_h - 1)))) +
1 / SUM(phase_1_summary.n_h) *
(SUM((1 - w_h) * phase_1_summary.n_h *
  (((nvl(ysum_hd_sqr, 0) / phase_1_summary.n_h) -
  ((nvl(ysum_hd, 0) / phase_1_summary.n_h) *
  (nvl(ysum_hd, 0) / phase_1_summary.n_h))) /
  (phase_1_summary.n_h - 1)))))) var_of_estimate,
total_area total_population_area_acres
FROM (SELECT peg.eval_grp,
  peg.cn pop_eval_grp_cn,
  psm.estn_unit_cn,
  psm.expns,
  psm.cn pop_stratum_cn,
  p1pointcnt /
  (SELECT SUM(strs.p1pointcnt)
   FROM fs_fiadb.pop_stratum strs
   WHERE strs.estn_unit_cn = psm.estn_unit_cn) w_h,
  (SELECT SUM(strs.p1pointcnt)
   FROM fs_fiadb.pop_stratum strs
   WHERE strs.estn_unit_cn = psm.estn_unit_cn) n_prime,
  p1pointcnt n_prime_h,
  (SELECT SUM(eu_s.area_used)
   FROM fs_fiadb.pop_estn_unit eu_s
   WHERE eu_s.cn = psm.estn_unit_cn) total_area,
  psm.p2pointcnt n_h
  FROM fs_fiadb.pop_estn_unit peu,
  fs_fiadb.pop_stratum psm,
  fs_fiadb.pop_eval pev,
  fs_fiadb.pop_eval_grp peg,
  fs_fiadb.pop_eval_typ pet
  WHERE peu.cn = psm.estn_unit_cn
  AND pev.cn = peu.eval_cn
  AND pet.eval_cn = pev.cn
  AND pet.eval_grp_cn = peg.cn
  AND pet.eval_typ = 'EXPVOL' -- specify the appropriate expansion
  AND peg.eval_grp = 272003 -- the desired evaluation group must be specified
) phase_1_summary,
(SELECT pop_stratum_cn,
  SUM(y_hid_adjusted) ysum_hd,
  SUM(y_hid_adjusted * y_hid_adjusted) ysum_hd_sqr,
  COUNT(*) number_plots_in_domain,
  SUM(decode(y_hid_adjusted, 0, 0, NULL, 0, 1)) non_zero_plots
  FROM (SELECT psm.cn pop_stratum_cn,
    p.cn plt_cn,
    SUM(t.tpa_unadj *
      decode(t.dia,
        NULL,
        psm.adj_factor_subp,
        decode(least(t.dia, 5 - 0.001),

```

```

        t.dia,
        psm.adj_factor_micr,
        decode(least(t.dia,
                    nvl(p.macro_breakpoint_dia,
                        9999) - 0.001),
              t.dia,
              psm.adj_factor_subp,
              psm.adj_factor_macr)))
    -- expression from ref_pop_attribute table
) y_hid_adjusted
FROM fs_fiadb.cond c,
     fs_fiadb.plot p,
     fs_fiadb.tree t,
    -- tree table must be included for tree-level estimates
     fs_fiadb.pop_plot_stratum_assgn ppsa,
     fs_fiadb.pop_stratum      psm,
     fs_fiadb.pop_estn_unit    peu,
     fs_fiadb.pop_eval        pev,
     fs_fiadb.pop_eval_grp    peg,
     fs_fiadb.pop_eval_typ    pet
WHERE p.cn = c.plt_cn
     AND pet.eval_typ = 'EXPVOL'
     AND t.plt_cn = c.plt_cn
     AND t.condid = c.condid
     AND c.cond_status_cd = 1
     AND t.statuscd = 1
     AND t.dia >= 1.0 -- additional where_clause from ref_pop_attribute table
     AND ppsa.plt_cn = p.cn
     AND ppsa.stratum_cn = psm.cn
     AND peu.cn = psm.estn_unit_cn
     AND pev.cn = peu.eval_cn
     AND pet.eval_cn = pev.cn
     AND pet.eval_grp_cn = peg.cn
     AND peg.eval_grp = 272003
-- the desired evaluation group must be specified
GROUP BY psm.cn, p.cn)
GROUP BY pop_stratum_cn) phase_2_summary
WHERE phase_1_summary.pop_stratum_cn =
      phase_2_summary.pop_stratum_cn(+)
GROUP BY pop_eval_grp_cn,
         eval_grp,
         estn_unit_cn,
         phase_1_summary.total_area) estimate_by_estn_unit
GROUP BY pop_eval_grp_cn, eval_grp

```



Produces an estimate of number of live trees on forest land with sampling error:

Item	Value
<b>EVAL GRP</b>	272003
<b>ESTIMATE</b>	12,078,196,211
<b>SE OF ESTIMATE PCT</b>	1.3
<b>VAR OF ESTIMATE</b>	25,846,103,844,454,600
<b>TOTAL PLOTS</b>	16,041
<b>NONZERO PLOTS</b>	5,069
<b>TOTAL POPULATION ACRES</b>	54,002,539

**Example 5-4:** Estimate number of live seedlings on timberland (seedlings) with sampling error.

```

SELECT eval_grp,
       SUM(estimate_by_estn_unit.estimate) estimate,
       CASE
         WHEN SUM(estimate_by_estn_unit.estimate) > 0 THEN
           round(sqrt(SUM(estimate_by_estn_unit.var_of_estimate)) /
                SUM(estimate_by_estn_unit.estimate) * 100,
                3)
         ELSE
           0
       END AS se_of_estimate_pct,
       SUM(estimate_by_estn_unit.var_of_estimate) var_of_estimate,
       SUM(estimate_by_estn_unit.total_plots) total_plots,
       SUM(estimate_by_estn_unit.non_zero_plots) non_zero_plots,
       SUM(estimate_by_estn_unit.total_population_area_acres) total_population_acres
FROM (SELECT pop_eval_grp_cn,
            eval_grp,
            estn_unit_cn,
            SUM(nvl(ysum_hd, 0) * phase_1_summary.expns) estimate,
            SUM(phase_1_summary.n_h) total_plots,
            SUM(phase_2_summary.number_plots_in_domain) domain_plots,
            SUM(phase_2_summary.non_zero_plots) non_zero_plots,
            total_area * total_area / SUM(phase_1_summary.n_h) *
            ((SUM(w_h * phase_1_summary.n_h *
                (((nvl(ysum_hd_sqr, 0) / phase_1_summary.n_h) -
                 ((nvl(ysum_hd, 0) / phase_1_summary.n_h) *
                  (nvl(ysum_hd, 0) / phase_1_summary.n_h))) /
                 (phase_1_summary.n_h - 1)))) +
                1 / SUM(phase_1_summary.n_h) *
                (SUM((1 - w_h) * phase_1_summary.n_h *
                    (((nvl(ysum_hd_sqr, 0) / phase_1_summary.n_h) -
                     ((nvl(ysum_hd, 0) / phase_1_summary.n_h) *
                      (nvl(ysum_hd, 0) / phase_1_summary.n_h))) /
                     (phase_1_summary.n_h - 1)))))) var_of_estimate,
            total_area total_population_area_acres
FROM (SELECT peg.eval_grp,
            peg.cn pop_eval_grp_cn,
            psm.estn_unit_cn,

```

```

psm.expns,
psm.cn pop_stratum_cn,
p1pointcnt /
(SELECT SUM(strs.p1pointcnt)
 FROM fs_fiadb.pop_stratum strs
 WHERE strs.estn_unit_cn = psm.estn_unit_cn) w_h,
(SELECT SUM(strs.p1pointcnt)
 FROM fs_fiadb.pop_stratum strs
 WHERE strs.estn_unit_cn = psm.estn_unit_cn) n_prime,
p1pointcnt n_prime_h,
(SELECT SUM(eu_s.area_used)
 FROM fs_fiadb.pop_estn_unit eu_s
 WHERE eu_s.cn = psm.estn_unit_cn) total_area,
psm.p2pointcnt n_h
FROM fs_fiadb.pop_estn_unit peu,
fs_fiadb.pop_stratum psm,
fs_fiadb.pop_eval pev,
fs_fiadb.pop_eval_grp peg,
fs_fiadb.pop_eval_typ pet
WHERE peu.cn = psm.estn_unit_cn
AND pev.cn = peu.eval_cn
AND pet.eval_cn = pev.cn
AND pet.eval_grp_cn = peg.cn
AND pet.eval_typ = 'EXPVOL' -- specify the appropriate expansion
AND peg.eval_grp = 272003 -- the desired evaluation group must be specified
) phase_1_summary,
(SELECT pop_stratum_cn,
SUM(y_hid_adjusted) ysum_hd,
SUM(y_hid_adjusted * y_hid_adjusted) ysum_hd_sqr,
COUNT(*) number_plots_in_domain,
SUM(decode(y_hid_adjusted, 0, 0, NULL, 0, 1)) non_zero_plots
FROM (SELECT psm.cn pop_stratum_cn,
p.cn plt_cn,
SUM(s.tpa_unadj * psm.adj_factor_micr) y_hid_adjusted
-- expression from ref_pop_attribute table
FROM fs_fiadb.cond c,
fs_fiadb.plot p,
fs_fiadb.seedling s,
-- seedling table must be included for seedling-level estimates
fs_fiadb.pop_plot_stratum_assgn ppsa,
fs_fiadb.pop_stratum psm,
fs_fiadb.pop_estn_unit peu,
fs_fiadb.pop_eval pev,
fs_fiadb.pop_eval_grp peg,
fs_fiadb.pop_eval_typ pet
WHERE p.cn = c.plt_cn
AND pet.eval_typ = 'EXPVOL'
AND s.plt_cn = c.plt_cn
AND s.condid = c.condid
AND c.cond_status_cd = 1
AND c.reservcd = 0
AND c.sitelcd IN (1, 2, 3, 4, 5, 6)
-- additional where_clause from ref_pop_attribute table
AND ppsa.plt_cn = p.cn
AND ppsa.stratum_cn = psm.cn

```

```

AND peu.cn = psm.estn_unit_cn
AND pev.cn = peu.eval_cn
AND pet.eval_cn = pev.cn
AND pet.eval_grp_cn = peg.cn
AND peg.eval_grp = 272003
-- the desired evaluation group must be specified
GROUP BY psm.cn, p.cn)
GROUP BY pop_stratum_cn) phase_2_summary
WHERE phase_1_summary.pop_stratum_cn =
phase_2_summary.pop_stratum_cn(+)
GROUP BY pop_eval_grp_cn,
eval_grp,
estn_unit_cn,
phase_1_summary.total_area) estimate_by_estn_unit
GROUP BY pop_eval_grp_cn, eval_grp

```

The example above produces an estimate of the number of live seedlings on timberland with sampling error:

Item	Value
<b>EVAL_GRP</b>	272003
<b>ESTIMATE</b>	36,531,715,033
<b>SE_OF_ESTIMATE_PCT</b>	1.8
<b>VAR_OF_ESTIMATE</b>	450,669,692,553,141,000
<b>TOTAL_PLOTS</b>	16,041
<b>NONZERO_PLOTS</b>	4,240
<b>TOTAL_POPULATION_ACRES</b>	54,002,539



## Chapter 6: Restricting the Attribute of Interest to a smaller subset of the population

The estimation procedures presented in examples 4-1 through 4-5 and 5-1 through 5-4 can all be modified to restrict the estimation to a subset, referred to as the domain of interest. An example of a domain would be only sawtimber stands on publicly owned timberland. In effect, the attributes identified in the REF\_POP\_ATTRIBUTE table are a combination of an attribute (e.g., area, number of trees, volume, number of seedlings) and a domain (e.g., forest land, timberland, ownership, growing-stock trees). The attribute of interest is defined in the REF\_POP\_ATTRIBUTE.EXPRESSION and the domain of interest is defined by REF\_POP\_ATTRIBUTE.WHERE\_CLAUSE. In example 4-2, the attribute of interest is area, and the domain of interest is restricted to timberland only. In example 4-3, the attribute of interest is number of trees, and the domain of interest is restricted to live trees on forest land with diameters 1 inch and larger. In example 4-4, the attribute of interest is number of seedlings, and the domain of interest is restricted to timberland. In example 4-5, the attribute of interest is volume of growing-stock trees, and the domain of interest is restricted to timberland.

A word of caution when working with periodic data - not all lands and all attributes were sampled in periodic inventories. In some States, only productive, non-reserved lands were sampled in periodic inventories. So, applying estimation of number of trees to all forest land in older periodic inventories will appear to work, but trees were only measured on timberland, so the estimates will only reflect the trees on timberland. Also, in many periodic inventories, seedlings were not tallied.

In the next example, the domain of interest in example 4-3 is further restricted to a specific species (SPCD = 129, eastern white pine), diameter (DIA ≥ 20, trees 20 inches and larger), and ownership (OWNGRPCD = 40, private owners only). The boxed lines have been added to the procedure. The procedure now provides an estimate of the total number of live eastern white pine, 20 inches and larger on privately owned forest land.

**Example 6-1:** Estimate number of live eastern white pine trees 20 inches and larger on privately owned forest land (trees).

```
SELECT SUM(psm.expns * t.tpa_unadj *
          decode(t.dia,
                NULL,
                psm.adj_factor_subp,
                decode(least(t.dia, 5 - 0.001),
                      t.dia,
                      psm.adj_factor_micr,
                      decode(least(t.dia,
                                nvl(p.macro_breakpoint_dia, 9999) -
                                0.001),
                              t.dia,
                              psm.adj_factor_subp,
                              psm.adj_factor_macr))) -- expression from ref_pop_attribute table
          ) estimate
FROM fs_fiadb.cond      c,
     fs_fiadb.plot      p,
     fs_fiadb.tree      t, -- tree table must be included for tree-level estimates
```

```

fs_fiadb.pop_plot_stratum_assgn ppsa,
fs_fiadb.pop_stratum           psm,
fs_fiadb.pop_estn_unit         peu,
fs_fiadb.pop_eval              pev,
fs_fiadb.pop_eval_grp         peg,
fs_fiadb.pop_eval_typ          pet
WHERE p.cn = c.plt_cn
AND pet.eval_typ = 'EXPVOL'
AND t.plt_cn = c.plt_cn
AND t.condid = c.condid
AND c.cond_status_cd = 1
AND t.statuscd = 1
AND t.dia >= 1.0 -- additional where_clause from ref_pop_attribute table
AND t.spcd = 129
AND t.dia >= 20.0
AND c.owngrpcd = 40 -- user-defined additional where_clause
AND ppsa.plt_cn = p.cn
AND ppsa.stratum_cn = psm.cn
AND peu.cn = psm.estn_unit_cn
AND pev.cn = peu.eval_cn
AND pev.cn = pet.eval_cn
AND pet.eval_grp_cn = peg.cn
AND peg.eval_grp = 272003 -- the desired evaluation group must be specified

```

The example above produces an estimate of the total number of live eastern white pine, 20 inches and larger on privately owned forest land:

Item	Value
<b>ESTIMATE</b>	519,317

Adding the same restrictions to the where clause in example 5-3 provides an estimate with sampling error:

Item	Value
<b>EVAL_GRP</b>	272003
<b>ESTIMATE</b>	519,317
<b>SE_OF_ESTIMATE_PCT</b>	25.1
<b>VAR_OF_ESTIMATE</b>	17,051,491,226
<b>TOTAL_PLOTS</b>	16,041
<b>NONZERO_PLOTS</b>	20
<b>TOTAL_POPULATION_ACRES</b>	54,002,539

The estimated 519,317 eastern white pine trees, 20 inches and larger on privately owned forest land has a sample error of 25.1 percent. Live eastern white pine 20 inches or larger on private forest land were observed on a total of 20 plots in the State.

## Chapter 7: Changing the Attribute of Interest with User-Defined Criteria

Users can define condition-level attributes of interest. The standard condition-level attributes of interest are sampled land area and all land area (expressed in acres). Sampled land area (adjusted for denied access and hazardous conditions that were not sampled) is the one used for nearly all standard FIA tables that report area estimates. All land area (where denied access and hazardous are considered part of the sample) is only used in estimation that treats denied access (plots on land where field crews were unable to obtain the owner's permission to measure the plot) and hazardous (conditions that were deemed too hazardous to measure the plots) as part of the sample attribute of interest. Most of the other condition-level attributes that FIA observes are typically used to categorize the condition, and are most often applied as restrictions on the population in defining the domain, and do not lend themselves as an attribute of interest. For example, BALIVE (the basal area of live trees 1 inch diameter and larger) is mainly used to categorize forest land area rather than as an attribute of interest in population-level estimation. Users are more interested in knowing how many acres of forest land meets some basal area requirement (say between 50 and 100 square feet per acre), rather than the total basal area of forest land in a State.

An example of a user-defined condition-level attribute of interest, for which an estimate of a total might be of interest, would be total land value (see example 7-1). Here the user would supply a function that assigns value (\$ per acre) to forest land, based on attributes in FIADB. As an example, we use a very arbitrary function of site index and basal area of live tree - value per acre =  $1000 + (\text{site index} \times 3) + (\text{basal area} \times 4)$ , and limit the domain of interest to only private timberland. Modifying example 4-1 produces the following script and estimate of total value. Since the function is a condition-level value per acre, it is simply included in the expression as a multiplication factor, and the domain restriction (private timberland) is added to the where clause. The sections that have been added to example 4-2 are in boxes. The same modifications were added to example 5-2 to produce the estimates with sampling errors.

**Example 7-1:** Estimated dollar value of private timberland (user-defined function).

```

SELECT SUM(psm.expns * c.condprop_unadj *
  DECODE(c.prop_basis,
    'MACR',
    psm.adj_factor_macr,
    psm.adj_factor_subp) -- expression from ref_pop_attribute table
  * (1000 + c.sicond * 3 + c.balive * 4) -- user-defined value function
) estimate
FROM fs_fiadb.cond c,
  fs_fiadb.plot p,
  fs_fiadb.pop_plot_stratum_assgn ppsa,
  fs_fiadb.pop_stratum psm,
  fs_fiadb.pop_estn_unit peu,
  fs_fiadb.pop_eval pev,
  fs_fiadb.pop_eval_grp peg,
  fs_fiadb.pop_eval_typ pet
WHERE p.cn = c.plt_cn
  AND pet.eval_typ = 'EXPCURR'
  AND c.cond_status_cd = 1
  AND c.reservcd = 0
  AND c.siteclcd IN (1, 2, 3, 4, 5, 6)
  AND c.owngrpcd = 40
  AND ppsa.plt_cn = p.cn
  AND ppsa.stratum_cn = psm.cn
  AND peu.cn = psm.estn_unit_cn
  AND pev.cn = peu.eval_cn
  AND pev.cn = pet.eval_cn
  AND pet.eval_grp_cn = peg.cn
  AND peg.eval_grp = 272003 -- the desired evaluation group must be specified

```

The example above produces an estimate:

Item	Value
ESTIMATE	10,402,769,126

And the same modification to example 5-2 produces an estimate with sampling errors:

Item	Value
EVAL_GRP	272003
ESTIMATE	10,402,769,126
SE_OF_ESTIMATE_PCT	1.3
VAR_OF_ESTIMATE	17,902,006,332,174,300
TOTAL_PLOTS	16,041
NON_ZERO_PLOTS	2,347
TOTAL_POPULATION_ACRES	54,002,539



Based on this function, the estimated total value of private timberland in the State is 10.4 billion dollars. This value function is used only as an example, any type of user-defined function that assigns quantities, such as value (\$ per acre), wildlife population level (animals per acre), productivity (yield per acre), or carbon sequestration potential (tons per acre) could be used as long as it is a function of data items in the FIADB, and/or data attributes from other sources that can be linked to FIA plots.



## Chapter 8: Estimates of Change over Time

A number of the attributes described in the REF\_POP\_ATTRIBUTE table are related to change over time and are based on computed attributes that utilize data from two points in time from the same plot. The attributes identified by values 25-44 (e.g., attribute number 25, "Average annual net growth of live trees (at least 5 inches d.b.h./d.r.c.), in cubic feet, on forest land") of REF\_POP\_ATTRIBUTE.ATTRIBUTE\_NBR are the standard net growth, removals and mortality attributes that FIA presents in its reports. The computation of these values as presented in the previous section will provide estimates of these change attributes; estimation of mortality and removals is done through the observations made and recorded at the second measurement (time 2) of the plot, estimates of net growth may utilize the time 2 or time 1 classifications of the plot, or both combined (accounting method). Users often want to do one of the following: (1) obtain estimates that reflect changes in attributes over the remeasurement of the plot that go beyond these attributes, (2) classify these standard estimates and other estimates by attributes from the previous measurement, or (3) cross-classify them by changes in various attributes over time. Examples of these types of estimations are as follows:

- Breakdowns of change in area over time by past and current land use, forest type, or other condition attributes.
- Number of trees on forest land that changed to nonforest land.
- Removals of trees on forest land of a specific forest type that changed to a different forest type.
- Mortality of trees that were in a specific diameter range in the previous measurement.
- Change in the number of seedlings per acre over time for a specific forest type.

The estimation of these and many other change attributes require properly selecting the appropriate set of plots that were measured at both points in time and linking data from these two measurements.

Prior to 1999, FIA used periodic inventories with different plot designs. Since 1999, the new annual inventory uses a national standard, 4-subplot fixed-area plot design. The change estimation procedures described here are applicable to all plots measured at least twice in the annual inventory, but may not be appropriate for change estimation between periodic and annual inventories.

## 8.1 Selecting an appropriate set of plots (evaluation) for change estimation

For change estimation, select an evaluation that is available for net growth, removals, and mortality estimates. These evaluations are generally available for periodic-to-periodic, periodic-to-annual, as well as annual-to-annual remeasurement plots. Area change estimates are only available on annual-to-annual remeasurement plots.

The net growth-removals-mortality (GRM) evaluations can be identified by including one of the following restrictions in the where clause.

The following statement will restrict the sample plots to only those used in the estimation of net growth:

```
and pop_eval_typ.eval_typ = 'EXPGROW'
```

The following statement will restrict the sample plots to only those used in the estimation of removals:

```
and pop_eval_typ.eval_typ = 'EXPREMV'
```

The following statement will restrict the sample plots to only those used in the estimation of mortality:

```
and pop_eval_typ.eval_typ = 'EXPMORT'
```

Area change evaluations are only available for annual-to-annual remeasurement plots as identified in the following statement:

```
and pop_eval_typ.eval_typ = 'EXPCHNG'
```

## 8.2 Linking tree-level data to past condition data

In the following example, we demonstrate how FIA produced a tree-level annual net growth estimate prior to FIADB 5.1.04.

The 2012 Minnesota evaluation used in this estimate (POP\_EVAL.EVALID = 271203) consists of plots measured in 2003, 2004, 2005, 2006, and 2007 that were remeasured in 2008, 2009, 2010, 2011, and 2012, respectively.

**Example 8-1:** Estimate annual net growth of live trees on forest land using traditional script (cubic feet per year).

```
SELECT SUM(psm.expns * t.tpagrow_unadj * t.fgrowcfa1 *
  DECODE(t.dia,
    null,
    psm.adj_factor_subp,
    DECODE(least(t.dia, 5 - 0.001),
      t.dia,
      psm.adj_factor_micr,
      DECODE(least(t.dia,
        nvl(p.macro_breakpoint_dia, 9999) - 0.001),
        t.dia,
        psm.adj_factor_subp,
        psm.adj_factor_macr)))) estimate_traditional
FROM fs_fiadb.cond          c,
     fs_fiadb.plot          p,
     fs_fiadb.tree          t,
     fs_fiadb.pop_plot_stratum_assgn ppsa,
     fs_fiadb.pop_stratum   psm,
     fs_fiadb.pop_estn_unit  peu,
     fs_fiadb.pop_eval      pev,
     fs_fiadb.pop_eval_grp   peg,
     fs_fiadb.pop_eval_typ   pet
WHERE p.cn = c.plt_cn
     AND pet.eval_typ = 'EXPGROW'
     AND t.plt_cn = c.plt_cn
     AND t.condid = c.condid
     AND ppsa.plt_cn = p.cn
     AND ppsa.stratum_cn = psm.cn
     AND peu.cn = psm.estn_unit_cn
     AND pev.cn = peu.eval_cn
     AND pev.cn = pet.eval_cn
     AND pet.eval_grp_cn = peg.cn
     AND peg.eval_grp = 272012 -- the desired evaluation group must be specified
```

The example above produces an estimate of the total annual net growth of live trees on forest land (cubic feet per year):

Item	Value
<b>ESTIMATE_TRADITIONAL</b>	392,158,565

There are two known issues with this script. One is how the subplot type (microplot, subplot, or macroplot) of each tree is determined. The subplot type is needed to apply the appropriate adjustment factor that compensates for nonsampled area. This script uses the TREE.DIA value to determine the subplot type. While this is valid for current estimates such as volume, it is not valid for remeasurement estimates for two reasons. First, TREE.DIA is not always populated on removal and mortality trees. Second, on remeasurement plots, the correctly applied subplot type is not directly related to tree diameter at time 2. For example, on removal and mortality trees, the tree remeasurement expansion factor is based on the previous plot type, which could be the microplot, not the subplot.

The other issue is that the trees per acre (TPAGROW\_UNADJ) value represented by a sample tree can be different depending on the land basis. This occurs on trees that were previously 1.0-4.9 inches on the microplot on timberland at time 1 then grew over the 5.0-inch threshold at time 2 (at threshold size the tree is tallied with the subplot) and the condition no longer qualifies as timberland but is still forest land. This can occur when the COND.RESERVCD changes from 0 to 1. For the timberland land basis, the tree is a diversion at the midpoint between time 1 and 2 with a TPAGROW\_UNADJ value based on the microplot (74.965282 trees per acre), but the same tree is ingrowth on forest land and is assigned the subplot TPAGROW\_UNADJ value (6.018046 trees per acre). Because the TREE table only stores one value for TPAGROW\_UNADJ, the traditional script does not employ the appropriate TPAGROW\_UNADJ value in these rare cases.

Note that this same issue applies to estimates of annual net removals and annual net mortality. The TREE table stores one value each for TPAREMV\_UNADJ and TPAMORT\_UNADJ, but there could be two different values for any of these attributes in rare cases.

## 8.3 Improved annual net growth estimation

The following example indicates how the traditional annual net growth script is modified to use the appropriate TPAGROW\_UNADJ values and adjustment factors for nonsampled area. To store these values for remeasurement trees properly, a new data table, TREE\_GRM\_ESTN, was added to FIADB version 5.1.04. This table may have up to six records per tree depending on applicable land basis (timberland or forest land) and estimation types (all live, growing stock, or sawlog). See the full table description of TREE\_GRM\_ESTN in chapter 3 of *The Forest Inventory and Analysis Database: Database Description and User Guide for Phase 2* (O'Connell et. al. 2017) for descriptions of each attribute.

The modified script has some important improvements over the traditional script. The remeasurement adjustment factor is determined from TREE\_GRM\_ESTN.SUBPTYP\_GRM. Also, given that the new table has separate records for timberland and forest land estimates, the varying TPAGROW\_UNADJ values for the same tree can be stored without conflict.

Finally, the table stores the annual net growth, removal, and mortality volume of each tree. The combined values of ESTIMATE, ESTN\_TYPE, ESTN\_UNITS, and LAND\_BASIS on each record identify the estimate (e.g., volume of all live in cubic feet on timberland) that the ANN\_NET\_GROWTH, REMOVALS, or MORTALITY attributes represent. The multiple records per tree and the combination of values available in the estimate descriptor, land basis, and GRM columns can be used in place of the GRM columns in the TREE table (e.g., FGROWCFAL, FREMVBFSG, and FMORTCFSL).

**Example 8-2:** Estimate annual net growth of live trees on forest land using improved script (cubic feet per year).

```
SELECT ROUND(SUM(psm.expns * grm.tpagrow_unadj * -- use tpagrow_unadj for trees per acre
  DECODE(grm.subptyp_grm, -- use subptyp_grm for adjustment factor
    1,
    psm.adj_factor_subp,
    2,
    psm.adj_factor_micr,
    3,
    psm.adj_factor_macr) *
  NVL(grm.ann_net_growth, -- analogous to tree.fgrowcfal
    0))) AS estimate_improved
FROM fs_fiadb.tree_grm_estn      grm, -- added to obtain SUBPTYP_GRM, TPAGROW_UNADJ,
etc.
  fs_fiadb.tree                t,
  fs_fiadb.cond                c,
  fs_fiadb.plot                p,
  fs_fiadb.pop_plot_stratum_assgn ppsa,
  fs_fiadb.pop_stratum         psm,
  fs_fiadb.pop_estn_unit       peu,
  fs_fiadb.pop_eval            pev,
  fs_fiadb.pop_eval_typ        pet,
  fs_fiadb.pop_eval_grp        peg
WHERE grm.estn_units = 'CF' -- cubic feet, added to filter tree_grm_estn to single record
  AND grm.estn_type = 'AL' -- all live trees, added to filter tree_grm_estn to single record
  AND grm.estimate = 'VOLUME' -- added to filter tree_grm_estn to single record
```

```

AND grm.land_basis = 'FORESTLAND' -- added to filter tree_grm_estn to single record
AND t.cn = grm.tre_cn
AND t.condid = c.condid
AND t.plt_cn = c.plt_cn
AND c.plt_cn = p.cn
AND p.cn = ppsa.plt_cn
AND ppsa.stratum_cn = psm.cn
AND psm.estn_unit_cn = peu.cn
AND peu.eval_cn = pev.cn
AND pev.cn = pet.eval_cn
AND pet.eval_typ = 'EXPGROW'
AND pet.eval_grp_cn = peg.cn
AND peg.eval_grp = 272012-- the desired evaluation group must be specified

```

The example above produces an estimate of the total annual net growth of live trees on forest land (cubic feet per year):

Item	Value
<b>ESTIMATE_IMPROVED</b>	392,104,751

Note that the difference between the traditional and improved estimate in this example is less than 0.05 percent. This small difference is due to the rare number of removal or mortality trees that need a different adjustment factor applied than is used in the traditional script, or due to a different TPAGROW\_UNADJ value than is stored in the TREE table for the land basis (see section 8.2).

For this query, the values from the TREE\_GRM\_ESTN table are 'AL' (all live), 'CF' (cubic feet), 'VOLUME', and 'FORESTLAND' for ESTN\_TYPE, ESTN\_UNITS, ESTIMATE, and LAND\_BASIS, respectively. See the TREE\_GRM\_ESTN table description in chapter 3 of [The Forest Inventory and Analysis Database: Database Description and User Guide for Phase 2](#) (O'Connell et. al. 2017) for a complete list of valid values for ESTIMATE, LAND\_BASIS, ESTN\_TYPE, and ESTN\_UNITS.



## 8.4 Annual net growth estimation summarized by current or previous attributes

The script can be further modified to summarize the total annual net growth estimate by any time 2 plot, condition, or tree attribute. For example, users may be interested in summarizing the annual net growth by the current (time 2) stand-size class.

In this case, all of the growth on each tree in the condition is assigned to the current stand-size class of the associated condition. It does not account for any shifts in stand-size class that may have occurred between time 1 and time 2. To account for shifts in classified attributes such as stand-size class, see the examples related to annual net growth accounting in section 8.5.

**Example 8-3:** Estimate annual net growth of live trees on forest land (cubic feet per year) by current stand-size class.

```
SELECT c.stdszcd, -- added to summarize estimate by current stdszcd
       ROUND(SUM(psm.expns * grm.tpagrow_unadj *
                DECODE(grm.subptyp_grm,
                        1,
                        psm.adj_factor_subp,
                        2,
                        psm.adj_factor_micr,
                        3,
                        psm.adj_factor_macr) *
                NVL(grm.ann_net_growth,
                    0))) AS estimate_improved
FROM fs_fiadb.tree_grm_estn      grm,
     fs_fiadb.tree              t,
     fs_fiadb.cond              c,
     fs_fiadb.plot              p,
     fs_fiadb.pop_plot_stratum_assgn ppsa,
     fs_fiadb.pop_stratum       psm,
     fs_fiadb.pop_estn_unit     peu,
     fs_fiadb.pop_eval          pev,
     fs_fiadb.pop_eval_grp      peg,
     fs_fiadb.pop_eval_typ      pet
WHERE grm.estn_units = 'CF' -- cubic feet, change to 'BF' when ESTN_TYPE = 'SL'
      AND grm.estn_type = 'AL' -- all live, change to 'GS' or 'SL' for growing-stock or sawlog estimates
      AND grm.estimate = 'VOLUME' -- volume is only valid value, biomass coming in future
      AND grm.land_basis = 'FORESTLAND' -- forest land, change to 'TIMBERLAND' if desired
      AND t.cn = grm.tre_cn
      AND p.cn = c.plt_cn
      AND t.plt_cn = c.plt_cn
      AND t.condid = c.condid
      AND ppsa.plt_cn = p.cn
      AND ppsa.stratum_cn = psm.cn
      AND peu.cn = psm.estn_unit_cn
      AND pev.cn = peu.eval_cn
      AND pev.cn = pet.eval_cn
      AND pet.eval_typ = 'EXPGROW'
      AND pet.eval_grp_cn = peg.cn
      AND peg.eval_grp = 272012
GROUP BY c.stdszcd -- added to summarize estimate by current stdszcd
```

Example 8-3 produces estimates of total net growth of all live trees on forest land by current stand-size class (cubic feet per year, description of code added for clarity):

<b>STDSZCD</b>	<b>DESCRIPTION</b>	<b>ESTIMATE_IMPROVED</b>
NULL	Nonforest	-1,307,397
1	Large diameter stands	147,818,500
2	Medium diameter stands	208,702,251
3	Small diameter stands	42,930,756
5	Nonstocked stands	-6,039,359
-	<b>SUM</b>	<b>392,104,751</b>

There may be minor rounding differences between the sum of the subtotals from this script and the sum of total net growth in example 8-2.

Also, there is an estimate for STDSZCD = NULL (-1,307,397 cubic feet per year). This is the amount of net growth that occurred on conditions where STDSZCD was not computed at time 2. This is the case on land that was forest land at time 1 but diverted to nonforest land by time 2. The amount of net growth that occurred on these conditions is summarized without a designated stand size class in this script.

The script can be further modified to link not only to the condition record at time 2, but also to the condition record at time 1 by using TREE.PREVCOND to link each tree record to its previous condition. We also added a group by clause to produce estimates by condition-level attributes COND\_STATUS\_CD (condition status code) and STDSZCD (stand-size class code) at both points in time. This procedure is shown in example 8-4, which was created by adding the bold sections to example 8-3.

**Example 8-4:** Estimate annual net growth of live trees on forest land (cubic feet per year) by condition status and stand-size class at two points in time.

```

SELECT c_past.cond_status_cd past_cond_status_cd,
       c_past.stdszcd past_stdszcd,
       c.cond_status_cd current_cond_status_cd,
       c.stdszcd current_stdszcd,
       ROUND(SUM(psm.expns * grm.tpagrow_unadj *
                DECODE(grm.subtyp_grm,
                        1,
                        psm.adj_factor_subp,
                        2,
                        psm.adj_factor_micr,
                        3,
                        psm.adj_factor_macr) * NVL(grm.ann_net_growth, 0))) AS estimate_improved
FROM fs_fiadb.tree_grm_estn      grm,
     fs_fiadb.cond              c_past, -- past condition is added
     fs_fiadb.tree              t,
     fs_fiadb.cond              c,
     fs_fiadb.plot              p,
     fs_fiadb.pop_plot_stratum_assgn ppsa,
     fs_fiadb.pop_stratum       psm,
     fs_fiadb.pop_estn_unit     peu,
     fs_fiadb.pop_eval          pev,
     fs_fiadb.pop_eval_grp      peg,
     fs_fiadb.pop_eval_typ      pet
WHERE grm.estn_units = 'CF' -- cubic feet, change to 'BF' when ESTN_TYPE = 'SL'
     AND grm.estn_type = 'AL'
       -- all live, change to 'GS' or 'SL' for growing-stock or sawlog estimates
     AND grm.estimate = 'VOLUME' -- volume is only valid value
     AND grm.land_basis = 'FORESTLAND' -- forest land, change to 'TIMBERLAND' if desired
     AND t.cn = grm.tre_cn
     AND c_past.plt_cn = p.prev_plt_cn
       -- links to only those conditions at previous measurement of plot
     AND c_past.condid = t.prevcond -- links trees to their past condition
     AND c.plt_cn = t.plt_cn
     AND c.condid = t.condid
     AND p.cn = c.plt_cn
     AND ppsa.plt_cn = p.cn
     AND ppsa.stratum_cn = psm.cn
     AND peu.cn = psm.estn_unit_cn
     AND pev.cn = peu.eval_cn
     AND pev.cn = pet.eval_cn
     AND pet.eval_typ = 'EXPGROW'
     AND pet.eval_grp_cn = peg.cn
     AND peg.eval_grp = 272012
GROUP BY c_past.cond_status_cd,
         c_past.stdszcd,
         c.cond_status_cd,
         c.stdszcd

```

Example 8-4 produces estimates of annual net growth of live trees on forest land by past and current COND\_STATUS\_CD and STDSZCD (cubic feet per year).

PAST_COND_STATUS_CD	PAST_STDSZCD	CURRENT_COND_STATUS_CD	CURRENT_STDSZCD	ESTIMATE_IMPROVED
1	1	1	1	69,750,165
1	1	1	2	-4,349,149
1	1	1	3	-10,167,386
1	1	1	5	-1,163,256
1	1	2	-	505,175
1	1	3	-	-737,274
1	1	4	-	-382,522
1	2	1	1	17,903,624
1	2	1	2	132,795,741
1	2	1	3	-2,608,407
1	2	1	5	-5,235,236
1	2	2	-	-493,068
1	3	1	1	4,216,173
1	3	1	2	43,452,890
1	3	1	3	46,329,508
1	3	1	5	-140,869
1	3	2	-	54,522
1	3	3	-	-31,583
1	5	1	1	999,684
1	5	1	2	82,267
1	5	1	3	781,986
1	5	1	5	-33,518
1	5	2	-	-222,648
2	-	1	1	51,077,047
2	-	1	2	33,803,039
2	-	1	3	8,027,811
2	-	1	5	533,520
3	-	1	1	1,061,927
3	-	1	2	1,200,633
3	-	1	3	180,089
4	-	1	1	2,809,880
4	-	1	2	1,716,829
4	-	1	3	387,155
-	-	-	<b>SUM</b>	<b>392,104,749</b>

There may be minor rounding differences between the sum of the subtotals from this script and the total annual net growth script in example 8-2.

The following tabulation of estimated annual net growth on forest land by condition status code and stand-size class at the two points in time can be made from the example 8-4 results. We have added the code labels to the last row and column headings, and each cell in table 8-1 is the appropriate value from example 8-4.

**Table 8-1:** Estimated total annual net growth of live trees on forest land by past and current condition status code and stand-size class, Minnesota, 2012 (cubic feet per year).

PAST_ COND_ STATUS_CD	PAST_ STDSZCD	CURRENT_COND_STATUS_CD								Total
		1 Forest land				Total on forest land	2 Nonforest land	3 Noncensus water	4 Census water	
		CURRENT_STDSZCD								
1 Large diameter	2 Medium diameter	3 Small diameter	5 Non- stocked							
1 Forest land	1 Large diameter	69,750,165	-4,349,149	-10,167,386	-1,163,256	53,070,374	505,175	-737,274	-382,522	53,455,753
	2 Medium diameter	17,903,624	132,795,741	-2,608,407	-5,235,236	142,855,722	-493,068	0	0	142,362,654
	3 Small diameter	4,216,173	43,452,890	46,329,508	-140,869	93,857,702	54,522	-31,583	0	93,880,641
	5 Non- stocked	999,684	82,267	781,986	-33,518	1,830,419	-222,648	0	0	1,607,771
Total on forest land		92,869,646	171,981,749	34,335,701	-6,572,879	292,614,217	-156,019	-768,856	-382,522	291,306,820
2 Nonforest land		51,077,047	33,803,039	8,027,811	533,520	93,441,417	-	-	-	93,441,417
3 Noncensus water		1,061,927	1,200,633	180,089	0	2,442,649	-	-	-	2,442,649
4 Census water		2,809,880	1,716,829	387,155	0	4,913,864	-	-	-	4,913,864
Total annual net growth		147,818,500	208,702,250	42,930,756	-6,039,359	393,412,147	-156,019	-768,856	-382,522	392,104,750

## 8.5 Annual net growth estimation using the accounting method

The annual net growth estimates in the previous examples are summaries of the biological annual net growth on each tree by either a current or past attribute, or a matrix consisting of both classifications. However, these scripts still do not take into account volume shifts across classified attributes that can change value between time 1 and time 2. Instead they only summarize the difference in volume on individual trees between time 1 and time 2 based on the attributes of interest. In order to account for volume that moves into and out of a single class between time 1 and time 2, some users may find it more appropriate to use a script that assigns the beginning and end volume to the initial and final class for the attribute of interest. This is referred to as the accounting method.

FIA uses the annual net growth equation defined by Bechtold and Patterson (2005):

$$(\text{Volume } t2 - \text{Volume } t1) / \text{REMPER}$$

where REMPER is the remeasurement period in years.

To compute the annual net growth on a tree that had a volume of 1.705 cubic feet at time 1 and a volume of 3.835 cubic feet at time 2 and remeasurement period of 5.5 years, the equation solves as follows:

$$(3.835 \text{ cubic feet} - 1.705 \text{ cubic feet}) / 5.5 \text{ years} = 0.387 \text{ cubic feet per year}$$

All of the previous annual net growth examples summarized this end result (0.387 cubic feet per year), which is the biological annual net growth of the tree. They assigned the resulting value for each tree (expanded to the population level) to either a previous or current classification, or a matrix consisting of both classifications. While those are valid analyses, the results may not match actual shifts in volume across classified attributes that change between time 1 and time 2 (e.g., stand-size class). To match shifts in volume across a classified attribute such as stand-size class, users can employ the accounting method, which uses an algebraically equivalent form of the standard equation.

$$(\text{Volume } t2 - \text{Volume } t1) / \text{REMPER}$$

can also be expressed as:

$$(\text{Volume } t2 / \text{REMPER}) - (\text{Volume } t1 / \text{REMPER})$$

So the same tree can be represented as:

$$(3.835 \text{ cubic feet} / 5.5 \text{ years}) - (1.705 \text{ cubic feet} / 5.5 \text{ years})$$

$$0.697 \text{ cubic feet per year} - 0.310 \text{ cubic feet per year} = 0.387 \text{ cubic feet per year}$$

Instead of summarizing the end result of the equation, the accounting method assigns the time 1 annualized volume (-0.310 cubic feet per year) to the time 1 attribute value and the time 2 annualized volume (0.697 cubic feet per year) to the time 2 attribute value. This effectively accounts for outgrowth from the time 1 class and ingrowth into the time 2 class. In the case where the time 1 class and the time 2 class have the same value, the net result is that the biological annual net growth of the tree is assigned to that class (0.387 cubic feet per year). If the attribute changes value over the remeasurement period, then the beginning annualized volume is deducted from the initial class and the ending annualized volume is added to the time 2 class.

In the current FIADB version only certain remeasurement evaluations have the necessary data to employ the accounting method. The evaluations that can use the accounting method are identified by POP\_EVAL.GROWTH\_ACCT = 'Y'. It is currently not available on periodic-to-periodic or periodic-to-annual remeasurement plots.

The TREE table must be joined to the COND table twice for current and past condition attributes as well as the TREE\_GRM\_ESTN table as shown in example 8-4. As described previously, the TREE\_GRM\_ESTN table contains multiple records per tree and must be filtered properly to obtain the appropriate estimate. In addition to the previously discussed attributes, the table stores the remeasurement period, the beginning and end volume estimates, beginning and end diameters, and component values (e.g., survivor, ingrowth, mortality, cut, diversion, and reversion). In cases with mortality and removal trees, midpoint diameter and volume estimates are supplied in lieu of the ending estimates.

Furthermore, the BEGINEND table is added (without a join) to split the record into two time periods (time 1 and time 2). This allows the beginning estimate to be summarized by the time 1 attribute and the end (or midpoint) estimate to be summarized by the time 2 attribute.

Finally, depending on the summary attribute, removal and mortality trees may use either the previous value or a midpoint value. At this time, only two attributes (diameter and stand age) have been identified as attributes that can be defined at the midpoint on removal and mortality trees. In all other cases, the previous attribute value is assigned to removal and mortality trees.

**Example 8-5:** Estimate annual net growth of live trees on forest land (cubic feet per year) by condition status and stand-size class using the accounting method.

```
SELECT DECODE(be.oneortwo,
             1, c_past.stdszcd, -- if time 1 then use past stand-size code
             2, DECODE(grm.component,
-- for survivor, ingrowth and reversion trees, use the time 2 stand-size code
                'SURVIVOR', c.stdszcd,
                'INGROWTH', c.stdszcd,
                'REVERSION1',c.stdszcd,
                'REVERSION2',c.stdszcd,
-- use the past stand-size code on all other component values (annual net removal and mortality)
                at time 2
                c_past.stdszcd)
             ) AS stdszcd,
       ROUND(SUM(psm.expns * grm.tpagrow_unadj *
                DECODE(grm.subptyp_grm,
                        1, psm.adj_factor_subp,
                        2, psm.adj_factor_micr,
                        3, psm.adj_factor_macr) *
                NVL(DECODE(BE.oneortwo,
                        1,
-- for time 1, set the beginning estimate negative and divide by remper to annualize
                        (-grm.est_begin / grm.remper),
                        2,
-- for time 2, use the end estimate if populated, otherwise use midpoint estimate
                        ((NVL(grm.est_end, grm.est_midpt)
-- for time 2, must subtract mortality to obtain net growth and divide by remper to annualize
                        - NVL(grm.mortality, 0)) / grm.remper)),
```

```

0))) AS estimate_accounting
FROM fs_fiadb.beginend          be, -- added to split tree_grm_estn record into time 1 and 2
   fs_fiadb.cond                c_past,
   fs_fiadb.tree_grm_estn       grm,
   fs_fiadb.tree                 t,
   fs_fiadb.cond                c,
   fs_fiadb.plot                p,
   fs_fiadb.pop_plot_stratum_assgn ppsa,
   fs_fiadb.pop_stratum         psm,
   fs_fiadb.pop_estn_unit       peu,
   fs_fiadb.pop_eval            pev,
   fs_fiadb.pop_eval_typ        pet,
   fs_fiadb.pop_eval_grp        peg
WHERE grm.estn_units = 'CF' -- cubic feet, added to filter tree_grm_estn table to single record
  AND grm.estn_type = 'AL' -- all live, added to filter tree_grm_estn table to single record
  AND grm.estimate = 'VOLUME' -- volume, added to filter tree_grm_estn table to single record
  AND grm.land_basis = 'FORESTLAND'
  -- forest land, added to filter tree_grm_estn table to single record

  AND t.cn = grm.tre_cn
  AND t.prevcond = c_past.condid
  AND p.prev_plt_cn = c_past.plt_cn
  AND t.condid = c.condid
  AND t.plt_cn = c.plt_cn
  AND c.plt_cn = p.cn
  AND p.cn = ppsa.plt_cn
  AND ppsa.stratum_cn = psm.cn
  AND psm.estn_unit_cn = peu.cn
  AND peu.eval_cn = pev.cn
  AND pev.growth_acct = 'Y'
  -- added to ensure evaluation is suitable for using the accounting method

  AND pev.cn = pet.eval_cn
  AND pet.eval_typ = 'EXPGROW'
  AND pet.eval_grp_cn = peg.cn
  AND peg.eval_grp = 272012
GROUP BY DECODE(be.oneortwo,
  1,
  c_past.stdszcd,
  2,
  DECODE(grm.component,
    'SURVIVOR',
    c.stdszcd,
    'INGROWTH',
    c.stdszcd,
    'REVERSION1',
    c.stdszcd,
    'REVERSION2',
    c.stdszcd,
    c_past.stdszcd))

```



Example 8-5 produces the following estimates of annual net growth of live trees on forest land by stand-size class using the accounting method (cubic feet per year, description of code added for clarity):

STDSZCD	DESCRIPTION	ESTIMATE_ACCOUNTING
NULL	Nonforest land or water	0
1	Large diameter stands	255,925,414
2	Medium diameter stands	122,699,802
3	Small diameter stands	18,257,717
5	Nonstocked stands	-4,778,189
-	<b>SUM</b>	<b>392,104,744</b>

This results in an estimated stand-size class distribution that is quite different from the distribution in any of the previous estimates. Note there is also a slight difference in the total estimate of growth due to rounding.

DESCRIPTION	Example 8-5 ESTIMATE_ ACCOUNTING	Example 8-3 ESTIMATE_ CURRENT	Example 8-4 ESTIMATE_ PAST
Nonforest land or water	0	-1,307,397	100,797,930
Large diameter stands	255,925,414	147,818,500	53,455,753
Medium diameter stands	122,699,802	208,702,251	142,362,654
Small diameter stands	18,257,717	42,930,756	93,880,641
Nonstocked stands	-4,778,189	-6,039,359	1,607,771
<b>SUM</b>	<b>392,104,744</b>	<b>392,104,751</b>	<b>392,104,749</b>

The accounting script assigns the annual net growth on reverted and diverted conditions to the current and previous stand-size classes, respectively. As a result, there is not an estimate of annual net growth on nonforest conditions using the accounting script.

***Comparison of annual net change in inventory to annual net growth accounting***

The results from the annual net growth accounting script are more in line with the shifts in inventory volume within each class than with summaries by the current or past stand-size class alone (or even in combination as shown in example 8-4). Because not all inventory plots are remeasured, it is not possible to match the exact change in inventory volume estimates (which includes plots that are not remeasured) by summing annual net growth and removals from just those plots that are remeasured, but the trends should be similar, especially as the proportion of remeasured plots increases.

For comparison, we use this formula for net change:

Annual Net Growth - Annual Removals = Annual Net Change  
which can be expressed as:

Annual Net Growth = Annual Net Change + Annual Removals

The tabulation below shows inventory estimates for live trees on forest land in MN 2007 and 2012 from the EXPVOL evaluation (EVALID = 270701 and 271201). Given that Minnesota is on a five-year remeasurement period, an approximate net annual change is derived by taking the difference in volume in each class and dividing by an average five-year remeasurement period. By adding in the average annual removal rate (using the past stand-size class distribution), a net annual growth rate for each stand-size class can be approximated from the difference in the inventory volume estimates. Given the stated limitations of comparing estimates from inventory and remeasurement plots, the accounting method is the best overall match of the various annual net growth estimates on the remeasurement plots in examples 8-3, 8-4, and 8-5 to the approximate annual net growth from the inventory plots within each stand-size class.

Stand-size Class	MN 2007 INVENTORY	MN 2012 INVENTORY	Approx. Annual Net Change	Annual Removals (Past Stand-size class)	Approx. Annual Net Growth
Large diameter	9,255,337,234	9,837,839,706	116,500,494	117,927,058	234,427,552
Medium diameter	7,399,550,291	7,601,692,465	40,428,435	98,051,083	138,479,518
Small diameter	1,284,704,452	1,359,625,977	14,984,305	4,867,651	19,851,956
Nonstocked	14,781,817	11,068,118	-742,740	54,769	-687,971
<b>SUM</b>	<b>17,954,373,794</b>	<b>18,810,226,266</b>	<b>171,170,494</b>	<b>220,900,561</b>	<b>392,071,055</b>

The estimates of inventory volume on forest land in MN 2007 and MN 2012 could be derived from only the remeasurement plots in the MN 2012 EXPGROW evaluation and the beginning and ending volume estimates from the TREE\_GRM\_ESTN table. Also, the actual remeasurement period for each plot can be applied to each tree record instead of using an average five-year remeasurement period. Doing so results in a much better match with the annual net growth estimate, as it should because this is how the annual net growth estimates are derived. The only differences in annual net growth using this method are due to rounding error. The user should be aware that the inventory estimates from the remeasured plots will not match the EXPVOL evaluation estimates.

Stand-size Class	MN 2007 INVENTORY ON REMEASURED PLOTS ONLY	MN 2012 INVENTORY ON REMEASURED PLOTS ONLY	Annual Net Change	Annual Removals (Past Stand-size class)	Annual Net Growth Calculated
Large diameter	9,684,331,058	10,396,930,239	137,998,364	117,927,058	255,925,414
Medium diameter	7,900,133,908	8,028,222,984	24,648,722	98,051,084	122,699,802
Small diameter	1,362,668,604	1,427,886,965	13,390,065	4,867,653	18,257,717
Nonstocked	36,526,699	12,211,956	-4,832,958	54,769	-4,778,189
<b>SUM</b>	<b>18,893,660,269</b>	<b>19,865,252,144</b>	<b>170,748,662</b>	<b>220,900,564</b>	<b>392,104,744</b>

### ***Which annual net growth script is "right"?***

Because all of the estimates above are valid, which option should be used: accounting, current, or previous? It really depends on the question at hand, but FIA recommends using accounting for most attributes that can change class between two points in time because it accounts for volume shifts into and out of each class. But there could be situations where users may not want to use the accounting method for such attributes.

For example, to identify annual net growth that occurred on stands that were medium diameter (poletimber size) at time 2, regardless of the stand-size class at time 1, then choose the "current" method script (example 8-3).

To identify annual net growth that occurred on stands that were formerly nonstocked at time 1, regardless of the stand-size class at time 2, then use the table joins from the "two points in time" method script (example 8-4) because it has the join to the past condition. Modify the script slightly by removing `c.stdszcd`, `c.cond_status_cd`, and `c_past.cond_status_cd` from the select and group by statements so that `c_past.stdszcd` remains the only attribute of interest.

To determine the annual net growth that occurred on stands that were sawlog size at time 2 and distinguish stand-size class at time 1, then use the "two points in time" method script (example 8-4) as it is.

To know how much annual net growth occurred within a certain stand-size class between time 1 and time 2, accounting for volume movement both into and out of that stand-size class, then employ the "accounting" method script (example 8-5).

If the value of the attribute of interest should not change over time (e.g., state, county, species) then it is not necessary to use the accounting method.

### ***Accounting method for removal or mortality trees***

On mortality and removal trees, the "accounting" method script in example 8-5 uses the previous attribute value in lieu of the time 2 value. According to Bechtold and Patterson (2005), the event that caused the annual removal or annual mortality is deemed to occur at the midpoint of the remeasurement period. Currently, FIA does not compute and store values for most attributes at the midpoint of the remeasurement period. In most cases, only the time 1 and time 2 values are available. Because the event that results in a removal or mortality tree can also significantly change the condition, it is generally acceptable to consider that the removal or mortality occurred while that attribute held its time 1 value.

For example, consider a forest condition that was a large stand-size class (sawlog size, STDSZCD = 1) at time 1, then was harvested prior to time 2, where it was recorded as a

small stand-size class (seedling/sapling, STDSZCD = 3) after the harvest. In such a scenario it is logical that the removals were from the large class recorded at time 1, and not from the small class as recorded at time 2.

***Special cases for removal and mortality trees (midpoint attribute is available)***

At this point, we have only identified two exceptions when the midpoint attribute value is used in the accounting script. First, when a midpoint value has been determined and is stored in the database (estimated midpoint tree diameter on removal and mortality trees stored in TREE\_GRM\_ESTN.DIA\_MIDPT) and when it is relatively easy and acceptable to calculate the midpoint value "on-the-fly" (e.g., stand age). The midpoint stand age is derived by starting with the previous stand age and adding one-half of the remeasurement period between time 1 and time 2. Both of these attributes are usually assigned to broader classes such as a 2-inch diameter class and 5-, 10-, or 20-year age classes.

**Example 8-6:** Estimate annual net growth of live trees on forest land by diameter class using the accounting method.

```
SELECT DECODE(be.oneortwo,
  1,
  ((TRUNC(grm.dia_begin / 2 + .5)) * 2),
  2,
  DECODE(grm.component,
    'SURVIVOR',
    ((TRUNC(grm.dia_end / 2 + .5)) * 2),
    'INGROWTH',
    ((TRUNC(grm.dia_end / 2 + .5)) * 2),
    'REVERSION1',
    ((TRUNC(grm.dia_end / 2 + .5)) * 2),
    'REVERSION2',
    ((TRUNC(grm.dia_end / 2 + .5)) * 2),
    ((TRUNC(grm.dia_midpt / 2 + .5)) * 2))) AS diaclass,
  ROUND(SUM(psm.expns * grm.tpagrow_unadj *
    DECODE(grm.subptyp_grm,
      1,
      psm.adj_factor_subp,
      2,
      psm.adj_factor_micr,
      3,
      psm.adj_factor_macr) *
    NVL(DECODE(BE.oneortwo,
      1,
      (-grm.est_begin / grm.rempcr),
      2,
      ((NVL(grm.est_end, grm.est_midpt) -
        NVL(grm.mortality, 0)) / grm.rempcr)),
    0))) AS estimate_accounting
FROM fs_fiadb.beginend      be,
fs_fiadb.tree              prev_tre,
fs_fiadb.cond              prev_cnd,
fs_fiadb.plot              prev_plt,
fs_fiadb.tree_grm_estn     grm,
fs_fiadb.tree              t,
```

```

fs_fiadb.cond          c,
fs_fiadb.plot         p,
fs_fiadb.pop_plot_stratum_assgn ppsa,
fs_fiadb.pop_stratum  psm,
fs_fiadb.pop_estn_unit  peu,
fs_fiadb.pop_eval     pev,
fs_fiadb.pop_eval_typ  pet,
fs_fiadb.pop_eval_grp  peg
WHERE grm.estn_units = 'CF'
AND grm.estn_type = 'AL'
AND grm.estimate = 'VOLUME'
AND grm.land_basis = 'FORESTLAND'
AND t.cn = grm.tre_cn
AND t.prev_tre_cn = prev_tre.cn(+)
AND t.prevcond = prev_cnd.condid
AND prev_plt.cn = prev_cnd.plt_cn
AND p.prev_plt_cn = prev_plt.cn
AND t.condid = c.condid
AND t.plt_cn = c.plt_cn
AND c.plt_cn = p.cn
AND p.cn = ppsa.plt_cn
AND ppsa.stratum_cn = psm.cn
AND psm.estn_unit_cn = peu.cn
AND peu.eval_cn = pev.cn
AND pev.cn = pet.eval_cn
AND pet.eval_typ = 'EXPGROW'
AND pet.eval_grp_cn = peg.cn
AND peg.eval_grp = 272012
GROUP BY DECODE(be.oneortwo,
1,
((TRUNC(grm.dia_begin / 2 + .5)) * 2),
2,
DECODE(grm.component,
'SURVIVOR',
((TRUNC(grm.dia_end / 2 + .5)) * 2),
'INGROWTH',
((TRUNC(grm.dia_end / 2 + .5)) * 2),
'REVERSION1',
((TRUNC(grm.dia_end / 2 + .5)) * 2),
'REVERSION2',
((TRUNC(grm.dia_end / 2 + .5)) * 2),
((TRUNC(grm.dia_midpt / 2 + .5)) * 2)))

```

The above example produces estimates of annual net growth of live trees on forest land by diameter class using the accounting method.

<b>DIACLASS</b>	<b>ESTIMATE_ACCOUNTING</b>
NULL	0
6	60,458,679
8	52,182,146
10	51,697,069
12	49,368,887
14	41,200,984
16	35,796,443
18	26,418,531
20	13,667,485
22	23,291,431
24	9,884,120
26	7,406,312
28	3,128,658
30	1,410,968
32	5,491,123
34	7,463,421
36	-2,312,807
38	1,373,555
40	538,076
42	2,683,309
46	549,730
50	-3,409,450
52	3,816,077
<b>SUM</b>	<b>392,104,747</b>

**Example 8-7:** Estimate annual net growth of live trees on forest land by stand-age class using the accounting method.

```

SELECT CASE
  WHEN stand_age IS NULL THEN
    'Unknown'
  WHEN stand_age <= 20 THEN
    '000-020 years'
  WHEN stand_age > 20 and stand_age <= 40 THEN
    '021-040 years'
  WHEN stand_age > 40 and stand_age <= 60 THEN
    '041-060 years'
  WHEN stand_age > 60 and stand_age <= 80 THEN
    '061-080 years'
  WHEN stand_age > 80 and stand_age <= 100 THEN
    '081-100 years'
  WHEN stand_age > 100 THEN
    '100+ years'
  ELSE
    'Unknown'
  END stand_age_class,
  ROUND(SUM(ESTIMATE)) AS ESTIMATE
FROM (SELECT DECODE(be.oneortwo,
  1,
  prev_cnd.stdage,
  2,
  DECODE(grm.component,
    'SURVIVOR',
    c.stdage,
    'INGROWTH',
    c.stdage,
    'REVERSION1',
    c.stdage,
    'REVERSION2',
    c.stdage,
    (prev_cnd.stdage + ROUND(NVL(p.remper, 0) / 2)))) AS stand_age,
  SUM(psm.expns * grm.tpagrow_unadj *
  DECODE(grm.subptyp_grm,
    1,
    psm.adj_factor_subp,
    2,
    psm.adj_factor_micr,
    3,
    psm.adj_factor_macr) *
  NVL(DECODE(BE.oneortwo,
    1,
    (-grm.est_begin / grm.remper),
    2,
    ((NVL(grm.est_end, grm.est_midpt) -
    NVL(grm.mortality, 0)) / grm.remper)),
  0)) AS estimate
FROM fs_fiadb.beginend      be,
  fs_fiadb.tree            prev_tre,
  fs_fiadb.cond            prev_cnd,
  fs_fiadb.plot            prev_plt,

```

```

fs_fiadb.tree_grm_estn      grm,
fs_fiadb.tree              t,
fs_fiadb.cond              c,
fs_fiadb.plot              p,
fs_fiadb.pop_plot_stratum_assgn ppsa,
fs_fiadb.pop_stratum       psm,
fs_fiadb.pop_estn_unit     peu,
fs_fiadb.pop_eval          pev,
fs_fiadb.pop_eval_typ      pet,
fs_fiadb.pop_eval_grp      peg
WHERE grm.estn_units = 'CF'
AND grm.estn_type = 'AL'
AND grm.estimate = 'VOLUME'
AND grm.land_basis = 'FORESTLAND'
AND t.cn = grm.tre_cn
AND t.prev_tre_cn = prev_tre.cn(+)
AND t.prevcond = prev_cnd.condid
AND prev_plt.cn = prev_cnd.plt_cn
AND p.prev_plt_cn = prev_plt.cn
AND t.condid = c.condid
AND t.plt_cn = c.plt_cn
AND c.plt_cn = p.cn
AND p.cn = ppsa.plt_cn
AND ppsa.stratum_cn = psm.cn
AND psm.estn_unit_cn = peu.cn
AND peu.eval_cn = pev.cn
AND pev.cn = pet.eval_cn
AND pet.eval_typ = 'EXPGROW'
AND pet.eval_grp_cn = peg.cn
AND peg.eval_grp = 272012
GROUP BY DECODE(be.oneortwo,
  1,
  prev_cnd.stdage,
  2,
  DECODE(grm.component,
    'SURVIVOR',
    c.stdage,
    'INGROWTH',
    c.stdage,
    'REVERSION1',
    c.stdage,
    'REVERSION2',
    c.stdage,
    (prev_cnd.stdage +
    ROUND(NVL(p.remper, 0) / 2))))))
GROUP BY CASE
  WHEN stand_age IS NULL THEN
    'Unknown'
  WHEN stand_age <= 20 THEN
    '000-020 years'
  WHEN stand_age > 20 and stand_age <= 40 THEN
    '021-040 years'
  WHEN stand_age > 40 and stand_age <= 60 THEN
    '041-060 years'
  WHEN stand_age > 60 and stand_age <= 80 THEN

```



```

'061-080 years'
WHEN stand_age > 80 and stand_age <= 100 THEN
'081-100 years'
WHEN stand_age > 100 THEN
'100+ years'
ELSE
'Unknown'
END

```

The above example produces estimates of annual net growth of live trees on forest land by stand-age class using the accounting method.

<b>STAND_AGE_CLASS</b>	<b>ESTIMATE_ACCOUNTING</b>
000-020 years	5,698,110
021-040 years	41,248,377
041-060 years	-54,652,283
061-080 years	124,613,720
081-100 years	176,580,499
100+ years	98,616,322
<b>SUM</b>	<b>392,104,745</b>

## 8.6 Net growth components

Net growth represents the change in volume of trees between two points in time (e.g., previous 2006 inventory and current 2011 inventory) accounting for gains in growth and losses from mortality but not for removal of volume due to cutting or land-use change. To help understand these changes in volume, net growth is broken down into a number of components.

FIA identifies the following components of net growth associated with forest land:

- Survivor growth - change in volume of live trees between inventories on land identified as forest in both inventories. Identified as SURVIVOR in table of example 8-8 below.
- Mortality - volume (negative) of live trees from the previous inventory that died before the current inventory. The land was forest in the previous inventory. Identified as MORTALITY1 and MORTALITY2 in table of example 8-8 below.
- Ingrowth - volume of trees that grew into a merchantable size (e.g., 5-inch diameter) since the previous inventory. The volume is not counted until the current inventory and the land is identified as forest in both inventories. Identified as INGROWTH in table of example 8-8 below.
- Reversion - volume of live trees on land that is now forest but was previously nonforest. Identified as REVERSION1 and REVERSION2 in table of example 8-8 below.
- Diversion growth - change in volume of live trees between inventories on land that changed from forest to nonforest. Diversion only counts trees that remained present and living. Identified as DIVERSION1 and DIVERSION2 in table of example 8-8 below.
- Cut growth - increase in volume of live trees from the previous inventory that were cut before the current inventory. The land was forest in the previous inventory. Identified as CUT1 and CUT2 in table of example 8-8 below.

In example 8-8, we estimate net growth of growing- and nongrowing-stock trees on forest land by net growth component for Maine, 2011 and Maine, 2006. The total net growth estimate increased from 544.5 to 699.6 million cubic feet. Most of the increase is attributed to a decrease in mortality and increases in reversions and ingrowth. The small increase in survivor growth had less of an effect.

**Example 8-8:** Estimate annual net growth of trees on forest land (cubic feet per year) by annual net growth component.

```

SELECT peg.eval_grp,
       grm.component,
       SUM(psm.expns * grm.tpagrow_unadj * grm.ann_net_growth *
          -- in this case analogous to tree.fgrowcfal
          DECODE(grm.subptyp_grm, 1, psm.adj_factor_subp,
                 2, psm.adj_factor_micr,
                 3, psm.adj_factor_macr, 0)) estimate
          -- "all live," growing and nongrowing stock on forest land
FROM fs_fiadb.plot           p,
     fs_fiadb.cond           c,
     fs_fiadb.pop_plot_stratum_assgn ppsa,
     fs_fiadb.pop_stratum    psm,
     fs_fiadb.pop_estn_unit  peu,
     fs_fiadb.pop_eval       pev,
     fs_fiadb.pop_eval_grp   peg,
     fs_fiadb.pop_eval_typ   pet,
     fs_fiadb.tree           t,
     fs_fiadb.tree_grm_estn  grm
WHERE p.cn = c.plt_cn
     AND ppsa.plt_cn = p.cn
     AND ppsa.stratum_cn = psm.cn
     AND peu.cn = psm.estn_unit_cn
     AND pev.cn = peu.eval_cn
     AND pev.cn = pet.eval_cn
     AND pet.eval_grp_cn = peg.cn
     AND peg.eval_grp in (232006, 232011)
          -- the desired evaluation group(s) must be specified
     AND pet.eval_typ = 'EXPGROW'
     AND t.plt_cn = c.plt_cn
     AND t.condid = c.condid
     AND grm.tre_cn = t.cn
     AND grm.estn_type = 'AL'
          -- specify estimation type, AL for "all live," growing and nongrowing stock
     AND grm.estn_units = 'CF' -- specify units, CF for cubic feet
     AND grm.estimate = 'VOLUME' -- specify estimate
     AND grm.land_basis = 'FORESTLAND' -- specify land basis
GROUP BY peg.eval_grp, grm.component
ORDER BY peg.eval_grp, grm.component

```

The example above produces the following:

EVAL_GRP	COMPONENT	ESTIMATE
232006	CUT1	3,919,875
232006	CUT2	1,643,007
232006	DIVERSION1	184,131
232006	INGROWTH	155,351,725
232006	MORTALITY1	-361,426,921
232006	MORTALITY2	0
232006	REVERSION1	7,798,281
232006	REVERSION2	36,662
232006	SURVIVOR	706,998,619
232011	CUT1	40,012,272
232011	CUT2	2,015,425
232011	DIVERSION1	326,866
232011	INGROWTH	194,629,689
232011	MORTALITY1	-304,764,329
232011	MORTALITY2	0
232011	REVERSION1	52,167,940
232011	REVERSION2	353,506
232011	SURVIVOR	714,829,723

Some of the component types are identified with a '1' or '2' (e.g., CUT1 and CUT2). The 1 denotes trees that met the minimum quality and/or size requirements in the previous inventory. The 2 denotes trees that did not meet minimum requirements in the previous inventory but meet the requirements in the current inventory. In the previous example using Maine, the current inventory is 2011 and the previous inventory is 2006 based on a five-year cycle of samples.

Diversion differs from the diversion component. When the land basis is forest land, as opposed to timberland, diversion is the volume of trees on land diverted from forest to nonforest between the previous and current inventory and is based on the midpoint in time between inventories. Tree size at the midpoint is modeled from the tree size at the previous inventory. When the land basis is timberland, diversions also include land diverted to reserved forest land (removed from timber production by statute or administrative designation) and less productive forest land (incapable of producing at least 20 cubic feet of growing stock per acre annually). The component is the change in volume of live trees between inventories on land that diverted and uses the modeled midpoint from the tree size at the previous inventory. This net growth component is equivalent to diversion growth in Bechtold and Patterson (2005).

When the land basis is forest land, reversion is the volume of trees on land that reverts from nonforest to forest between the previous and current inventory and is based on the modeled midpoint in time between inventories using the tree size in the current inventory. Unlike the diversion component of net growth, the reversion component, which is simply reversion, counts the total tree volume at the modeled midpoint between inventories.

Thus, reversion can have substantially more impact on net growth estimates as compared to the impacts from diversion, given equal total tree volumes.

Cut or harvest removals differ from the cut component. Cut or harvest removals are the volume of trees cut or killed in conjunction with a harvest or silvicultural operation between the previous and current inventory and is based on the midpoint in time between inventories. Tree size at the midpoint is modeled from the tree size at the previous inventory. The cut component is only the increase in volume associated with these trees from the previous inventory to the modeled midpoint between inventories based on the tree size at the previous inventory. This net growth component is equivalent to cut growth in Bechtold and Patterson (2005).

Ingrowth differs from the ingrowth component. Ingrowth is the volume of trees at the time they grow across a minimum quality and/or size threshold between inventories. Minimum size thresholds vary by live, growing-stock, and sawtimber trees. Minimum quality thresholds apply to growing-stock and sawtimber trees. The growth on ingrowth is the volume the trees grew since crossing the minimum thresholds until the current inventory. The ingrowth component includes ingrowth plus growth on ingrowth.

Mortality is not equivalent to the mortality component (see example 8-9). Mortality is the volume of trees that die from natural causes between the previous and current inventory and is based on the midpoint in time between inventories. Tree size at the midpoint is modeled from the tree size at the previous inventory. The mortality component equals the volume of the tree at the previous inventory. Thus, the mortality component of net growth is always smaller than mortality volume. Examples 8-8 and 8-9 focus on the same mortality component of net growth but example 8-8 represents the volume as negative.

**Example 8-9:**

$M_{ng}$  = Mortality component of net growth

$V_{mid}$  = Volume of tree at modeled midpoint between inventories or mortality volume

$V_{t1}$  = Volume of tree at previous inventory

$M_{ng} = V_{mid} - (V_{mid} - V_{t1})$  or  $M_{ng} = V_{t1}$

Bechtold and Patterson (2005) also cover the components presented here but present them in the context of net change. Presented in the context of net growth and as implemented in the FIA database, some component names differ in meaning as previously described.

## 8.7 Traditional removals estimation

In the following example, we demonstrate how FIA produced a tree-level removals estimate prior to FIADB 5.1.04.

The 2012 Minnesota evaluation used in this estimate (POP\_EVAL.EVALID = 271203) consists of plots measured in 2003, 2004, 2005, 2006 and 2007 that were remeasured in 2008, 2009, 2010, 2011 and 2012, respectively.

**Example 8-10:** Estimate annual removals of live trees on forest land using traditional script (cubic feet per year).

```
SELECT ROUND(SUM(psm.expns * t.tparemv_unadj * t.fremvcfal *
  DECODE(t.dia,
    null,
    psm.adj_factor_subp,
    DECODE(least(t.dia, 5 - 0.001),
      t.dia,
      psm.adj_factor_micr,
      DECODE(least(t.dia,
        nvl(p.macro_breakpoint_dia, 9999) -
        0.001),
        t.dia,
        psm.adj_factor_subp,
        psm.adj_factor_macr)))))) estimate_traditional
FROM fs_fiadb.cond          c,
     fs_fiadb.plot         p,
     fs_fiadb.tree         t,
     fs_fiadb.pop_plot_stratum_assgn ppsa,
     fs_fiadb.pop_stratum  psm,
     fs_fiadb.pop_estn_unit  peu,
     fs_fiadb.pop_eval     pev,
     fs_fiadb.pop_eval_grp  peg,
     fs_fiadb.pop_eval_typ  pet
WHERE p.cn = c.plt_cn
     AND pet.eval_typ = 'EXPREMV'
     AND t.plt_cn = c.plt_cn
     AND t.condid = c.condid
     AND ppsa.plt_cn = p.cn
     AND ppsa.stratum_cn = psm.cn
     AND peu.cn = psm.estn_unit_cn
     AND pev.cn = peu.eval_cn
     AND pev.cn = pet.eval_cn
     AND pet.eval_grp_cn = peg.cn
     AND peg.eval_grp = 272012
```

The example above produces an estimate of total annual removals of live trees on forest land (cubic feet per year):

Item	Value
<b>ESTIMATE_TRADITIONAL</b>	220,900,536

## 8.8 Improved removals estimation

The following example indicates how the traditional removals script is modified to use the appropriate TPAREMV\_UNADJ values and adjustment factors for nonsampled area. See section 8.3 for a detailed explanation of the reasons for the modifications.

**Example 8-11:** Estimate annual removals of live trees on forest land using improved script (cubic feet per year).

```

SELECT ROUND(SUM(psm.expns * grm.tparemv_unadj *
                -- use tparemv_unadj for trees per acre per year
                DECODE(grm.subptyp_grm, -- use subptyp_grm for adjustment factor
                    1,
                    psm.adj_factor_subp,
                    2,
                    psm.adj_factor_micr,
                    3,
                    psm.adj_factor_macr) *
                NVL(grm.removals, -- analogous to tree.fremvcfal
                    0)) AS estimate_improved
FROM fs_fiadb.tree_grm_estn      grm, -- added to obtain SUBPTYP_GRM, TPAGROW_UNADJ
et al.
fs_fiadb.tree                  t,
fs_fiadb.cond                  c,
fs_fiadb.plot                  p,
fs_fiadb.pop_plot_stratum_assgn ppsa,
fs_fiadb.pop_stratum           psm,
fs_fiadb.pop_estn_unit         peu,
fs_fiadb.pop_eval              pev,
fs_fiadb.pop_eval_typ          pet,
fs_fiadb.pop_eval_grp          peg
WHERE grm.estn_units = 'CF' -- cubic feet, added to filter tree_grm_estn to single record
AND grm.estn_type = 'AL' -- all live, added to filter tree_grm_estn to single record
AND grm.estimate = 'VOLUME' -- added to filter tree_grm_estn to single record
AND grm.land_basis = 'FORESTLAND' -- added to filter tree_grm_estn to single record
AND t.cn = grm.tre_cn
AND t.condid = c.condid
AND t.plt_cn = c.plt_cn
AND c.plt_cn = p.cn
AND p.cn = ppsa.plt_cn
AND ppsa.stratum_cn = psm.cn
AND psm.estn_unit_cn = peu.cn
AND peu.eval_cn = pev.cn
AND pev.cn = pet.eval_cn
AND pet.eval_typ = 'EXPREMV'
AND pet.eval_grp_cn = peg.cn
AND peg.eval_grp = 272012 -- the desired evaluation group must be specified

```

Example 8-11 produces the following estimate of total removals of live trees on forest land (cubic feet per year):

Item	Value
<b>ESTIMATE_IMPROVED</b>	220,900,563

In this example there is no difference between the traditional and improved estimates. Regardless, FIA recommends using the improved script because it will always use the appropriate TPAREMV\_UNADJ and adjustment factors, whereas the traditional script, in rare cases, may not.



## 8.9 Annual removals estimation summarized by previous attributes

The script can be further modified to summarize the annual removals estimate by any previous plot, condition, or tree attribute. For example, users may be interested in summarizing the removals by the time 1 stand-size class.

According to Bechtold and Patterson (2005), the event that caused the removal is deemed to occur at the midpoint of the remeasurement period. Currently, FIA does not compute and store values for every attribute at the midpoint of the remeasurement period. In most cases, only the time 1 and time 2 values are available. Because the event that results in a removal or mortality tree can also significantly change the condition, it is generally acceptable to consider that the removal or mortality occurred while that attribute held its time 1 value.

For example, consider a forest condition that was a large stand-size class (sawlog size, STDSZCD = 1) at time 1, then was harvested prior to time 2, where it was recorded as a small stand-size class (seedling/sapling, STDSZCD = 3) after the harvest. In such a scenario it is logical that the removals were from the large class recorded at time 1, and not from the small class as recorded at time 2.

**Example 8-12:** Estimate annual removals of live trees on forest land (cubic feet per year) by past stand-size class.

```
SELECT c_past.stdszcd as past_stdszcd, -- added to summarize estimate by past stdszcd
       ROUND(SUM(psm.expns * grm.tparemv_unadj *
                DECODE(grm.subptyp_grm,
                       1,
                       psm.adj_factor_subp,
                       2,
                       psm.adj_factor_micr,
                       3,
                       psm.adj_factor_macr) * grm.removals)) AS estimate_improved
FROM fs_fiadb.cond          c_past, -- past condition is added
     fs_fiadb.tree_grm_estn grm,
     fs_fiadb.tree         t,
     fs_fiadb.cond         c,
     fs_fiadb.plot         p,
     fs_fiadb.pop_plot_stratum_assgn ppsa,
     fs_fiadb.pop_stratum  psm,
     fs_fiadb.pop_estn_unit peu,
     fs_fiadb.pop_eval     pev,
     fs_fiadb.pop_eval_typ pet,
     fs_fiadb.pop_eval_grp peg
WHERE grm.estn_units = 'CF' -- cubic feet, added to filter tree_grm_estn table to single record
     AND grm.estn_type = 'AL' -- all live, added to filter tree_grm_estn table to single record
     AND grm.estimate = 'VOLUME' -- volume, added to filter tree_grm_estn table to single record
     AND grm.land_basis = 'FORESTLAND'
                                     -- forest land, added to filter tree_grm_estn table to single record
     AND t.cn = grm.tre_cn
     AND t.prevcond = c_past.condid
     AND p.prev_plt_cn = c_past.plt_cn
     AND t.condid = c.condid
```

```

AND t.plt_cn = c.plt_cn
AND c.plt_cn = p.cn
AND p.cn = ppsa.plt_cn
AND ppsa.stratum_cn = psm.cn
AND psm.estn_unit_cn = peu.cn
AND peu.eval_cn = pev.cn
AND pev.cn = pet.eval_cn
AND pet.eval_typ = 'EXPREMV'
AND pet.eval_grp_cn = peg.cn
AND peg.eval_grp = 272012
GROUP BY c_past.stdszcd -- added to summarize estimate by past stdszcd

```

Example 8-12 produces the following estimate of annual removals of live trees on forest land by past stand-size class (cubic feet per year, description of code added for clarity):

PAST_STDSZCD	DESCRIPTION	ESTIMATE_IMPROVED
NULL	Nonforest	0
1	Large diameter stands	117,927,058
2	Medium diameter stands	98,051,084
3	Small diameter stands	4,867,653
5	Nonstocked stands	54,769
-	<b>SUM</b>	<b>220,900,564</b>

The above results indicate that most removals took place on stands in the large and medium size classes.

CURRENT_STDSZCD	DESCRIPTION	ESTIMATE_IMPROVED
NULL	Nonforest	15,887,176
1	Large diameter stands	38,645,486
2	Medium diameter stands	20,636,057
3	Small diameter stands	140,395,034
5	Nonstocked stands	5,336,812
-	<b>SUM</b>	<b>220,900,564</b>

Here are the removal estimates by current stand-size class, which is the size of the stand after the removals took place. This shows how much annual removal volume occurred on stands that are now in a nonforest condition (see annual net growth discussion in section 8.3 for detailed description), and the resulting stand-size class of the condition after the removals occurred on land that remained forest land.

There may be minor rounding differences between the sum of the subtotals from these scripts and the total annual removals from the script in example 8-11.

## 8.10 Estimation summarized by midpoint attributes

As discussed in the annual net growth accounting section 8.5, only two attributes are available to summarize by at the midpoint (diameter and stand age). The midpoint diameters are stored in TREE\_GRM\_ESTN.DIA\_MIDPT. The midpoint stand age is derived by starting with the previous stand age and adding one-half of the remeasurement period between time 1 and time 2. Both of these attributes are usually assigned to broader classes such as a 2-inch diameter class and 5-, 10-, or 20-year age classes.

As in annual net growth accounting, the midpoint diameter may only be available for remeasured annual-to-annual inventory plots. In periodic inventories, the diameter may be the diameter at the estimated time of death/removal instead of the midpoint of the remeasurement period. For some periodic-to-periodic and periodic-to-annual inventories, the estimated midpoint diameter for removals may be stored in TREE.DIA or TREE.DIACALC. If this is the case, the script below still can be modified by replacing "grm.dia\_midpt" with "t.dia" or "t.diacalc" as appropriate.

**Example 8-13:** Estimate removals of live trees on forest land (cubic feet per year) by estimated midpoint diameter class.

```
SELECT ((TRUNC(grm.dia_midpt / 2 + .5)) * 2) as dia_class,
       -- added to summarize mortality or removals by the estimated midpoint diameter
       ROUND(SUM(psm.expns * grm.tparemv_unadj *
                DECODE(grm.subptyp_grm,
                        1,
                        psm.adj_factor_subp,
                        2,
                        psm.adj_factor_micr,
                        3,
                        psm.adj_factor_macr) * grm.removals)) AS estimate_improved
FROM fs_fiadb.cond c_past, -- past condition is added
     fs_fiadb.tree_grm_estn grm,
     fs_fiadb.tree t,
     fs_fiadb.cond c,
     fs_fiadb.plot p,
     fs_fiadb.pop_plot_stratum_assgn ppsa,
     fs_fiadb.pop_stratum psm,
     fs_fiadb.pop_estn_unit peu,
     fs_fiadb.pop_eval pev,
     fs_fiadb.pop_eval_typ pet,
     fs_fiadb.pop_eval_grp peg
WHERE grm.estn_units = 'CF' -- cubic feet, added to filter tree_grm_estn table to single record
      AND grm.estn_type = 'AL' -- all live, added to filter tree_grm_estn table to single record
      AND grm.estimate = 'VOLUME' -- volume, added to filter tree_grm_estn table to single record
      AND grm.land_basis = 'FORESTLAND'
      -- forest land, added to filter tree_grm_estn table to single record

      AND t.cn = grm.tre_cn
      AND t.prevcond = c_past.condid
      AND p.prev_plt_cn = c_past.plt_cn
      AND t.condid = c.condid
      AND t.plt_cn = c.plt_cn
      AND c.plt_cn = p.cn
      AND p.cn = ppsa.plt_cn
```

```

AND ppsa.stratum_cn = psm.cn
AND psm.estn_unit_cn = peu.cn
AND peu.eval_cn = pev.cn
AND pev.cn = pet.eval_cn
AND pet.eval_typ = 'EXPREMV'
AND pet.eval_grp_cn = peg.cn
AND peg.eval_grp = 272012
GROUP BY ((TRUNC(grm.dia_midpt / 2 + .5)) * 2)
-- added to summarize annual mortality or removals by the estimated midpoint
diameter

```

Example 8-13 produces the following estimate of annual removals of live trees on forest land by current stand-size class (cubic feet per year, description of code added for clarity):

<b>DIACCLASS</b>	<b>ESTIMATE_IMPROVED</b>
6	21,996,033
8	37,510,701
10	42,151,873
12	39,208,887
14	30,459,777
16	20,117,367
18	10,167,626
20	7,334,230
22	5,448,706
24	2,041,324
26	1,421,708
28	369,630
30	699,062
36	534,069
42	1,439,570
<b>SUM</b>	<b>220,900,563</b>

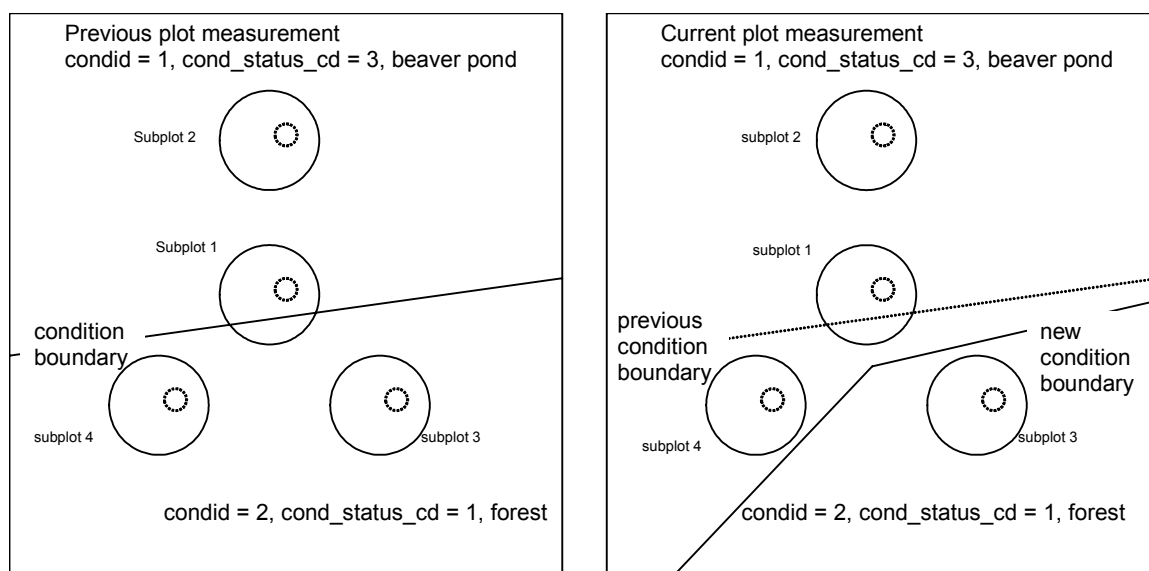
## 8.11 Annual mortality estimation

Annual mortality estimation mirrors annual removals estimation in all respects. Modification of the example removals scripts to obtain mortality estimates is achieved by replacing the following:

- tpamort\_unadj for tparemv\_unadj
- t.fmortcfal for t.fremvcfal
- grm.mortality for grm.removals
- 'EXPMORT' for 'EXPREMV'

## 8.12 The SUBP\_COND\_CHNG\_MTRX (CMX) table

The SUBP\_COND\_CHNG\_MTRX (CMX) table was added in the FIADB version 4.0 to facilitate the tracking of area change for the annual inventory. Under this design, a plot measures area change by tracking the movement in condition boundaries within the area of the four subplots. Figure 8-1 shows what can happen on a plot when a condition boundary (in this case the edge of a beaver pond) moves over time. Beaver activity raised the level of the pond, increasing the pond area and converting some of the forest land to water. The same kind of changes can occur from any number of human-caused events such as timber harvesting, land clearing or road construction, or natural events such as fire, storms, or insect attacks.



**Figure 8-1:** Example plot layout where condition boundaries changed between previous (left panel) and current plot measurements (right panel). The solid circles are the subplots and the smaller dashed circles are the microplots.

It is important to remember that condition boundaries are not just defined along changes in condition status code, but also may occur within forest land. The following tabulation shows how the area change information in figure 8-1 would be recorded in the CMX table.

**CMX table data for figure 8-1:**

SUBP	SUBPTYP	CONDID	PREVCOND	SUBPTYP_PROP_CHNG
1	1	1	1	.8000
1	1	1	2	.2000
1	2	1	1	1.000
2	1	1	1	1.000
2	2	1	1	1.000
3	1	2	2	1.000
3	2	2	2	1.000
4	1	1	2	1.000
4	2	1	2	1.000

The CMX table tracks the change in condition areas for each of the four subplots (SUBPTYP = 1) and each of the four microplots (SUBPTYP = 2) on this plot. In inventories where the macroplot is used there would also be entries for each macroplot (SUBPTYP = 3). The attribute PROP\_BASIS in the COND table identifies how area estimation was conducted for each plot, on the basis of either the macroplot or the subplot. In this example area estimation (and thus area change estimation) is based on the subplot information, not the macroplot. Area estimation is typically based on the largest area sampled (macroplot in States where it is measured, otherwise the subplot) and not on the microplot. Area and area change estimation based on the microplot is only appropriate with another estimate solely collected on the microplot such as number of trees or biomass in trees <5 inches diameter at breast height. The examples of change presented here are based on the subplot, but could easily be modified to obtain estimates based on the microplots.

In the example shown in figure 8-1, the CMX table has two entries where SUBPTYP = 1 and SUBP = 1. The first entry indicates that 80 percent of the subplot area was in condition 1 (water) at both measurements, and the second entry indicates 20 percent of the subplot area changed from forest to water. For the other three subplots and all four microplots, only one record exists, indicating that the entire subplot or microplot either stayed in the same condition (subplots and microplots 2 and 3) or the entire area changed from one condition to another (subplot and microplot 4). For this remeasured plot, change based on the four subplots is water to water 45 percent, forest to water 30 percent, and forest to forest 25 percent; change based on the four microplots is water to water 50 percent, forest to water 25 percent, and forest to forest 25 percent. The following section presents SQL script that produces these estimates.

## 8.13 Using the CMX table to estimate area change between two measurements

The estimation of area change over time requires linking current and past (most previous) conditions through the CMX (SUBP\_COND\_CHNG\_MTRX) table to determine the portion of plot area that transitioned from conditions observed at time 1 (past) to those observed at time 2 (current). These methods are applicable only between two measurements in the annual inventory, annual-to-annual observations. There are no means available for linking past to current conditions in periodic-to-periodic or periodic-to-annual observations.

We begin by modifying the script that produces the estimate of area of forest land so that it uses the area change evaluation EXPCHNG rather than the current area evaluation EXPCURR that is standard for area estimations. Example 8-14 shows this modification in bold.

**Example 8-14:** Estimate area of forest land (acres) based on the area change evaluation.

```
SELECT SUM(psm.expns * c.condprop_unadj *
  DECODE(c.prop_basis,
    'MACR',
    psm.adj_factor_macr,
    psm.adj_factor_subp) -- expression from ref_pop_attribute table
  ) estimate
FROM fs_fiadb.cond          c,
  fs_fiadb.plot            p,
  fs_fiadb.pop_plot_stratum_assgn ppsa,
  fs_fiadb.pop_stratum     psm,
  fs_fiadb.pop_estn_unit   peu,
  fs_fiadb.pop_eval        pev,
  fs_fiadb.pop_eval_grp    peg,
  fs_fiadb.pop_eval_typ    pet
WHERE p.cn = c.plt_cn
  AND pet.eval_typ = 'EXPCHNG'
  AND c.cond_status_cd = 1 -- additional where_clause from ref_pop_attribute table
  AND ppsa.plt_cn = p.cn
  AND ppsa.stratum_cn = psm.cn
  AND peu.cn = psm.estn_unit_cn
  AND pev.cn = peu.eval_cn
  AND pev.cn = pet.eval_cn
  AND pet.eval_grp_cn = peg.cn
  AND peg.eval_grp = 272007 -- the desired evaluation group must be specified
```

The remeasured plots (12,280 plots) associated with EXPCHNG produce an area estimate of 16,962,391.8 acres of forest land versus 16,723,529.5 provided by EXPCURR using all plots (17,855 plots). The estimate based on EXPCURR is valid. In this case, the estimate provided by the remeasurement sample EXPCHNG may not be valid if areas that are currently forest were not sampled in the past measurement. Using EXPCHNG, estimates should only include areas that are sampled in both the current and past measurement. The adjustment factors, pop\_stratum.adj\_factor\_macr and pop\_stratum.adj\_factor\_subp, compensate for nonsampled areas in either the current or past measurement. Including nonsampled areas results in an erroneous over-estimation of acreage. To estimate area



change over time, the script has been further modified to link past and current condition records. The modified script correctly restricts the remeasurement sample to areas sampled at both points in time. Past and current conditions are linked in the CMX table. This table has entries for every subplot on a remeasured plot and stores the proportion of the area of each subplot by the two points in time in the attribute CMX.SUBTYP\_PROP\_CHNG. Again, changes and additions from example 8-14 are shown in bold. Line numbers are for reference purposes.

**Example 8-15:** Estimate area change (acres) by condition status and stand size at two points in time, Minnesota, time 1 from 1999-2002 and time 2 from 2003-2007.

Line	Script
1	SELECT <b>c_past.cond_status_cd</b> <b>past_cond_status_cd</b> ,
2	<b>c_past.stdszcd</b> <b>past_stdszcd</b> ,
3	<b>c.cond_status_cd</b> <b>current_cond_status_cd</b> ,
4	<b>c.stdszcd</b> <b>current_stdszcd</b> ,
5	SUM(psm.expns * <b>cmx.subptyp_prop_chng</b> / 4 *
6	DECODE(c.prop_basis,
7	'MACR',
8	psm.adj_factor_macr,
9	psm.adj_factor_subp) -- expression from ref_pop_attribute table
10	) estimate,
11	<b>count(*)</b> <b>COUNT</b> ,
12	<b>SUM(cmx.subptyp_prop_chng / 4)</b> <b>plot_area</b>
13	FROM fs_fiadb.cond c,
14	fs_fiadb.plot p,
15	fs_fiadb.pop_plot_stratum_assgn ppsa,
16	fs_fiadb.pop_stratum psm,
17	fs_fiadb.pop_estn_unit peu,
18	fs_fiadb.pop_eval pev,
19	fs_fiadb.pop_eval_typ pet,
20	fs_fiadb.pop_eval_grp peg,
21	<b>fs_fiadb.cond</b> <b>c_past</b> ,
22	<b>fs_fiadb.subp_cond_chng_mtrx</b> <b>cmx</b>
23	WHERE p.cn = c.plt_cn
24	AND pet.eval_typ = 'EXPCHNG'
25	<b>AND (c.cond_status_cd = 1 or c_past.cond_status_cd = 1)</b>
26	<b>AND nvl(c.cond_nonsample_reasn_cd, 0) = 0</b>
27	<b>AND nvl(c_past.cond_nonsample_reasn_cd, 0) = 0</b>
28	AND ppsa.plt_cn = p.cn
29	AND ppsa.stratum_cn = psm.cn
30	AND peu.cn = psm.estn_unit_cn
31	AND pev.cn = peu.eval_cn

Line	Script
32	AND pev.cn = pet.eval_cn
33	AND pet.eval_grp_cn = peg.cn
34	AND peg.eval_grp = 272007 -- the desired evaluation group must be specified
<b>35</b>	<b>AND p.prev_plt_cn = c_past.plt_cn</b>
<b>36</b>	<b>AND cmx.prev_plt_cn = c_past.plt_cn</b>
<b>37</b>	<b>AND cmx.prevcond = c_past.condid</b>
<b>38</b>	<b>AND cmx.condid = c.condid</b>
<b>39</b>	<b>AND ((cmx.subptyp = 3 and c.prop_basis = 'MACR') or</b>
<b>40</b>	<b>(cmx.subptyp = 1 and c.prop_basis = 'SUBP'))</b>
<b>41</b>	<b>group by c_past.cond_status_cd,</b>
<b>42</b>	<b>c_past.stdszcd,</b>
<b>43</b>	<b>c.cond_status_cd,</b>
<b>44</b>	<b>c.stdszcd</b>

Example 8-15 can be used as a template to create almost any cross tabulation of past and current area estimates based on a remeasured set of plots. The following changes (bold sections) were made to example 8-14 to facilitate the estimation of area change:

- Line 21 - The table **COND** with the alias **c\_past** was added to the list of tables to be joined. This provides the condition-level attributes for the past (time 1) measurement of the plot.
- Line 22 - The table **SUBP\_COND\_CHG\_MTRX** with the alias **cmx** was added to the list of tables to be joined. This table provides the link between past (time 1) and current (time 2) conditions at the subplot level. Each entry in this table defines the portion (0-1) of the subplot, microplot or macroplot that was observed in a condition at time 2 and observed in a condition at time 1. For a subplot that was entirely in a single condition at both times, there will only be one entry for the subplot, with **CMX.SUBPTYP\_PROP\_CHNG = 1.0**. For a subplot that was mapped to be 40 percent in one condition and 60 percent in another condition at both times with no change in boundary, there will be two entries for the subplot, one with **CMX.SUBPTYP\_PROP\_CHNG = 0.4** and the other with **CMX.SUBPTYP\_PROP\_CHNG = 0.6**. For subplots where boundaries have changed, there will be entries that account for all the pieces of the subplot area with the total value of **CMX.SUBPTYP\_PROP\_CHNG** adding to 1.0.
- Lines 1-4 and 41-44 - As in example 8-4, past and current condition status and stand-size class codes (**group by c\_past.cond\_status\_cd, c\_past.stdszcd, c.cond\_status\_cd, c.stdszcd**) were grouped to obtain estimate breakdowns by these attributes.
- Line 5 - **c.condprop\_unadj** (the total plot condition proportions that are within a specific condition) was replaced with **cmx.subptyp\_prop\_chng / 4** (the subplot condition proportion divided by the number of subplots in the plot). The division by 4 is required because the CMX table tracks area at the subplot level (4 subplots per plot).
- Line 25 - The restrictions were changed in the where clause from **AND c.cond\_status\_cd = 1** to **AND (c.cond\_status\_cd = 1 or**

**c\_past.cond\_status\_cd = 1**), to select conditions that were forest in at least one of the measurements, not just the current measurement. This query tracks the area of land that moves in and out of forest, as well as changes in stand-size class on land that remains forest.

- Lines 26-27 - These additions limit observations to areas sampled in both the current and most previous measurement. The **cmx** table accounts for all combinations of current and previous observations, even nonsampled areas. The script estimates change based on sampled areas
- Lines 35-40 - These additions to the where clause provide the proper links to the **c\_past** and **cmx** tables that were added to the table list. Line 35 (**AND p\_prev\_plt\_cn = c\_past.plt\_cn**) matches the past and current condition records to the same plot, and lines 36-40 provide the other restrictions that link the appropriate conditions at the two measurements through the **cmx** table. Lines 39 and 40 ensure that in inventories where area estimates are based on the macroplot observations, the area change estimates are based on the macroplot observations, and in all other cases the estimates are based on the subplot observations.
- Lines 11 and 12 - **count(\*) COUNT** and **SUM(cmx.subptyp\_prop\_chng / 4) PLOT\_AREA** provide two additional summary attributes along with the area estimates. **COUNT** is the total number of subplot pieces that is tracked in the estimation. **PLOT\_AREA** is the total portion of plots that is tracked in the estimation.

Example 8-15 produces the following estimates of total area (ESTIMATE), total number of subplots (COUNT), and total portion of plots (PLOT\_AREA) broken down by past and current COND\_STATUS\_CD and STDSZCD values, for land that was forest at measurement time 1, measurement time 2, or both.

PAST_COND_STATUS_CD	PAST_STDSZCD	CURRENT_STATUS_CD	CURRENT_STDSZCD	ESTIMATE	COUNT	PLOT_AREA
1	1	1	1	3,631,160.4	3208	767.8
1	1	1	2	291,277.3	274	63.1
1	1	1	3	390,763.5	360	83.0
1	1	1	5	58,700.4	53	12.0
1	1	2	-	70,387.0	117	15.2
1	1	3	-	3,961.3	10	0.8
1	1	4	-	2,892.6	9	0.6
1	2	1	1	786,401.0	709	167.1
1	2	1	2	4,648,293.5	4160	996.0
1	2	1	3	620,036.7	571	132.4
1	2	1	5	46,356.9	46	10.2
1	2	2	-	84,928.1	133	18.8
1	2	3	-	1,990.6	6	0.4
1	2	4	-	895.2	1	0.2
1	3	1	1	158,110.2	151	32.5
1	3	1	2	648,108.5	604	138.3
1	3	1	3	4,243,065.9	3884	934.6

PAST_COND_STATUS_CD	PAST_STDSZCD	CURRENT_STATUS_CD	CURRENT_STDSZCD	ESTIMATE	COUNT	PLOT_AREA
1	3	1	5	61,623.3	56	13.1
1	3	2	-	98,616.9	126	21.4
1	3	3	-	12,348.1	11	2.1
1	3	4	-	4,707.5	4	1.0
1	5	1	1	16,820.1	18	3.7
1	5	1	2	18,273.1	20	4.2
1	5	1	3	95,244.4	94	21.5
1	5	1	5	61,597.5	59	14.2
1	5	2	-	55,411.0	53	11.9
1	5	3	-	549.8	1	0.1
2	-	1	1	234,236.1	288	50.7
2	-	1	2	267,173.3	326	59.6
2	-	1	3	556,373.0	564	126.3
2	-	1	5	48,463.7	51	11.0
3	-	1	1	14,427.4	19	3.1
3	-	1	2	9,767.2	13	2.3
3	-	1	3	21,966.0	21	4.3
3	-	1	5	1,225.5	2	0.3
4	-	1	1	17,585.0	19	4.0
4	-	1	2	4,149.1	10	0.9
4	-	1	3	8,858.1	9	2.0

These results are used to produce the following tabulation of estimated change in forest area by condition status code and stand-size class at two points in time.

**Table 8-2:** Estimated forest land area broken down by past and current condition status code and stand-size class, Minnesota, 2007 (acres).

		CURRENT_COND_STATUS_CD								Total
		1 Forest land				Total on Forest land	2 Nonforest land	3 Noncensus water	4 Census water	
PAST_COND_STATUS_CD	PAST_STDSZCD	CURRENT_STDSZCD								
		1 Large diameter	2 Medium diameter	3 Small diameter	5 Non-stocked					
1 Forest land	1 Large diameter	3,631,160.4	291,277.3	390,763.5	58,700.4	4,371,901.6	70,387.0	3,961.3	2,892.6	4,449,142.5
	2 Medium diameter	786,401.0	4,648,293.5	620,036.7	46,356.9	6,101,088.1	84,928.1	1,990.6	895.2	6,188,902.0
	3 Small diameter	158,110.2	648,108.5	4,243,065.9	61,623.3	5,110,907.8	98,616.9	12,348.1	4,707.5	5,226,580.4
	5 Non-stocked	16,820.1	18,273.1	95,244.4	61,597.5	191,935.1	55,411.0	549.8	-	247,895.9
Total forest land		4,592,491.7	5,605,952.3	5,349,110.6	228,278.0	15,775,832.6	309,343.1	18,849.8	8,495.3	16,112,520.8
2 Nonforest land		234,236.1	267,173.3	556,373.0	48,463.7	1,106,246.1	-	-	-	1,106,246.1
3 Noncensus water		14,427.4	9,767.2	21,966.0	1,225.5	47,386.1	-	-	-	47,386.1
4 Census water		17,585.0	4,149.1	8,858.1	-	30,592.1	-	-	-	30,592.1
Total		4,858,740.2	5,887,041.9	5,936,307.6	277,967.2	16,960,056.9	309,343.1	18,849.8	8,495.3	17,296,745.1

**Note:** Includes lands classified as forest at either or both measurements. Based on plots first measured in 1999-2002 and remeasured in 2003-2007

The total current forest land area in the table above (16,960,056.9 acres) is close to the results we obtained in example 8-14 (16,962,391.8 acres). The preponderance of the difference between these two estimates is 2,339.8 acres that were nonsampled at time 1 and are now forest. The remaining difference is due to rounding error introduced by storing and computing condition proportions for each of the individual subplot sections in **cmx.subtyp\_prop\_chng** versus the total condition proportion in **c.condprop\_unadj**. The total past forest land area in the tabulation above (16,112,520.8 acres) is based on the same remeasured plots and comes close, but does not match the 2003 estimate of forest land area (16,230,326.1 acres) one obtains when using example 8-14 and setting `pet.eval_typ='EXPCURR'` and `pop_eval_grp.eval_grp = 272003`.

The COUNT and PLOT\_AREA values provide data users with the number of measurements associated with each estimate, giving users some information about the reliability of the estimates. For example, conditions that remained as large diameter (COND.STDSZCD equals 1) from time 1 to time 2 had an area estimate of 3,631,160.4 acres at time 2. From time 1 to time 2, there were 3,208 subplots or portions of subplots that maintained their large diameter condition. These subplots or portions of subplots represent an area equivalent to 767.8 total plots. The estimates are based on a considerable number of observations. In contrast, if one is interested in tracking area of water (either census or noncensus water) that converts to or from forest land over time, estimates are based on far fewer observed changes. The estimated area that changed from water (COND.COND\_STATUS\_CD equals 3 or 4) to forest (COND.COND\_STATUS\_CD equals 1) is 77,978.2 acres, and the estimated change from forest to water is 27,345.1 acres. The water to forest change is based on observations from 93 subplots where at least a portion of the subplot was observed to change from water to forest. The total area of this observed change is equal to 16.8 plots. The change from forest to water estimate (27,345.1 acres) is based on 42 subplot observations over an area equivalent to 5.2 plots.

Example 8-16 presents sampling errors for the forest to water area change estimate. This script was created from the script presented in example 5-2 with modifications similar to those made in example 8-15. The bold sections indicate where changes were made. The addition of the following code to the where clause restricts the estimation to conditions that change from forest (`c_past.cond_status_cd = 1`) to water (`c.cond_status_cd IN (3,4)`):

**AND (c.cond\_status\_cd IN (3,4) AND c\_past.cond\_status\_cd = 1).**

Further modifications to this example were made to produce estimates and sampling errors for the water to forest area change and for areas that remained as large diameter conditions as discussed in the previous paragraph. The results are presented in the tabulation that follows example 8-16. Users will note that the sampling errors for the estimates of forest to water and water to forest area change are quite high (29.2 percent and 18.4 percent, respectively) and the sampling error on conditions remaining large diameter is fairly low (2.9 percent). To obtain other area change and sampling error estimates, users should modify the where clause and eval\_grp. Any modifications to the where clause should ensure comparisons do not include nonsampled areas. Examples 8-15 and 8-16 only include areas sampled at time 1 and time 2.

**Example 8-16:** Estimate area change from forest (cond\_status\_cd equals 1) to water (cond\_status\_cd equals 3 or 4) with sampling error. Based on the Minnesota 2007 remeasurement sample. (Note the bold sections in this example indicate where changes in code from example 5-2 were made.)

```

SELECT eval_grp,
       SUM(estimate_by_estn_unit.estimate) estimate,
       CASE
         WHEN SUM(estimate_by_estn_unit.estimate) > 0 THEN
           ROUND(sqrt(SUM(estimate_by_estn_unit.var_of_estimate)) /
                 SUM(estimate_by_estn_unit.estimate) * 100,
                 3)
         ELSE
           0
       END AS se_of_estimate_pct,
       SUM(estimate_by_estn_unit.var_of_estimate) var_of_estimate,
       SUM(estimate_by_estn_unit.total_plots) total_plots,
       SUM(estimate_by_estn_unit.non_zero_plots) non_zero_plots,
       SUM(estimate_by_estn_unit.total_population_area_acres) total_population_acres
FROM (SELECT pop_eval_grp_cn,
            eval_grp,
            estn_unit_cn,
            sum(nvl(ysum_hd, 0) * phase_1_summary.expns) estimate,
            SUM(phase_1_summary.n_h) total_plots,
            SUM(phase_2_summary.number_plots_in_domain) domain_plots,
            SUM(phase_2_summary.non_zero_plots) non_zero_plots,
            total_area * total_area / SUM(phase_1_summary.n_h) *
            ((SUM(w_h * phase_1_summary.n_h *
                (((nvl(ysum_hd_sqr, 0) / phase_1_summary.n_h) -
                 ((nvl(ysum_hd, 0) / phase_1_summary.n_h) *
                  (nvl(ysum_hd, 0) / phase_1_summary.n_h)))) /
                (phase_1_summary.n_h - 1)))) +
            1 / SUM(phase_1_summary.n_h) *
            (SUM(((1 - w_h) * phase_1_summary.n_h *
                (((nvl(ysum_hd_sqr, 0) / phase_1_summary.n_h) -
                 ((nvl(ysum_hd, 0) / phase_1_summary.n_h) *
                  (nvl(ysum_hd, 0) / phase_1_summary.n_h)))) /
                (phase_1_summary.n_h - 1)))))) var_of_estimate,
            total_area total_population_area_acres
FROM (SELECT peg.eval_grp,
            peg.cn pop_eval_grp_cn,
            psm.estn_unit_cn,
            psm.cn pop_stratum_cn,
            psm.expns,
            p1pointcnt /
            (SELECT SUM(strs.p1pointcnt)
             FROM fs_fiadb.pop_stratum strs
             WHERE strs.estn_unit_cn = psm.estn_unit_cn) w_h,
            (SELECT SUM(strs.p1pointcnt)
             FROM fs_fiadb.pop_stratum strs
             WHERE strs.estn_unit_cn = psm.estn_unit_cn) n_prime,
            p1pointcnt n_prime_h,
            (SELECT SUM(eu_s.area_used)
             FROM fs_fiadb.pop_estn_unit eu_s
             WHERE eu_s.cn = psm.estn_unit_cn) total_area,

```

```

    psm.p2pointcnt n_h
FROM fs_fiadb.pop_estn_unit peu,
    fs_fiadb.pop_stratum      psm,
    fs_fiadb.pop_eval         pev,
    fs_fiadb.pop_eval_grp     peg,
    fs_fiadb.pop_eval_typ     pet
WHERE peu.cn = psm.estn_unit_cn
    AND pev.cn = peu.eval_cn
    AND pet.eval_cn = pev.cn
    AND pet.eval_grp_cn = peg.cn
    AND pet.eval_typ = 'EXPCHNG' -- expansion factor area change estimation
    AND peg.eval_grp = 272007 -- desired evaluation group must be specified
) phase_1_summary,
(SELECT pop_stratum_cn,
    SUM(y_hid_adjusted) ysum_hd,
    SUM(y_hid_adjusted * y_hid_adjusted) ysum_hd_sqr,
    COUNT(*) number_plots_in_domain,
    SUM(DECODE(y_hid_adjusted, 0, 0, NULL, 0, 1)) non_zero_plots
FROM (SELECT psm.cn pop_stratum_cn,
    p.cn plt_cn,
    SUM(cmx.subptyp_prop_chng / 4 *
        DECODE(c.prop_basis,
            'MACR',
            psm.adj_factor_macr,
            psm.adj_factor_subp) -- expression for proportion of tracked plots
        ) y_hid_adjusted
FROM fs_fiadb.cond          c,
    fs_fiadb.plot            p,
    fs_fiadb.pop_plot_stratum_assgn ppsa,
    fs_fiadb.pop_stratum      psm,
    fs_fiadb.pop_estn_unit     peu,
    fs_fiadb.pop_eval         pev,
    fs_fiadb.pop_eval_typ     pet,
    fs_fiadb.pop_eval_grp     peg,
    fs_fiadb.cond             c_past,
    fs_fiadb.subp_cond_chng_mtrx cmx
WHERE p.cn = c.plt_cn
    AND pet.eval_typ = 'EXPCHNG'
    AND (c.cond_status_cd IN (3, 4) AND c_past.cond_status_cd = 1)
        -- where clause tracking change
    AND ppsa.plt_cn = p.cn
    AND ppsa.stratum_cn = psm.cn
    AND peu.cn = psm.estn_unit_cn
    AND pev.cn = peu.eval_cn
    AND pev.cn = pet.eval_cn
    AND pet.eval_grp_cn = peg.cn
    AND peg.eval_grp = 272007 -- desired evaluation group must be specified
    AND p.prev_plt_cn = c_past.plt_cn
    AND cmx.prev_plt_cn = c_past.plt_cn
    AND cmx.prevcond = c_past.condid
    AND cmx.condid = c.condid
    AND ((cmx.subptyp = 3 and c.prop_basis = 'MACR') or
        (cmx.subptyp = 1 and c.prop_basis = 'SUBP'))
        -- join past conditions / change matrix table
GROUP BY psm.cn, p.cn)

```



```

GROUP BY pop_stratum_cn) phase_2_summary
WHERE phase_1_summary.pop_stratum_cn =
      phase_2_summary.pop_stratum_cn(+)
GROUP BY pop_eval_grp_cn,
      eval_grp,
      estn_unit_cn,
      phase_1_summary.total_area) estimate_by_estn_unit
GROUP BY pop_eval_grp_cn, eval_grp

```

Results of example 8-16:

Area change estimates and sampling errors based on remeasured plots, Minnesota, 2007.

-	Forest to water	Water to forest	Large diameter forest at both measurements
<b>Changes to where clause</b>	<b>AND (c.cond_status_cd IN (3,4) AND c_past.cond_status_cd = 1)</b>	<b>AND (c.cond_status_cd=1 AND c_past.cond_status_cd IN (3,4))</b>	<b>AND (c.cond_status_cd=1 AND c_past.cond_status_cd=1 AND C.STDSZCD = 1 AND c_past.STDSZCD = 1 )</b>
EVAL_GRP	272007	272007	272007
ESTIMATE	27,345.1	77,978.2	3,631,160.4
SE_OF_ESTIMATE_PCT	29.2	18.4	2.9
VAR_OF_ESTIMATE	63,796,853	206,390,712	11,427,498,039
TOTAL_PLOTS	12,280	12,280	12,280
NON_ZERO_PLOTS	32	57	1,007
TOTAL_POPULATION_ACRES	54,008,479	54,008,479	54,008,479



# Chapter 9: Using Population-by-Evaluation Type Views

Beginning with FIADB 1.6.0.02, population-by-evaluation-type views are available to users who query the FIADB within the Forest Service firewall. The views allow users to select the appropriate population with only two joins, rather than the seven used in standard queries.

View Name	Description
POP_EXPALL_VW	All plots: sampled and nonsampled.
POP_EXPCHNG_VW	Sampled plots used for area change estimates.
POP_EXPCURR_VW	Sampled plots used for current area and condition-level estimates.
POP_EXPDWM_VW	Sampled plots used for down woody material estimates.
POP_EXPGROW_VW	Sampled plots used for tree growth estimates.
POP_EXPMORT_VW	Sampled plots used for tree mortality estimates.
POP_EXPREGEN_VW	Sampled plots used for tree regeneration estimates.
POP_EXPREMV_VW	Sampled plots used for tree removal estimates.
POP_EXPVOL_VW	Sampled plots used for tree inventory estimates.

The Oracle view for the POP\_EXPCURR\_VW is constructed using this script. The other views can be similarly constructed by replacing "EXPCURR" with the appropriate EVAL\_TYP. The script can also be modified for use in MS Access.

### Example 9-1: Script to create Oracle view (POP\_EXPCURR\_VW)

```
CREATE or REPLACE VIEW pop_expcurr_vw AS -- modify view name for the desired eval_type
SELECT peg.eval_grp,
       peg.eval_grp_descr,
       peg.statecd,
       peg.rscd,
       pet.eval_typ,
       pev.evalid,
       pet.eval_cn,
       psm.adj_factor_subp,
       psm.adj_factor_macr,
       psm.adj_factor_micr,
       peu.area_used,
       peu.p1pntcnt_eu,
       psm.p1pointcnt,
       psm.p2pointcnt
FROM fs_fiadb.pop_eval_grp           peg,
     fs_fiadb.pop_eval_typ         pet,
     fs_fiadb.pop_eval             pev,
     fs_fiadb.pop_estn_unit        peu,
     fs_fiadb.pop_stratum          psm,
     fs_fiadb.pop_plot_stratum_assgn ppsa
WHERE peg.cn = pet.eval_grp_cn
```

```

AND pet.eval_typ = 'EXPCURR' -- modify for the appropriate eval_typ
AND pet.eval_cn = pev.cn
AND pev.cn = peu.eval_cn
AND peu.cn = psm.estn_unit_cn
AND psm.cn = ppsa.stratum_cn

```

Example 4-2, which estimates area of timberland in acres, selects the EVAL\_TYP and uses the POP tables to select the appropriate population, as highlighted below.

```

SELECT SUM(psm.expns * c.condprop_unadj *
DECODE(c.prop_basis,
'MACR',
psm.adj_factor_macr,
psm.adj_factor_subp) -- this is the expression from ref_pop_attribute table
) estimate
FROM fs_fiadb.cond      c,
    fs_fiadb.plot      p,
    fs_fiadb.pop_plot_stratum_assgn ppsa,
    fs_fiadb.pop_stratum      psm,
    fs_fiadb.pop_estn_unit    peu,
    fs_fiadb.pop_eval        pev,
    fs_fiadb.pop_eval_typ    pet,
    fs_fiadb.pop_eval_grp    peg
WHERE p.cn = c.plt_cn
AND pet.eval_typ = 'EXPCURR'
AND c.cond_status_cd = 1
AND c.reservcd = 0
AND c.siteclcd IN (1, 2, 3, 4, 5, 6)
-- this is the where_clause from ref_pop_attribute table

AND ppsa.plt_cn = p.cn
AND ppsa.stratum_cn = psm.cn
AND peu.cn = psm.estn_unit_cn
AND pev.cn = peu.eval_cn
AND pev.cn = pet.eval_cn
AND pet.eval_grp_cn = peg.cn
AND peg.eval_grp = 272003 -- the desired evaluation group must be specified

```

Using the POP\_EXPCURR\_VW shortens the joins as highlighted below.

**Example 9-2:** Estimate area of timberland (acres) using POP\_EXPCURR\_VW.

```

SELECT SUM(pvw.expns * c.condprop_unadj *
  decode (c.prop_basis,
    'MACR',
    pvw.adj_factor_macr,
    pvw.adj_factor_subp) -- this is the expression from ref_pop_attribute table
  ) estimate
FROM fs_fiadb.cond c,
  fs_fiadb.plot p,
  fs_fiadb.pop_expcurr_vw pvw
  -- POP_EXPCURR_VW view joins the pop tables for the EXPCURR eval type
WHERE p.cn = c.plt.cn
  AND c.cond_status_cd = 1
  AND c.reservcd = 0
  AND c.siteclcd IN (1, 2, 3, 4, 5, 6) -- this is the where_clause from ref_pop_attribute table
  AND pvw.plt_cn = p.cn
  AND pvw.eval_grp = 272003 -- the desired evaluation group must be specified

```



# Literature Cited

- Bechtold, W.A.; Patterson, P.L., editors. 2005. The enhanced Forest Inventory and Analysis program - national sampling design and estimation procedures. Gen. Tech. Rep. SRS-80. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 85 p.
- Miles, P.D.; Jacobson, K.; Brand, G.J. [and others]. 2007. Minnesota's forests 1999-2003 (Part A). Reourc. Bull. NRS-12A. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 92 p.
- O'Connell, B.M.; Conkling, B.L.; Wilson, A.M. [and others]. 2017. [The Forest Inventory and Analysis Database: Database description and user guide for Phase 2 \(version 7.0\)](#). U.S. Department of Agriculture, Forest Service. 870 p. [Online]. Available at web address: <http://www.fia.fs.fed.us/library/database-documentation/>.





## Appendix A: Values and Descriptions in REF\_POP\_ATTRIBUTE

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
1	Area of sampled and nonsampled land and water, in acres, within U.S. boundary.
2	Area of forest land, in acres.
3	Area of timberland, in acres.
4	Number of live trees (at least 1 inch d.b.h./d.r.c.), in trees, on forest land.
5	Number of growing-stock trees (at least 5 inches d.b.h.), in trees, on forest land.
6	Number of standing-dead trees (at least 5 inches d.b.h./d.r.c.), in trees, on forest land.
7	Number of live trees (at least 1 inch d.b.h./d.r.c.), in trees, on timberland.
8	Number of growing-stock trees (at least 5 inches d.b.h.), in trees, on timberland.
9	Number of standing-dead trees (at least 5 inches d.b.h./d.r.c.), in trees, on timberland.
10	Aboveground dry weight of live trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
11	Dry weight of merchantable bole for live trees (timber species at least 5 inches d.b.h.), in short tons, on forest land.
12	Dry weight of merchantable bole for live trees (timber species at least 5 inches d.b.h.), in short tons, on timberland.
13	Aboveground dry weight of live trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.
14	Net volume of live trees (at least 5 inches d.b.h./d.r.c.), in cubic feet, on forest land.
15	Net volume of growing-stock trees (at least 5 inches d.b.h.), in cubic feet, on forest land.
16	Net volume of saw-log portion of sawtimber trees, in cubic feet, on forest land.
17	Net volume of live trees (at least 5 inches d.b.h./d.r.c.), in cubic feet, on timberland.
18	Net volume of growing-stock trees (at least 5 inches d.b.h.), in cubic feet, on timberland.
19	Net volume of saw-log portion of sawtimber trees, in cubic feet, on timberland.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
20	Net volume of sawtimber trees, in board feet (International ¼-inch rule), on forest land.
21	Net volume of sawtimber trees, in board feet (International ¼-inch rule), on timberland.
22	Gross volume of sawtimber trees, in board feet (International ¼-inch rule), on forest land.
23	Gross volume of live trees (at least 5 inches d.b.h./d.r.c.), in cubic feet, on forest land.
24	Sound volume of live trees (at least 5 inches d.b.h./d.r.c.), in cubic feet, on forest land.
25	Average annual net growth of live trees (at least 5 inches d.b.h./d.r.c.), in cubic feet, on forest land.
26	Average annual net growth of growing-stock trees (at least 5 inches d.b.h.), in cubic feet, on forest land.
27	Average annual net growth of sawtimber trees, in board feet (International ¼-inch rule), on forest land.
28	Average annual net growth of live trees (at least 5 inches d.b.h./d.r.c.), in cubic feet, on timberland.
29	Average annual net growth of growing-stock trees (at least 5 inches d.b.h.), in cubic feet, on timberland.
30	Average annual net growth of sawtimber trees, in board feet (International ¼-inch rule), on timberland.
31	Average annual mortality of trees (at least 5 inches d.b.h./d.r.c.), in cubic feet, on forest land.
32	Average annual mortality of trees (at least 5 inches d.b.h./d.r.c.), in trees, on forest land.
33	Average annual mortality of growing-stock trees (at least 5 inches d.b.h.), in cubic feet, on forest land.
34	Average annual mortality of sawtimber trees, in board feet (International ¼-inch rule), on forest land.
35	Average annual mortality of trees (at least 5 inches d.b.h./d.r.c.), in cubic feet, on timberland.
36	Average annual mortality of trees (at least 5 inches d.b.h./d.r.c.), in trees, on timberland.
37	Average annual mortality of growing-stock trees (at least 5 inches d.b.h.), in cubic feet, on timberland.
38	Average annual mortality of sawtimber trees, in board feet (International ¼-inch rule), on timberland.
39	Average annual removals of live trees (at least 5 inches d.b.h./d.r.c.), in cubic feet, on forest land.
40	Average annual removals of growing-stock trees (at least 5 inches d.b.h.), in cubic feet, on forest land.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
41	Average annual removals of sawtimber trees, in board feet (International ¼-inch rule), on forest land.
42	Average annual removals of live trees (at least 5 inches d.b.h./d.r.c.), in cubic feet, on timberland.
43	Average annual removals of growing-stock trees (at least 5 inches d.b.h.), in cubic feet, on timberland.
44	Average annual removals of sawtimber trees, in board feet (International ¼-inch rule), on timberland.
45	Number of live seedlings (less than 1 inch d.b.h./d.r.c.), in seedlings, on forest land.
46	Number of live seedlings (less than 1 inch d.b.h./d.r.c.), in seedlings, on timberland.
47	Above- and belowground carbon in standing-dead trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
48	Aboveground carbon in live seedlings, shrubs, and bushes, in short tons, on forest land.
49	Belowground carbon in live seedlings, shrubs, and bushes, in short tons, on forest land.
50	Carbon in stumps, coarse roots, and coarse woody debris, in short tons, on forest land.
51	Carbon in litter, in short tons, on forest land.
52	Carbon in organic soil, in short tons, on forest land.
53	Aboveground carbon in live trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
54	Belowground carbon in live trees (at least 1 inch d.b.h./d.r.c.) in short tons on forest land.
55	Above- and belowground carbon in live trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
56	Dry weight of tops and limbs for live trees (timber species at least 5 inches d.b.h.), in short tons, on forest land.
57	Aboveground dry weight of live saplings (timber species at least 1 and less than 5 inches d.b.h.), in short tons, on forest land.
58	Dry weight of stumps for live trees (timber species at least 5 inches d.b.h.), in short tons, on forest land.
59	Belowground dry weight of live trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
60	Aboveground dry weight of live trees (woodland species at least 1 inch d.r.c.), in short tons, on forest land.
61	Above- and belowground carbon in standing-dead trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.
62	Aboveground carbon in live seedlings, shrubs, and bushes, in short tons, on timberland.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
63	Belowground carbon in live seedlings, shrubs, and bushes, in short tons, on timberland.
64	Carbon in stumps, coarse roots, and coarse woody debris, in short tons, on timberland.
65	Carbon in litter, in short tons, on timberland.
66	Carbon in organic soil, in short tons, on timberland.
67	Aboveground carbon in live trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.
68	Belowground carbon in live trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.
69	Above- and belowground carbon in live trees (at least 1 inch d.b.h./d.r.c.) in short tons on timberland.
70	Dry weight of tops and limbs for live trees (timber species at least 5 inches d.b.h.), in short tons, on timberland.
71	Aboveground dry weight of live saplings (timber species at least 1 and less than 5 inches d.b.h.), in short tons, on timberland.
72	Dry weight of stumps for live trees (timber species at least 5 inches d.b.h.), in short tons, on timberland.
73	Belowground dry weight of live trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.
74	Aboveground dry weight of live trees (woodland species at least 1 inch d.r.c.), in short tons, on timberland.
75	Aboveground dry weight of live trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land calculated with retired regional methods.
76	Aboveground merchantable dry weight of live trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land calculated with retired regional methods.
77	Aboveground merchantable dry weight of live trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland calculated with retired regional methods.
78	Aboveground dry weight of live trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland calculated with retired regional methods.
79	Area of sampled land and water, in acres.
80	Average annual harvest removals of live trees (at least 5 inches d.b.h./d.r.c.), in cubic feet, on forest land.
81	Average annual harvest removals of growing-stock trees (at least 5 inches d.b.h.), in cubic feet, on forest land.
82	Average annual harvest removals of sawtimber trees, in board feet (International 1/4-inch rule), on forest land.
83	Average annual harvest removals of live trees (at least 5 inches d.b.h./d.r.c.), in cubic feet, on timberland.
84	Average annual harvest removals of growing-stock trees (at least 5 inches d.b.h.), in cubic feet, on timberland.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
85	Average annual harvest removals of sawtimber trees, in board feet (International ¼-inch rule), on timberland.
86	Average annual other removals of live trees (at least 5 inches d.b.h./d.r.c.), in cubic feet, on forest land.
87	Average annual other removals of growing-stock trees (at least 5 inches d.b.h.), in cubic feet, on forest land.
88	Average annual other removals of sawtimber trees, in board feet (International ¼-inch rule), on forest land.
89	Average annual other removals of live trees (at least 5 inches d.b.h./d.r.c.), in cubic feet, on timberland.
90	Average annual other removals of growing-stock trees (at least 5 inches d.b.h.), in cubic feet, on timberland.
91	Average annual other removals of sawtimber trees, in board feet (International ¼-inch rule), on timberland.
92	Net volume of standing-dead trees (at least 5 inches d.b.h./d.r.c.) in cubic feet on forest land.
93	Net volume of standing-dead trees (at least 5 inches d.b.h./d.r.c.), in cubic feet, on timberland.
94	Aboveground dry weight of bark for live trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
96	Aboveground dry weight of standing-dead trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
97	Total carbon, in short tons, on forest land.
98	Forest carbon pool 1: live aboveground, in metric tonnes, on forest land.
99	Forest carbon pool 2: live belowground, in metric tonnes, on forest land.
100	Forest carbon pool 3: dead wood, in metric tonnes, on forest land.
101	Forest carbon pool 4: litter, in metric tonnes, on forest land.
102	Forest carbon pool 5: soil organic, in metric tonnes, on forest land.
103	Forest carbon total: all 5 pools, in metric tonnes, on forest land.
104	Total volume of FWD (small) pieces, in cubic feet, on forest land.
105	Dry weight of FWD (small) pieces, in short tons, on forest land.
106	Carbon in FWD (small) pieces, in short tons, on forest land.
107	Total volume of FWD (medium) pieces, in cubic feet, on forest land.
108	Dry weight of FWD (medium) pieces, in short tons, on forest land.
109	Carbon in FWD (medium) pieces, in short tons, on forest land.
110	Total volume of FWD (large) pieces, in cubic feet, on forest land.
111	Dry weight of FWD (large) pieces, in short tons, on forest land.
112	Carbon in FWD (large) pieces, in short tons, on forest land.
113	Number of CWD pieces, in pieces, on forest land.
114	Total volume of CWD, in cubic feet, on forest land.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
115	Dry weight of CWD, in short tons, on forest land.
116	Carbon in CWD, in short tons, on forest land.
117	Total volume of DWM piles, in cubic feet, on forest land.
118	Dry weight of DWM piles, in short tons, on forest land.
119	Carbon in DWM piles, in short tons, on forest land.
120	Total volume of FWD (all sizes) pieces, in cubic feet, on forest land.
121	Dry weight of FWD (all sizes) pieces, in short tons, on forest land.
122	Carbon in FWD (all sizes) pieces, in short tons, on forest land.
123	Total volume of DWM (FWD, CWD and piles), in cubic feet, on forest land.
124	Total dry weight of DWM (FWD, CWD and piles), in short tons, on forest land.
125	Total carbon in DWM (FWD, CWD and piles), in short tons, on forest land.
126	Area change - sampled at both inventories by re-measured plots.
127	Area change - area forest land both measurements from re-measured plots.
128	Area change - area forest land either measurement from re-measured plots.
129	Area change - area timberland both measurements from re-measured plots.
130	Area change - area timberland either measurement from re-measured plots.
131	Sound volume of sawlog portion of sawtimber trees, in cubic feet, on forest land.
132	Sound volume of sawlog portion of sawtimber trees, in cubic feet, on timberland.
133	Dry weight of sawlog portion of sawtimber trees, in short tons, on forest land.
134	Dry weight of sawlog portion of sawtimber trees, in short tons, on timberland.
201	Average annual net growth volume in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in cubic feet, on forest land.
202	Average annual net growth volume in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in cubic feet, on forest land.
203	Average annual net growth volume in the sawlog of sawtimber trees, in board feet (International 1/4-inch rule), on forest land.
204	Average annual net growth volume in the sawlog of sawtimber trees, in cubic feet, on forest land.
205	Average annual net growth volume in the merchantable bole above the sawlog of sawtimber trees, in cubic feet, on forest land.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
206	Average annual net growth volume in the merchantable bole of sawtimber trees (at least 5 inches d.b.h.), in cubic feet, on forest land.
207	Average annual net growth volume in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in cubic feet, on timberland.
208	Average annual net growth volume in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in cubic feet, on timberland.
209	Average annual net growth volume in the sawlog of sawtimber trees, in board feet (International 1/4-inch rule), on timberland.
210	Average annual net growth volume in the sawlog of sawtimber trees, in cubic feet, on timberland.
211	Average annual net growth volume in the merchantable bole above the sawlog of sawtimber trees, in cubic feet, on timberland.
212	Average annual net growth volume in the merchantable bole of sawtimber trees, in cubic feet, on timberland.
213	Average annual mortality volume in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in cubic feet, on forest land.
214	Average annual mortality volume in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in cubic feet, on forest land.
215	Average annual mortality volume in the sawlog of sawtimber trees, in board feet (International 1/4-inch rule), on forest land.
216	Average annual mortality volume in the sawlog of sawtimber trees, in cubic feet, on forest land.
217	Average annual mortality volume in the merchantable bole above the sawlog of sawtimber trees, in cubic feet, on forest land.
218	Average annual mortality volume in the merchantable bole of sawtimber trees, in cubic feet, on forest land.
219	Average annual mortality volume in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in cubic feet, on timberland.
220	Average annual mortality volume in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in cubic feet, on timberland.
221	Average annual mortality volume in the sawlog of sawtimber trees, in board feet (International 1/4-inch rule), on timberland.
222	Average annual mortality volume in the sawlog of sawtimber trees, in cubic feet, on timberland.
223	Average annual mortality volume in the merchantable bole above the sawlog of sawtimber trees, in cubic feet, on timberland.
224	Average annual mortality volume in the merchantable bole of sawtimber trees, in cubic feet, on timberland.
225	Average annual removals volume in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in cubic feet, on forest land.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
226	Average annual removals volume in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in cubic feet, on forest land.
227	Average annual removals volume in the sawlog of sawtimber trees, in board feet (International 1/4-inch rule), on forest land.
228	Average annual removals volume in the sawlog of sawtimber trees, in cubic feet, on forest land.
229	Average annual removals volume in the merchantable bole above the sawlog of sawtimber trees, in cubic feet, on forest land.
230	Average annual removals volume in the merchantable bole of sawtimber trees, in cubic feet, on forest land.
231	Average annual removals volume in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in cubic feet, on timberland.
232	Average annual removals volume in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in cubic feet, on timberland.
233	Average annual removals volume in the sawlog of sawtimber trees, in board feet (International 1/4-inch rule), on timberland.
234	Average annual removals volume in the sawlog of sawtimber trees, in cubic feet, on timberland.
235	Average annual removals volume in the merchantable bole above the sawlog of sawtimber trees, in cubic feet, on timberland.
236	Average annual removals volume in the merchantable bole of sawtimber trees, in cubic feet, on timberland.
237	Average annual harvest removals in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in cubic feet, on forest land.
238	Average annual harvest removals in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in cubic feet, on forest land.
239	Average annual harvest removals in the sawlog of sawtimber trees, in board feet (International 1/4-inch rule), on forest land.
240	Average annual harvest removals in the sawlog of sawtimber trees, in cubic feet, on forest land.
241	Average annual harvest removals in the merchantable bole above the sawlog of sawtimber trees, in cubic feet, on forest land.
242	Average annual harvest removals in the merchantable bole of sawtimber trees, in cubic feet, on forest land.
243	Average annual harvest removals in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in cubic feet, on timberland.
244	Average annual harvest removals in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in cubic feet, on timberland.
245	Average annual harvest removals in the sawlog of sawtimber trees, in board feet (International 1/4-inch rule), on timberland.



Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
246	Average annual harvest removals in the sawlog of sawtimber trees, in cubic feet, on timberland.
247	Average annual harvest removals in the merchantable bole above the sawlog of sawtimber trees, in cubic feet, on timberland.
248	Average annual harvest removals in the merchantable bole of sawtimber trees, in cubic feet, on timberland.
249	Average annual other removals in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in cubic feet, on forest land.
250	Average annual other removals in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in cubic feet, on forest land.
251	Average annual other removals in the sawlog of sawtimber trees, in board feet (International 1/4-inch rule), on forest land.
252	Average annual other removals in the sawlog of sawtimber trees, in cubic feet, on forest land.
253	Average annual other removals in the merchantable bole above the sawlog of sawtimber trees, in cubic feet, on forest land.
254	Average annual other removals in the merchantable bole of sawtimber trees, in cubic feet, on forest land.
255	Average annual other removals in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in cubic feet, on timberland.
256	Average annual other removals in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in cubic feet, on timberland.
257	Average annual other removals in the sawlog of sawtimber trees, in board feet (International 1/4-inch rule), on timberland.
258	Average annual other removals in the sawlog of sawtimber trees, in cubic feet, on timberland.
259	Average annual other removals in the merchantable bole above the sawlog of sawtimber trees, in cubic feet, on timberland.
260	Average annual other removals in the merchantable bole of sawtimber trees, in cubic feet, on timberland.
301	Average annual net growth biomass in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
302	Average annual net growth biomass in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in short tons, on forest land.
303	Average annual net growth biomass in the sawlog of sawtimber trees, in short tons, on forest land.
304	Average annual net growth biomass in the merchantable bole above the sawlog of sawtimber trees, in short tons, on forest land.
305	Average annual net growth biomass in the merchantable bole of sawtimber trees, in short tons, on forest land.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
306	Average annual net growth biomass in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
307	Average annual net growth biomass in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in short tons, on timberland.
308	Average annual net growth biomass in the sawlog of sawtimber trees, in short tons, on timberland.
309	Average annual net growth biomass in the merchantable bole above the sawlog of sawtimber trees, in short tons, on timberland.
310	Average annual net growth biomass in the merchantable bole of sawtimber trees, in short tons, on timberland.
311	Average annual net growth biomass aboveground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
312	Average annual net growth biomass aboveground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
313	Average annual net growth biomass aboveground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
314	Average annual net growth biomass aboveground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.
315	Average annual net growth biomass aboveground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
316	Average annual net growth biomass aboveground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
317	Average annual net growth biomass belowground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
318	Average annual net growth biomass belowground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
319	Average annual net growth biomass belowground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
320	Average annual net growth biomass belowground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.
321	Average annual net growth biomass belowground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
322	Average annual net growth biomass belowground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
323	Average annual net growth biomass in the stump of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
324	Average annual net growth biomass in the stump of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
325	Average annual net growth biomass in the stump of sawtimber trees, in short tons, on forest land.
326	Average annual net growth biomass in the stump of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
327	Average annual net growth biomass in the stump of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
328	Average annual net growth biomass in the stump of sawtimber trees, in short tons, on timberland.
329	Average annual net growth biomass in the top and limbs of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
330	Average annual net growth biomass in the top and limbs of grow-stocking trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
331	Average annual net growth biomass in the top and limbs of sawtimber trees, in short tons, on forest land.
332	Average annual net growth biomass in the top and limbs of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
333	Average annual net growth biomass in the top and limbs of grow-stocking trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
334	Average annual net growth biomass in the top and limbs of sawtimber trees, in short tons, on timberland.
335	Average annual mortality biomass aboveground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
336	Average annual mortality biomass aboveground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
337	Average annual mortality biomass aboveground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
338	Average annual mortality biomass aboveground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.
339	Average annual mortality biomass aboveground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
340	Average annual mortality biomass aboveground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
341	Average annual mortality biomass belowground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
342	Average annual mortality biomass belowground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
343	Average annual mortality biomass belowground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
344	Average annual mortality biomass belowground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.
345	Average annual mortality biomass belowground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
346	Average annual mortality biomass belowground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
347	Average annual mortality biomass in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
348	Average annual mortality biomass in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in short tons, on forest land.
349	Average annual mortality biomass in the merchantable bole of sawtimber trees, in short tons, on forest land.
350	Average annual mortality biomass in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
351	Average annual mortality biomass in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in short tons, on timberland.
352	Average annual mortality biomass in the merchantable bole of sawtimber trees, in short tons, on timberland.
353	Average annual mortality biomass in the sawlog of sawtimber trees, in short tons, on forest land.
354	Average annual mortality biomass in the sawlog of sawtimber trees, in short tons, on timberland.
355	Average annual mortality biomass in the merchantable bole above the sawlog of sawtimber trees, in short tons, on forest land.
356	Average annual mortality biomass in the merchantable bole above the sawlog of sawtimber trees, in short tons, on timberland.
357	Average annual mortality biomass in the stump of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
358	Average annual mortality biomass in the stump of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
359	Average annual mortality biomass in the stump of sawtimber trees, in short tons, on forest land.
360	Average annual mortality biomass in the stump of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
361	Average annual mortality biomass in the stump of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
362	Average annual mortality biomass in the stump of sawtimber trees, in short tons, on timberland.
363	Average annual mortality biomass in the top and limbs of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
364	Average annual mortality biomass in the top and limbs of grow-stocking trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
365	Average annual mortality biomass in the top and limbs of sawtimber trees, in short tons, on forest land.
366	Average annual mortality biomass in the top and limbs of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
367	Average annual mortality biomass in the top and limbs of grow-stocking trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
368	Average annual mortality biomass in the top and limbs of sawtimber trees, in short tons, on timberland.
369	Average annual removals biomass aboveground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
370	Average annual removals biomass aboveground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
371	Average annual removals biomass aboveground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
372	Average annual removals biomass aboveground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.
373	Average annual removals biomass aboveground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
374	Average annual removals biomass aboveground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
375	Average annual removals biomass belowground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
376	Average annual removals biomass belowground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
377	Average annual removals biomass belowground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
378	Average annual removals biomass belowground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.
379	Average annual removals biomass belowground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
380	Average annual removals biomass belowground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
381	Average annual removals biomass in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
382	Average annual removals biomass in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in short tons, on forest land.
383	Average annual removals biomass in the merchantable bole of sawtimber trees, in short tons, on forest land.
384	Average annual removals biomass in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
385	Average annual removals biomass in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in short tons, on timberland.
386	Average annual removals biomass in the merchantable bole of sawtimber trees, in short tons, on timberland.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
387	Average annual removals biomass in the sawlog of sawtimber trees, in short tons, on forest land.
388	Average annual removals biomass in the sawlog of sawtimber trees, in short tons, on timberland.
389	Average annual removals biomass in the merchantable bole above the sawlog of sawtimber trees, in short tons, on forest land.
390	Average annual removals biomass in the merchantable bole above the sawlog of sawtimber trees, in short tons, on timberland.
391	Average annual removals biomass in the stump of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
392	Average annual removals biomass in the stump of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
393	Average annual removals biomass in the stump of sawtimber trees, in short tons, on forest land.
394	Average annual removals biomass in the stump of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
395	Average annual removals biomass in the stump of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
396	Average annual removals biomass in the stump of sawtimber trees, in short tons, on timberland.
397	Average annual removals biomass in the top and limbs of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
398	Average annual removals biomass in the top and limbs of grow-stocking trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
399	Average annual removals biomass in the top and limbs of sawtimber trees, in short tons, on forest land.
400	Average annual removals biomass in the top and limbs of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
401	Average annual removals biomass in the top and limbs of grow-stocking trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
402	Average annual removals biomass in the top and limbs of sawtimber trees, in short tons, on timberland.
403	Average annual harvest removals biomass aboveground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
404	Average annual harvest removals biomass aboveground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
405	Average annual harvest removals biomass aboveground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
406	Average annual harvest removals biomass aboveground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
407	Average annual harvest removals biomass aboveground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
408	Average annual harvest removals biomass aboveground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
409	Average annual harvest removals biomass belowground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
410	Average annual harvest removals biomass belowground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
411	Average annual harvest removals biomass belowground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
412	Average annual harvest removals biomass belowground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.
413	Average annual harvest removals biomass belowground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
414	Average annual harvest removals biomass belowground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
415	Average annual harvest removals biomass in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
416	Average annual harvest removals biomass in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in short tons, on forest land.
417	Average annual harvest removals biomass in the merchantable bole of sawtimber trees (at least 5 inches d.b.h.), in short tons, on forest land.
418	Average annual harvest removals biomass in the merchantable bole of trees (at least 5 inches d.b.h.), in short tons, on timberland.
419	Average annual harvest removals biomass in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in short tons, on timberland.
420	Average annual harvest removals biomass in the merchantable bole of sawtimber trees (at least 5 inches d.b.h.), in short tons, on timberland.
421	Average annual harvest removals biomass in the sawlog of sawtimber trees, in short tons, on forest land.
422	Average annual harvest removals biomass in the sawlog of sawtimber trees, in short tons, on timberland.
423	Average annual harvest removals biomass in the merchantable bole above the sawlog of sawtimber trees, in short tons, on forest land.
424	Average annual harvest removals biomass in the merchantable bole above the sawlog of sawtimber trees, in short tons, on timberland.
425	Average annual harvest removals biomass in the stump of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
426	Average annual harvest removals biomass in the stump of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
427	Average annual harvest removals biomass in the stump of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
428	Average annual harvest removals biomass in the stump of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
429	Average annual harvest removals biomass in the stump of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
430	Average annual harvest removals biomass in the stump of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
431	Average annual harvest removals biomass in the top and limbs of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
432	Average annual harvest removals biomass in the top and limbs of grow-stocking trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
433	Average annual harvest removals biomass in the top and limbs of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
434	Average annual harvest removals biomass in the top and limbs of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
435	Average annual harvest removals biomass in the top and limbs of grow-stocking trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
436	Average annual harvest removals biomass in the top and limbs of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
437	Average annual other removals biomass aboveground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
438	Average annual other removals biomass aboveground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
439	Average annual other removals biomass aboveground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
440	Average annual other removals biomass aboveground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.
441	Average annual other removals biomass aboveground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
442	Average annual other removals biomass aboveground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
443	Average annual other removals biomass belowground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
444	Average annual other removals biomass belowground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
445	Average annual other removals biomass belowground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.



Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
446	Average annual other removals biomass belowground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.
447	Average annual other removals biomass belowground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
448	Average annual other removals biomass belowground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
449	Average annual other removals biomass in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
450	Average annual other removals biomass in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in short tons, on forest land.
451	Average annual other removals biomass in the merchantable bole of sawtimber trees (at least 5 inches d.b.h.), in short tons, on forest land.
452	Average annual other removals biomass in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
453	Average annual other removals biomass in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in short tons, on timberland.
454	Average annual other removals biomass in the merchantable bole of sawtimber trees (at least 5 inches d.b.h.), in short tons, on timberland.
455	Average annual other removals biomass in the sawlog of sawtimber trees, in short tons, on forest land.
456	Average annual other removals biomass in the sawlog of sawtimber trees, in short tons, on timberland.
457	Average annual other removals biomass in the merchantable bole above the sawlog of sawtimber trees, in short tons, on forest land.
458	Average annual other removals biomass in the merchantable bole above the sawlog of sawtimber trees, in short tons, on timberland.
459	Average annual other removals biomass in the stump of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
460	Average annual other removals biomass in the stump of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
461	Average annual other removals biomass in the stump of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
462	Average annual other removals biomass in the stump of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
463	Average annual other removals biomass in the stump of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
464	Average annual other removals biomass in the stump of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
465	Average annual other removals biomass in the top and limbs of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
466	Average annual other removals biomass in the top and limbs of grow-stocking trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
467	Average annual other removals biomass in the top and limbs of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
468	Average annual other removals biomass in the top and limbs of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
469	Average annual other removals biomass in the top and limbs of grow-stocking trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
470	Average annual other removals biomass in the top and limbs of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
510	Aboveground green weight of live trees (at least 1 inch d.b.h./d.r.c), in short tons, on forest land.
511	Green weight of merchantable bole for live trees (timber species at least 5 inches d.b.h.), in short tons, on forest land.
512	Green weight of merchantable bole for live trees (timber species at least 5 inches d.b.h.), in short tons, on timberland.
513	Aboveground green weight of live trees (at least 1 inch d.b.h./d.r.c), in short tons, on timberland.
533	Green weight of saw-log portion of sawtimber trees, in short tons, on forest land.
534	Green weight of saw-log portion of sawtimber trees, in short tons, on timberland.
556	Green weight of tops and limbs for live trees (timber species at least 5 inches d.b.h.), in short tons, on forest land.
557	Aboveground green weight of live saplings (timber species at least 1 and less than 5 inches d.b.h.), in short tons, on forest land.
558	Green weight of stumps for live trees (timber species at least 5 inches d.b.h.), in short tons, on forest land.
560	Aboveground green weight of live trees (woodland species at least 1 inch d.r.c.), in short tons, on forest land.
570	Green weight of tops and limbs for live trees (timber species at least 5 inches d.b.h.), in short tons, on timberland.
571	Aboveground green weight of live saplings (timber species at least 1 and less than 5 inches d.b.h.), in short tons, on timberland.
572	Green weight of stumps for live trees (timber species at least 5 inches d.b.h.), in short tons, on timberland.
574	Aboveground green weight of live trees (woodland species at least 1 inch d.r.c.), in short tons, on timberland.
575	Aboveground green weight of live trees (at least 1 inch d.b.h./d.r.c), in short tons, on forest land calculated with retired regional methods.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
576	Aboveground merchantable green weight of live trees (at least 5 inches d.b.h./d.r.c), in short tons, on forest land calculated with retired regional methods.
577	Aboveground merchantable green weight of live trees (at least 5 inches d.b.h./d.r.c), in short tons, on timberland calculated with retired regional methods.
578	Aboveground green weight of live trees (at least 1 inch d.b.h./d.r.c), in short tons, on timberland calculated with retired regional methods.
594	Aboveground green weight of bark for live trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
601	Average annual net growth carbon in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
602	Average annual net growth carbon in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in short tons, on forest land.
603	Average annual net growth carbon in the sawlog of sawtimber trees, in short tons, on forest land.
604	Average annual net growth carbon in the merchantable bole above the sawlog of sawtimber trees, in short tons, on forest land.
605	Average annual net growth carbon in the merchantable bole of sawtimber trees, in short tons, on forest land.
606	Average annual net growth carbon in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
607	Average annual net growth carbon in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in short tons, on timberland.
608	Average annual net growth carbon in the sawlog of sawtimber trees, in short tons, on timberland.
609	Average annual net growth carbon in the merchantable bole above the sawlog of sawtimber trees, in short tons, on timberland.
610	Average annual net growth carbon in the merchantable bole of sawtimber trees, in short tons, on timberland.
611	Average annual net growth carbon aboveground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
612	Average annual net growth carbon aboveground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
613	Average annual net growth carbon aboveground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
614	Average annual net growth carbon aboveground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.
615	Average annual net growth carbon aboveground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
616	Average annual net growth carbon aboveground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
617	Average annual net growth carbon belowground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
618	Average annual net growth carbon belowground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
619	Average annual net growth carbon belowground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
620	Average annual net growth carbon belowground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.
621	Average annual net growth carbon belowground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
622	Average annual net growth carbon belowground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
623	Average annual net growth carbon in the stump of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
624	Average annual net growth carbon in the stump of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
625	Average annual net growth carbon in the stump of sawtimber trees, in short tons, on forest land.
626	Average annual net growth carbon in the stump of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
627	Average annual net growth carbon in the stump of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
628	Average annual net growth carbon in the stump of sawtimber trees, in short tons, on timberland.
629	Average annual net growth carbon in the top and limbs of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
630	Average annual net growth carbon in the top and limbs of grow-stocking trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
631	Average annual net growth carbon in the top and limbs of sawtimber trees, in short tons, on forest land.
632	Average annual net growth carbon in the top and limbs of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
633	Average annual net growth carbon in the top and limbs of grow-stocking trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
634	Average annual net growth carbon in the top and limbs of sawtimber trees, in short tons, on timberland.
635	Average annual mortality carbon aboveground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
636	Average annual mortality carbon aboveground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
637	Average annual mortality carbon aboveground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
638	Average annual mortality carbon aboveground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.
639	Average annual mortality carbon aboveground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
640	Average annual mortality carbon aboveground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
641	Average annual mortality carbon belowground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
642	Average annual mortality carbon belowground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
643	Average annual mortality carbon belowground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
644	Average annual mortality carbon belowground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.
645	Average annual mortality carbon belowground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
646	Average annual mortality carbon belowground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
647	Average annual mortality carbon in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
648	Average annual mortality carbon in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in short tons, on forest land.
649	Average annual mortality carbon in the merchantable bole of sawtimber trees, in short tons, on forest land.
650	Average annual mortality carbon in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
651	Average annual mortality carbon in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in short tons, on timberland.
652	Average annual mortality carbon in the merchantable bole of sawtimber trees, in short tons, on timberland.
653	Average annual mortality carbon in the sawlog of sawtimber trees, in short tons, on forest land.
654	Average annual mortality carbon in the sawlog of sawtimber trees, in short tons, on timberland.
655	Average annual mortality carbon in the merchantable bole above the sawlog of sawtimber trees, in short tons, on forest land.
656	Average annual mortality carbon in the merchantable bole above the sawlog of sawtimber trees, in short tons, on timberland.
657	Average annual mortality carbon in the stump of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
658	Average annual mortality carbon in the stump of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
659	Average annual mortality carbon in the stump of sawtimber trees, in short tons, on forest land.
660	Average annual mortality carbon in the stump of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
661	Average annual mortality carbon in the stump of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
662	Average annual mortality carbon in the stump of sawtimber trees, in short tons, on timberland.
663	Average annual mortality carbon in the top and limbs of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
664	Average annual mortality carbon in the top and limbs of grow-stocking trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
665	Average annual mortality carbon in the top and limbs of sawtimber trees, in short tons, on forest land.
666	Average annual mortality carbon in the top and limbs of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
667	Average annual mortality carbon in the top and limbs of grow-stocking trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
668	Average annual mortality carbon in the top and limbs of sawtimber trees, in short tons, on timberland.
669	Average annual removals carbon aboveground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
670	Average annual removals carbon aboveground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
671	Average annual removals carbon aboveground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
672	Average annual removals carbon aboveground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.
673	Average annual removals carbon aboveground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
674	Average annual removals carbon aboveground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
675	Average annual removals carbon belowground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
676	Average annual removals carbon belowground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
677	Average annual removals carbon belowground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
678	Average annual removals carbon belowground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
679	Average annual removals carbon belowground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
680	Average annual removals carbon belowground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
681	Average annual removals carbon in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
682	Average annual removals carbon in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in short tons, on forest land.
683	Average annual removals carbon in the merchantable bole of sawtimber trees, in short tons, on forest land.
684	Average annual removals carbon in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
685	Average annual removals carbon in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in short tons, on timberland.
686	Average annual removals carbon in the merchantable bole of sawtimber trees, in short tons, on timberland.
687	Average annual removals carbon in the sawlog of sawtimber trees, in short tons, on forest land.
688	Average annual removals carbon in the sawlog of sawtimber trees, in short tons, on timberland.
689	Average annual removals carbon in the merchantable bole above the sawlog of sawtimber trees, in short tons, on forest land.
690	Average annual removals carbon in the merchantable bole above the sawlog of sawtimber trees, in short tons, on timberland.
691	Average annual removals carbon in the stump of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
692	Average annual removals carbon in the stump of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
693	Average annual removals carbon in the stump of sawtimber trees, in short tons, on forest land.
694	Average annual removals carbon in the stump of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
695	Average annual removals carbon in the stump of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
696	Average annual removals carbon in the stump of sawtimber trees, in short tons, on timberland.
697	Average annual removals carbon in the top and limbs of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
698	Average annual removals carbon in the top and limbs of grow-stocking trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
699	Average annual removals carbon in the top and limbs of sawtimber trees, in short tons, on forest land.
700	Average annual removals carbon in the top and limbs of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
701	Average annual removals carbon in the top and limbs of grow-stocking trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
702	Average annual removals carbon in the top and limbs of sawtimber trees, in short tons, on timberland.
703	Average annual harvest removals carbon aboveground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
704	Average annual harvest removals carbon aboveground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
705	Average annual harvest removals carbon aboveground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
706	Average annual harvest removals carbon aboveground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.
707	Average annual harvest removals carbon aboveground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
708	Average annual harvest removals carbon aboveground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
709	Average annual harvest removals carbon belowground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
710	Average annual harvest removals carbon belowground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
711	Average annual harvest removals carbon belowground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
712	Average annual harvest removals carbon belowground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.
713	Average annual harvest removals carbon belowground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
714	Average annual harvest removals carbon belowground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
715	Average annual harvest removals carbon in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
716	Average annual harvest removals carbon in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in short tons, on forest land.
717	Average annual harvest removals carbon in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
718	Average annual harvest removals carbon in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in short tons, on timberland.



Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
719	Average annual harvest removals carbon in the merchantable bole of sawtimber trees (at least 5 inches d.b.h.), in short tons, on timberland.
720	Average annual harvest removals carbon in the sawlog of sawtimber trees, in short tons, on forest land.
721	Average annual harvest removals carbon in the sawlog of sawtimber trees, in short tons, on timberland.
722	Average annual harvest removals carbon in the merchantable bole of sawtimber trees (at least 5 inches d.b.h.), in short tons, on forest land.
723	Average annual harvest removals carbon in the merchantable bole above the sawlog of sawtimber trees, in short tons, on forest land.
724	Average annual harvest removals carbon in the merchantable bole above the sawlog of sawtimber trees, in short tons, on timberland.
725	Average annual harvest removals carbon in the stump of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
726	Average annual harvest removals carbon in the stump of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
727	Average annual harvest removals carbon in the stump of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
728	Average annual harvest removals carbon in the stump of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
729	Average annual harvest removals carbon in the stump of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
730	Average annual harvest removals carbon in the stump of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
731	Average annual harvest removals carbon in the top and limbs of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
732	Average annual harvest removals carbon in the top and limbs of grow-stocking trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
733	Average annual harvest removals carbon in the top and limbs of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
734	Average annual harvest removals carbon in the top and limbs of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
735	Average annual harvest removals carbon in the top and limbs of grow-stocking trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
736	Average annual harvest removals carbon in the top and limbs of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
737	Average annual other removals carbon aboveground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
738	Average annual other removals carbon aboveground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
739	Average annual other removals carbon aboveground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
740	Average annual other removals carbon aboveground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.
741	Average annual other removals carbon aboveground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
742	Average annual other removals carbon aboveground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
743	Average annual other removals carbon belowground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
744	Average annual other removals carbon belowground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
745	Average annual other removals carbon belowground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
746	Average annual other removals carbon belowground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.
747	Average annual other removals carbon belowground of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
748	Average annual other removals carbon below ground of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
749	Average annual other removals carbon in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
750	Average annual other removals carbon in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in short tons, on forest land.
751	Average annual other removals carbon in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
752	Average annual other removals carbon in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in short tons, on timberland.
753	Average annual other removals carbon in the merchantable bole of sawtimber trees (at least 5 inches d.b.h.), in short tons, on forest land.
754	Average annual other removals carbon in the merchantable bole of sawtimber trees (at least 5 inches d.b.h.), in short tons, on timberland.
755	Average annual other removals carbon in the sawlog of sawtimber trees, in short tons, on forest land.
756	Average annual other removals carbon in the sawlog of sawtimber trees, in short tons, on timberland.
757	Average annual other removals carbon in the merchantable bole above the sawlog of sawtimber trees, in short tons, on forest land.
758	Average annual other removals carbon in the merchantable bole above the sawlog of sawtimber trees, in short tons, on timberland.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
759	Average annual other removals carbon in the stump of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
760	Average annual other removals carbon in the stump of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
761	Average annual other removals carbon in the stump of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
762	Average annual other removals carbon in the stump of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
763	Average annual other removals carbon in the stump of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
764	Average annual other removals carbon in the stump of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
765	Average annual other removals carbon in the top and limbs of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
766	Average annual other removals carbon in the top and limbs of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
767	Average annual other removals carbon in the top and limbs of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
768	Average annual other removals carbon in the top and limbs of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
769	Average annual other removals carbon in the top and limbs of growing-stock trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
770	Average annual other removals carbon in the top and limbs of sawtimber trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
901	Average annual mortality number of trees (at least 5 inches d.b.h./d.r.c.), in number of trees, on forest land.
902	Average annual mortality number of growing-stock trees (at least 5 inches d.b.h.), in number of trees, on forest land.
903	Average annual mortality number of sawtimber trees, in number of trees, on forest land.
904	Average annual mortality number of trees (at least 5 inches d.b.h./d.r.c.), in number of trees, on timberland.
905	Average annual mortality number of growing-stock trees (at least 5 inches d.b.h.), in number of trees, on timberland.
906	Average annual mortality number of sawtimber trees, in number of trees, on timberland.
907	Average annual removals number of trees (at least 5 inches d.b.h./d.r.c.), in number of trees, on forest land.
908	Average annual removals number of growing-stock trees (at least 5 inches d.b.h.), in number of trees, on forest land.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
909	Average annual removals number of sawtimber trees, in number of trees, on forest land.
910	Average annual removals number of trees (at least 5 inches d.b.h./d.r.c.), in number of trees, on timberland.
911	Average annual removals number of growing-stock trees (at least 5 inches d.b.h.), in number of trees, on timberland.
912	Average annual removals number of sawtimber trees, in number of trees, on timberland.
913	Average annual harvest removals of trees (at least 5 inches d.b.h./d.r.c.), in number of trees, on forest land.
914	Average annual harvest removals of growing-stock trees (at least 5 inches d.b.h.), in number of trees, on forest land.
915	Average annual harvest removals of sawtimber trees, in number of trees, on forest land.
916	Average annual harvest removals of trees (at least 5 inches d.b.h./d.r.c.), in number of trees, on timberland.
917	Average annual harvest removals of growing-stock trees (at least 5 inches d.b.h.), in number of trees, on timberland.
918	Average annual harvest removals of sawtimber trees, in number of trees, on timberland.
919	Average annual other removals of trees (at least 5 inches d.b.h./d.r.c.), in number of trees, on forest land.
920	Average annual other removals of growing-stock trees (at least 5 inches d.b.h.), in number of trees, on forest land.
921	Average annual other removals of sawtimber trees, in number of trees, on forest land.
922	Average annual other removals of trees (at least 5 inches d.b.h./d.r.c.), in number of trees, on timberland.
923	Average annual other removals of growing-stock trees (at least 5 inches d.b.h.), in number of trees, on timberland.
924	Average annual other removals of sawtimber trees, in number of trees, on timberland.
1201	Average annual gross growth volume in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in cubic feet, on forest land.
1202	Average annual gross growth volume in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in cubic feet, on forest land.
1203	Average annual gross growth volume in the sawlog of sawtimber trees, in board feet (International 1/4-inch rule), on forest land.
1204	Average annual gross growth volume in the sawlog of sawtimber trees, in cubic feet, on forest land.
1205	Average annual gross growth volume in the merchantable bole above the sawlog of sawtimber trees, in cubic feet, on forest land.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
1206	Average annual gross growth volume in the merchantable bole of sawtimber trees, in cubic feet, on forest land.
1207	Average annual gross growth volume in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in cubic feet, on timberland.
1208	Average annual gross growth volume in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in cubic feet, on timberland.
1209	Average annual gross growth volume in the sawlog of sawtimber trees, in board feet (International 1/4-inch rule), on timberland.
1210	Average annual gross growth volume in the sawlog of sawtimber trees, in cubic feet, on timberland.
1211	Average annual gross growth volume in the merchantable bole above the sawlog of sawtimber trees, in cubic feet, on timberland.
1212	Average annual gross growth volume in the merchantable bole of sawtimber trees, in cubic feet, on timberland.
1301	Average annual gross growth biomass in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
1302	Average annual gross growth biomass in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in short tons, on forest land.
1303	Average annual gross growth biomass in the sawlog of sawtimber trees, in short tons, on forest land.
1304	Average annual gross growth biomass in the merchantable bole above the sawlog of sawtimber trees, in short tons, on forest land.
1305	Average annual gross growth biomass in the merchantable bole of sawtimber trees, in short tons, on forest land.
1306	Average annual gross growth biomass in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
1307	Average annual gross growth biomass in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in short tons, on timberland.
1308	Average annual gross growth biomass in the sawlog of sawtimber trees, in short tons, on timberland.
1309	Average annual gross growth biomass in the merchantable bole above the sawlog of sawtimber trees, in short tons, on timberland.
1310	Average annual gross growth biomass in the merchantable bole of sawtimber trees, in short tons, on timberland.
1311	Average annual gross growth biomass aboveground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
1312	Average annual gross growth biomass aboveground of growing-stock trees (at least 5 inches d.b.h.), in short tons, on forest land.
1313	Average annual gross growth biomass aboveground of sawtimber trees, in short tons, on forest land.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
1314	Average annual gross growth biomass aboveground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.
1315	Average annual gross growth biomass aboveground of growing-stock trees (at least 5 inches d.b.h.), in short tons, on timberland.
1316	Average annual gross growth biomass aboveground of sawtimber trees, in short tons, on timberland.
1317	Average annual gross growth biomass belowground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
1318	Average annual gross growth biomass belowground of growing-stock trees (at least 5 inches d.b.h.), in short tons, on forest land.
1319	Average annual gross growth biomass belowground of sawtimber trees, in short tons, on forest land.
1320	Average annual gross growth biomass belowground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.
1321	Average annual gross growth biomass belowground of growing-stock trees (at least 5 inches d.b.h.), in short tons, on timberland.
1322	Average annual gross growth biomass belowground of sawtimber trees, in short tons, on timberland.
1323	Average annual gross growth biomass in the stump of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
1324	Average annual gross growth biomass in the stump of growing-stock trees (at least 5 inches d.b.h.), in short tons, on forest land.
1325	Average annual gross growth biomass in the stump of sawtimber trees, in short tons, on forest land.
1326	Average annual gross growth biomass in the stump of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
1327	Average annual gross growth biomass in the stump of growing-stock trees (at least 5 inches d.b.h.), in short tons, on timberland.
1328	Average annual gross growth biomass in the stump of sawtimber trees, in short tons, on timberland.
1329	Average annual gross growth biomass in the top and limbs of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
1330	Average annual gross growth biomass in the top and limbs of growing-stock trees (at least 5 inches d.b.h.), in short tons, on forest land.
1331	Average annual gross growth biomass in the top and limbs of sawtimber trees, in short tons, on forest land.
1332	Average annual gross growth biomass in the top and limbs of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
1333	Average annual gross growth biomass in the top and limbs of growing-stock trees (at least 5 inches d.b.h.), in short tons, on timberland.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
1334	Average annual gross growth biomass in the top and limbs of sawtimber trees, in short tons, on timberland.
1601	Average annual gross growth carbon in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
1602	Average annual gross growth carbon in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in short tons, on forest land.
1603	Average annual gross growth carbon in the sawlog of sawtimber trees, in short tons, on forest land.
1604	Average annual gross growth carbon in the merchantable bole above the sawlog of sawtimber trees, in short tons, on forest land.
1605	Average annual gross growth carbon in the merchantable bole of sawtimber trees, in short tons, on forest land.
1606	Average annual gross growth carbon in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
1607	Average annual gross growth carbon in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in short tons, on timberland.
1608	Average annual gross growth carbon in the sawlog of sawtimber trees, in short tons, on timberland.
1609	Average annual gross growth carbon in the merchantable bole above the sawlog of sawtimber trees, in short tons, on timberland.
1610	Average annual gross growth carbon in the merchantable bole of sawtimber trees, in short tons, on timberland.
1611	Average annual gross growth carbon aboveground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
1612	Average annual gross growth carbon aboveground of growing-stock trees (at least 5 inches d.b.h.), in short tons, on forest land.
1613	Average annual gross growth carbon aboveground of sawtimber trees, in short tons, on forest land.
1614	Average annual gross growth carbon aboveground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.
1615	Average annual gross growth carbon aboveground of growing-stock trees (at least 5 inches d.b.h.), in short tons, on timberland.
1616	Average annual gross growth carbon aboveground of sawtimber trees, in short tons, on timberland.
1617	Average annual gross growth carbon belowground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
1618	Average annual gross growth carbon belowground of growing-stock trees (at least 5 inches d.b.h.), in short tons, on forest land.
1619	Average annual gross growth carbon belowground of sawtimber trees, in short tons, on forest land.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
1620	Average annual gross growth carbon belowground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.
1621	Average annual gross growth carbon belowground of growing-stock trees (at least 5 inches d.b.h.), in short tons, on timberland.
1622	Average annual gross growth carbon belowground of sawtimber trees, in short tons, on timberland.
1623	Average annual gross growth carbon in the stump of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
1624	Average annual gross growth carbon in the stump of growing-stock trees (at least 5 inches d.b.h.), in short tons, on forest land.
1625	Average annual gross growth carbon in the stump of sawtimber trees, in short tons, on forest land.
1626	Average annual gross growth carbon in the stump of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
1627	Average annual gross growth carbon in the stump of growing-stock trees (at least 5 inches d.b.h.), in short tons, on timberland.
1628	Average annual gross growth carbon in the stump of sawtimber trees, in short tons, on timberland.
1629	Average annual gross growth carbon in the top and limbs of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
1630	Average annual gross growth carbon in the top and limbs of growing-stock trees (at least 5 inches d.b.h.), in short tons, on forest land.
1631	Average annual gross growth carbon in the top and limbs of sawtimber trees, in short tons, on forest land.
1632	Average annual gross growth carbon in the top and limbs of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
1633	Average annual gross growth carbon in the top and limbs of growing-stock trees (at least 5 inches d.b.h.), in short tons, on timberland.
1634	Average annual gross growth carbon in the top and limbs of sawtimber trees, in short tons, on timberland.
2201	Average annual net change volume in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in cubic feet, on forest land.
2202	Average annual net change volume in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in cubic feet, on forest land.
2203	Average annual net change volume in the sawlog of sawtimber trees, in board feet (International 1/4-inch rule), on forest land.
2204	Average annual net change volume in the sawlog of sawtimber trees, in cubic feet, on forest land.
2205	Average annual net change volume in the merchantable bole above the sawlog of sawtimber trees, in cubic feet, on forest land.



Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
2206	Average annual net change volume in the merchantable bole of sawtimber trees, in cubic feet, on forest land.
2207	Average annual net change volume in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in cubic feet, on timberland.
2208	Average annual net change volume in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in cubic feet, on timberland.
2209	Average annual net change volume in the sawlog of sawtimber trees, in board feet (International 1/4-inch rule), on timberland.
2210	Average annual net change volume in the sawlog of sawtimber trees, in cubic feet, on timberland.
2211	Average annual net change volume in the merchantable bole above the sawlog of sawtimber trees, in cubic feet, on timberland.
2212	Average annual net change volume in the merchantable bole of sawtimber trees, in cubic feet, on timberland.
2301	Average annual net change biomass in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
2302	Average annual net change biomass in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in short tons, on forest land.
2303	Average annual net change biomass in the sawlog of sawtimber trees, in short tons, on forest land.
2304	Average annual net change biomass in the merchantable bole above the sawlog of sawtimber trees, in short tons, on forest land.
2305	Average annual net change biomass in the merchantable bole of sawtimber trees, in short tons, on forest land.
2306	Average annual net change biomass in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
2307	Average annual net change biomass in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in short tons, on timberland.
2308	Average annual net change biomass in the sawlog of sawtimber trees, in short tons, on timberland.
2309	Average annual net change biomass in the merchantable bole above the sawlog of sawtimber trees, in short tons, on timberland.
2310	Average annual net change biomass in the merchantable bole of sawtimber trees, in short tons, on timberland.
2311	Average annual net change biomass aboveground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
2312	Average annual net change biomass aboveground of growing-stock trees (at least 5 inches d.b.h.), in short tons, on forest land.
2313	Average annual net change biomass aboveground of sawtimber trees, in short tons, on forest land.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
2314	Average annual net change biomass aboveground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.
2315	Average annual net change biomass aboveground of growing-stock trees (at least 5 inches d.b.h.), in short tons, on timberland.
2316	Average annual net change biomass aboveground of sawtimber trees, in short tons, on timberland.
2317	Average annual net change biomass belowground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
2318	Average annual net change biomass belowground of growing-stock trees (at least 5 inches d.b.h.), in short tons, on forest land.
2319	Average annual net change biomass belowground of sawtimber trees, in short tons, on forest land.
2320	Average annual net change biomass belowground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.
2321	Average annual net change biomass belowground of growing-stock trees (at least 5 inches d.b.h.), in short tons, on timberland.
2322	Average annual net change biomass belowground of sawtimber trees, in short tons, on timberland.
2323	Average annual net change biomass in the stump of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
2324	Average annual net change biomass in the stump of growing-stock trees (at least 5 inches d.b.h.), in short tons, on forest land.
2325	Average annual net change biomass in the stump of sawtimber trees, in short tons, on forest land.
2326	Average annual net change biomass in the stump of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
2327	Average annual net change biomass in the stump of growing-stock trees (at least 5 inches d.b.h.), in short tons, on timberland.
2328	Average annual net change biomass in the stump of sawtimber trees, in short tons, on timberland.
2329	Average annual net change biomass in the top and limbs of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
2330	Average annual net change biomass in the top and limbs of growing-stock trees (at least 5 inches d.b.h.), in short tons, on forest land.
2331	Average annual net change biomass in the top and limbs of sawtimber trees, in short tons, on forest land.
2332	Average annual net change biomass in the top and limbs of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
2333	Average annual net change biomass in the top and limbs of growing-stock trees (at least 5 inches d.b.h.), in short tons, on timberland.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
2334	Average annual net change biomass in the top and limbs of sawtimber trees, in short tons, on timberland.
2601	Average annual net change carbon in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
2602	Average annual net change carbon in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in short tons, on forest land.
2603	Average annual net change carbon in the sawlog of sawtimber trees, in short tons, on forest land.
2604	Average annual net change carbon in the merchantable bole above the sawlog of sawtimber trees, in short tons, on forest land.
2605	Average annual net change carbon in the merchantable bole of sawtimber trees, in short tons, on forest land.
2606	Average annual net change carbon in the merchantable bole of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
2607	Average annual net change carbon in the merchantable bole of growing-stock trees (at least 5 inches d.b.h.), in short tons, on timberland.
2608	Average annual net change carbon in the sawlog of sawtimber trees, in short tons, on timberland.
2609	Average annual net change carbon in the merchantable bole above the sawlog of sawtimber trees, in short tons, on timberland.
2610	Average annual net change carbon in the merchantable bole of sawtimber trees, in short tons, on timberland.
2611	Average annual net change carbon aboveground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
2612	Average annual net change carbon aboveground of growing-stock trees (at least 5 inches d.b.h.), in short tons, on forest land.
2613	Average annual net change carbon aboveground of sawtimber trees, in short tons, on forest land.
2614	Average annual net change carbon aboveground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.
2615	Average annual net change carbon aboveground of growing-stock trees (at least 5 inches d.b.h.), in short tons, on timberland.
2616	Average annual net change carbon aboveground of sawtimber trees, in short tons, on timberland.
2617	Average annual net change carbon belowground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on forest land.
2618	Average annual net change carbon belowground of growing-stock trees (at least 5 inches d.b.h.), in short tons, on forest land.
2619	Average annual net change carbon belowground of sawtimber trees, in short tons, on forest land.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
2620	Average annual net change carbon belowground of trees (at least 1 inch d.b.h./d.r.c.), in short tons, on timberland.
2621	Average annual net change carbon belowground of growing-stock trees (at least 5 inches d.b.h.), in short tons, on timberland.
2622	Average annual net change carbon belowground of sawtimber trees, in short tons, on timberland.
2623	Average annual net change carbon in the stump of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
2624	Average annual net change carbon in the stump of growing-stock trees (at least 5 inches d.b.h.), in short tons, on forest land.
2625	Average annual net change carbon in the stump of sawtimber trees, in short tons, on forest land.
2626	Average annual net change carbon in the stump of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
2627	Average annual net change carbon in the stump of growing-stock trees (at least 5 inches d.b.h.), in short tons, on timberland.
2628	Average annual net change carbon in the stump of sawtimber trees, in short tons, on timberland.
2629	Average annual net change carbon in the top and limbs of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
2630	Average annual net change carbon in the top and limbs of growing-stock trees (at least 5 inches d.b.h.), in short tons, on forest land.
2631	Average annual net change carbon in the top and limbs of sawtimber trees, in short tons, on forest land.
2632	Average annual net change carbon in the top and limbs of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
2633	Average annual net change carbon in the top and limbs of growing-stock trees (at least 5 inches d.b.h.), in short tons, on timberland.
2634	Average annual net change carbon in the top and limbs of sawtimber trees, in short tons, on timberland.
2635	Average annual net growth biomass aboveground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
2636	Average annual net growth biomass aboveground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
2637	Average annual mortality biomass aboveground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
2638	Average annual mortality biomass aboveground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
2639	Average annual net growth biomass belowground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
2640	Average annual net growth biomass belowground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
2641	Average annual mortality biomass belowground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
2642	Average annual mortality biomass belowground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
2643	Average annual net growth carbon aboveground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
2644	Average annual harvest removals carbon belowground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
2645	Average annual harvest removals carbon belowground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
2646	Average annual net growth carbon aboveground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
2647	Average annual net growth carbon belowground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
2648	Average annual net growth carbon belowground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
2649	Average annual harvest removals biomass aboveground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
2650	Average annual harvest removals biomass aboveground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
2651	Average annual harvest removals biomass belowground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
2652	Average annual gross growth biomass aboveground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
2653	Average annual gross growth biomass aboveground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
2654	Average annual harvest removals biomass belowground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
2655	Average annual other removals carbon aboveground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
2656	Average annual other removals carbon aboveground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
2657	Average annual other removals carbon belowground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
2658	Average annual mortality carbon aboveground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
2659	Average annual mortality carbon aboveground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
2660	Average annual other removals carbon belowground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
2661	Average annual gross growth biomass belowground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
2662	Average annual gross growth biomass belowground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
2663	Average annual mortality carbon belowground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
2664	Average annual mortality carbon belowground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
2665	Average annual other removals biomass above ground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
2666	Average annual gross growth carbon aboveground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
2667	Average annual other removals biomass aboveground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland
2668	Average annual other removals biomass belowground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
2669	Average annual other removals biomass belowground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
2670	Average annual removals carbon aboveground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land
2671	Average annual removals carbon aboveground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
2672	Average annual removals carbon belowground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
2673	Average annual removals carbon belowground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
2674	Average annual removals biomass aboveground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
2675	Average annual removals biomass aboveground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland
2676	Average annual removals biomass belowground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land
2677	Average annual removals biomass belowground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
2678	Average annual harvest removals carbon aboveground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
2679	Average annual harvest removals carbon aboveground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
2680	Average annual net change biomass aboveground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
2681	Average annual net change biomass aboveground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
2682	Average annual net change biomass belowground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.

Attribute Number (ATTRIBUTE_NBR)	Attribute Description (ATTRIBUTE_DESCR)
2683	Average annual net change biomass belowground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
2684	Average annual net change carbon aboveground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
2685	Average annual gross growth carbon aboveground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
2686	Average annual net change carbon aboveground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
2687	Average annual gross growth carbon belowground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
2688	Average annual gross growth carbon belowground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.
2689	Average annual net change carbon belowground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on forest land.
2690	Average annual net change carbon belowground of trees (at least 5 inches d.b.h./d.r.c.), in short tons, on timberland.

