

# NEW FEATURES ADDED TO EVALIDATOR: RATIO ESTIMATION AND COUNTY CHOROPLETH MAPS

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Patrick D. Miles and Mark H. Hansen<sup>1</sup>

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**Abstract.**—The EVALIDator Web application, developed in 2007, provides estimates and sampling errors for many user selected forest statistics from the Forest Inventory and Analysis Database (FIADB). Among the statistics estimated are forest area, number of trees, biomass, volume, growth, removals, and mortality. A new release of EVALIDator, developed in 2012, has an option to select two statistics and generate a ratio estimate of the pair. The new feature can estimate statistics such as volume or growth per acre or the growth to removals ratio. Also, the program now makes county choropleth maps of all estimates. We provide information on the data and methods used along with sample output from a simple query that demonstrates these new features.

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## INTRODUCTION

The Forest Inventory and Analysis (FIA) Program of the U.S. Forest Service monitors the status and trends of the Nation's forest resources. FIA delivers data, information, and knowledge to the public via a multitude of products, including online estimation tools. FIA's EVALIDator Web application (<http://apps.fs.fed.us/Evalidator/tmattribute.jsp>) can produce estimates for 125 attributes falling into the 12 groups depicted in Table 1. Groups are based on subsets of inventory plots, where each subset is a valid sample and the attributes in the group are observed on all of the plots in the subset. FIA uses the term "evaluation" for these subsets of plots and the associated Phase 1 stratification that provides the sample base for the estimation of specific attributes. Area and volume estimates, for example, are based on the plots measured in the current inventory; removals estimates are based on a smaller set of plots measured in the previous inventory and then measured again in the current inventory. The EVAL\_TYP column in

Table 1 identifies the evaluation used to generate the estimates. Down woody material estimates are based on a small subset of plots on which forest health monitoring (Phase 3) measurements were taken. The right column in this table shows the number of plots in each evaluation (for Minnesota, as an example) where a non-zero value for the first attribute in the group was observed in the specified inventory and provides information on the intensity of the inventory with respect to various attributes.

In addition to the ability to produce population estimates with sampling errors for user specified inventories, the EVALIDator program has the flexibility to place restrictions on the estimates and breakdowns of the estimates into user defined tables. Users can also obtain the Oracle SQL code that produces the estimates for further modification.

## METHODS

EVALIDator is flexible with many options selected via radio buttons and dropdown lists. In this new version, once the user selects the attribute to be estimated, there is now a radio button to select between population estimate (default) and ratio estimate. When ratio estimate is selected, the attribute

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<sup>1</sup> Research Forester (PDM), U.S. Forest Service, Northern Research Station, 1992 Folwell Ave., St. Paul, MN 55108; Research Associate (MHH), University of Minnesota. PDM is corresponding author: to contact, call 651-649-5146 or email at [pmiles@fs.fed.us](mailto:pmiles@fs.fed.us).

**Table 1.—The EVALIDator program can produce reports for these types of estimates**

<b>EVAL_TYP</b>	<b>ESTIMATE GROUP</b>	<b>Non-zero plots Minnesota 2011</b>
EXPALL	Area of sampled land	17,711
EXPCURR	Area of forest land or timberland	6,208
EXPVOL	# trees, # seedlings, volume, biomass or carbon on forest land	6,089
EXPVOL	# trees, # seedlings, volume, biomass or carbon on timberland	5,751
EXPGROW	Average annual net growth on forest land	5,705
EXPGROW	Average annual net growth on timberland	5,459
EXPMORT	Average annual mortality on forest land	3,296
EXPMORT	Average annual mortality on timberland	3,140
EXPREMV	Average annual removals on forest land	544
EXPREMV	Average annual removals on timberland	605
EXPDWM	Down woody material (#, vol., biomass or carbon) on forest land	xxx
EXPDWM	Down woody material (#, vol., biomass or carbon) on timberland	xxx

initially selected will be the numerator, and a second dropdown list of attributes appears for the user to select the denominator. The user then selects the evaluation(s) (identified by state and inventory years) to be included in the estimate and a classification variable used to break down the estimate in the final table. For ratio estimation, an additional radio button determines how to apply the classification variable to the table of estimates, either to both numerator and denominator (default) or to the numerator but the total of all classes is used for the denominator in every class. For ratio estimates, there are two options (population estimates have just one) for the user to put more restrictions on the estimates through additions to the “where” clause. One option is applied to both the numerator and denominator and the other is applied just to the numerator. Once all of these selections have been made, the program will generate the estimates requested in a table and a county choropleth map will be generated if county was selected as a classification variable. There is an option to generate a second table that contains estimates and their associated sampling errors. All of the estimates of ratios and their associated sampling errors are generated following the stratified ratio-of-means estimators (Bechtold and Patterson 2005).

Users of the ratio estimates produced by EVALIDator need to be aware of three issues. First, ratio estimation requires that the same evaluation be used to estimate both the numerator and denominator. This reduces the evaluation to the smaller of the two. For example, when estimating net growth per acre of forest land, the area of forest land estimate is based on a smaller sample of plots than is normally used to estimate forest area. For this ratio, only those plots measured at two points in time (the EXPGROW evaluation) are used to estimate both the numerator and denominator. Because this estimate of forest land area is based on a somewhat different sample, it probably will not match other estimates of forest land area produced by EVALIDator or those published by FIA.

The second issue is that ratio estimates of all growth, removals, or mortality (GRM) attributes are based only on the components associated with no change in condition classification of the land. These GRM estimates exclude diversions and reversions and the area associated with the change in classification. Thus, the area estimate in the denominator of the net growth per acre of forest land estimate is an estimate of forest land area that was forest at the time of the first measurement and that remained forest at the

time of the second measurement. The numerator and denominator estimates in the ratios usually will not match population estimates obtained from EVALIDator or those published in most FIA reports because those include the diversion and reversion components and associated areas.

The third issue relates to how restrictions on the numerator and denominator are applied and how breakdowns in the table of ratio estimates are made when ratio estimates are computed. Table 2 identifies the type of ratio estimates and classification variables that can be derived using EVALIDator and provides information as to whether the classification variable is derived from data collected during the current inventory or, in the case of GRM, from information collected during the previous inventory (Note: using the previous or current classification variable for GRM ratio estimates may not be appropriate for all analyses). In some cases ratio estimates are not logical and the program will not allow the user to produce

an estimate. For example, although it is possible to compute acres of timberland per cubic foot of volume, it is not logical to report these estimates by a classification such as species because area cannot be classified by species. The EVALIDator program will not allow the user to select a tree classification variable when an area estimate has been selected for the numerator. These situations are labeled as “not possible” in Table 2.

## RESULTS

Partial output from a simple volume per acre retrieval is presented in Table 3. In this example the user selected “Net volume of live trees in cubic feet on forest land” as the numerator, “Area of forest land, in acres” as the denominator, the 2011 inventories of Minnesota and Wisconsin as the geographic area, and “County code and name” as the classification variable. The EVALIDator first generates the estimates in Table 3 and then, if desired, may also generate more

**Table 2.—Limitations on stand and tree level ratio estimates in EVALIDator**

<b>Stand or Tree Classification Variable</b>	<b>Numerator Estimate</b>	<b>Denominator Estimate</b>	<b>Classification variable is derived from current or previous inventory</b>	<b>Denominator can be based on class total rather than grand total</b>
Stand	Area	Area	current	YES
Stand	Area	Volume	current	YES
Stand	Area	GRM	previous	YES
Stand	Volume	Area	current	YES
Stand	Volume	Volume	current	YES
Stand	Volume	GRM	previous	YES
Stand	GRM	Area	previous	YES
Stand	GRM	Volume	previous	YES
Stand	GRM	GRM	previous	YES
Tree	Area	Area	not possible <sup>a</sup>	not possible <sup>a</sup>
Tree	Area	Volume	not possible <sup>a</sup>	not possible <sup>a</sup>
Tree	Area	GRM	not possible <sup>a</sup>	not possible <sup>a</sup>
Tree	Volume	Area	current	NO
Tree	Volume	Volume	current	YES
Tree	Volume	GRM	current	YES
Tree	GRM	Area	previous	NO
Tree	GRM	Volume	previous	YES
Tree	GRM	GRM	previous	YES

<sup>a</sup>Not possible - Tree classification variable cannot be applied to area estimate.

**Table 3.—All live volume per acre of forest land by county, Minnesota and Wisconsin 2011**

<b>County Code and Name</b>	<b>Ratio Estimate (cf/acre)</b>	<b>Estimate of Numerator (cubic feet)</b>	<b>Estimate of Denominator (acres)</b>
Total	1,244.22	42,739,454,212	34,350,476
27001 Aitkin	1,114.52	922,606,356	827,809
27003 Anoka	1,402.15	91,676,643	65,383
27005 Becker	1,289.74	430,711,212	333,953
...	...	...	...

statistics that include sampling errors, variances, and number of plots used in the estimate. “County code and name” was selected as the classification variable so the user also has the option of producing a county choropleth map as depicted in Figure 1.

## DISCUSSION

The EVALIDator program continues to evolve to meet user needs. This latest version introduces two new features, ratio estimates and county choropleth maps. Recent changes to the FIADB have also made it possible to generate population estimates for down woody material. The ability to produce ratio

estimates for down woody material was not included in the EVALIDator program due to a paucity of data for down woody estimates. As the FIADB evolves, additional reporting of forest health monitoring estimates will be added to the EVALIDator program.

## LITERATURE CITED

Bechtold, W.A.; Patterson, P.L., eds. 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.

The content of this paper reflects the views of the author(s), who are responsible for the facts and accuracy of the information presented herein.

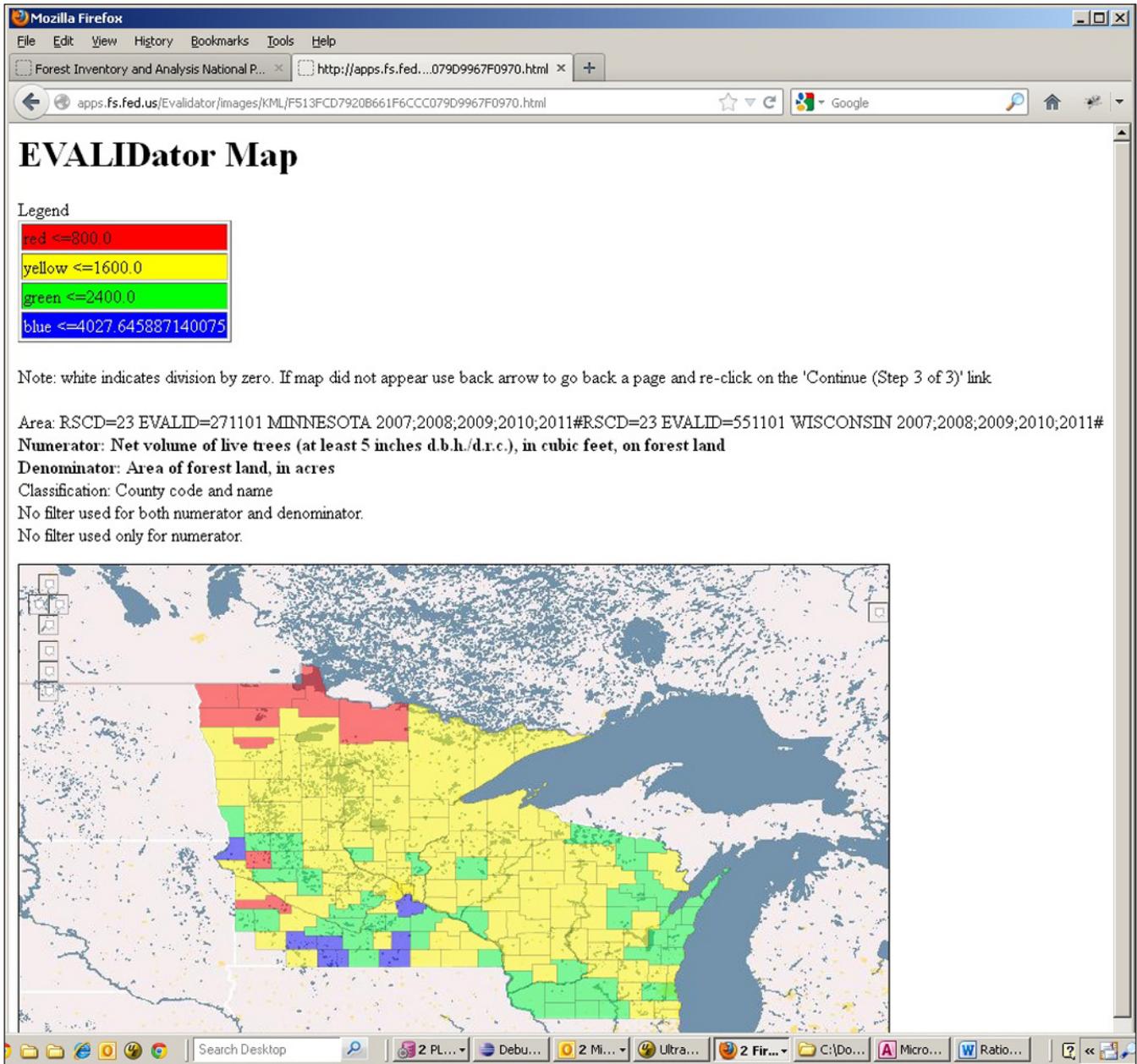


Figure 1.—All live volume per acre of forest land by county, Minnesota and Wisconsin 2011.