Vegetation Resources Inventory Localization Procedures

Prepared by
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For further information about the Resources Information Standards Committee, please access the RISC website at: http://srmwww.gov.bc.ca/risc/.

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1. Introduction

Inventory localization is a set of tools for gathering information to update an existing inventory. It addresses one of the recommendations made by the Vegetation Inventory Working Group (VIWG). In its 1995 report titled, *Final Report from the Vegetation Inventory Working Group on a Proposed New Inventory*, the VIWG recommended that

> "The inventory should be flexible enough to include additional information gathered at a later date." (Recommendation #52)

In the past, a process called field visitation performed this function. This process had two objectives: 1) to improve the accuracy of the inventory at the Timber Supply Area (TSA) level; and 2) to encourage the Forest District staff[1] (FDS) to spend more time in the field keeping current with the state of the inventory.

In this old process, more emphasis was placed on fulfilling Objective #2. Furthermore, Objective #1 was too generalized and ambiguous. In the end this process was not effective, although there was general recognition that it could be a very useful tool in improving inventory accuracy. From an operational point of view, the accuracy of the inventory information is more critical in areas targeted for short-term wood supply or for specific strata or watersheds where a need to improve accuracy has been identified.

A new process called inventory localization was initiated to replace field visitation. This new program was to be focused on improving the inventory at the watershed (landscape) level or in specific strata. The key factor that distinguishes inventory localization from the regular full Vegetation Resources Inventory (VRI) is scale. The data collection exercise is considered to be localization if the targeted area is a few polygons, one or two mapsheets or a stratum within a management unit.

1.1 Definition

Inventory localization is a process by which existing inventory information can be augmented or localized and, by so doing, improves the accuracy of the inventory. To "localize" is to improve the precision of the inventory for a specific geographic area, which may be contiguous (e.g., watershed), or non-contiguous (e.g., individual polygons with a target leading species).

The inventory localization process includes those techniques for filling in missing data or changing information in the official inventory database based on:

- ad hoc field observations by district staff;
- re-photo interpretation; and
- sub-unit inventories for special purposes.

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[1] Each forest district has an officer designated as the contact person for inventory issues. The title of the designated individual varies from district to district.

It also involves those techniques for bringing in external or new information—information that was not part of the regular inventory—via Geographic Information System (GIS) to the inventory database. External data sources include silviculture surveys and special (sub-unit) inventories.

1.2 Premise

The premise of inventory localization is that a base inventory exists and that the localization will not cause bias in the overall inventory unit (e.g., TSA) inventory.

1.3 Objectives

The objectives of the inventory localization process can be stated in general terms as:

1. To provide more accurate polygon information for strata or watersheds where problems have been identified.

2. To provide operational level information when such information is required.

3. To improve species composition, height and age attributes for target polygons.

4. To provide the FDSs with opportunities to improve their knowledge of the composition and complexity of the vegetation cover in their area of jurisdiction.

These objectives, which were based on identified needs of inventory information users[2], give the inventory localization program better focus, but also expand its role to include providing data for planning purposes at the watershed and landscape levels. Funding for the program should depend on business needs.

1.4 Project Initiation

The need for inventory localization arises when users of the inventory information at the district level become aware of a consistent and persistent lack of accuracy in portions of the inventory. In most cases, the issue is brought to the attention of the FDS. The FDS then makes the decision on what course of action should be taken.

The FDS should document and catalog all reports of inventory inaccuracy. Proper documentation of inventory information complaints is essential to the success of any remedial measures that may be developed. Without a concise definition of the issues, the localization objectives cannot be met.

1.5 Localization Options

There are three options for inventory localization:

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[2] These objectives were developed after a meeting between district, region and Resources Inventory Branch staff at the Vernon Inventory Workshop in 1995.

1. Ad hoc observations and correction of individual polygon attributes without extrapolation to other polygons.
2. New photo interpretation of one or two map sheets.
3. Sub-unit inventories to adjust a stratum across the entire inventory unit.

These options provide data to suit different situations; therefore, the information collected for each option may have limitations as to what it can be used for and how it is processed during incorporation into the official inventory files. During the normal course of business, a district FDS may employ one or more of the options depending on their needs and the local resources available.

Sections 2 to 4 of this manual outline the procedures for using each of the three options and explain under what circumstances each should be used.

1.6 Data Management

Data from inventory localization are incorporated into the official vegetation inventory database through a process called statistical re-adjustment. Statistical re-adjustment involves adding newer information (as estimates) to all or some of the Phase I estimates, and then applying existing or new regression adjustments to the newer information (Figure 1).

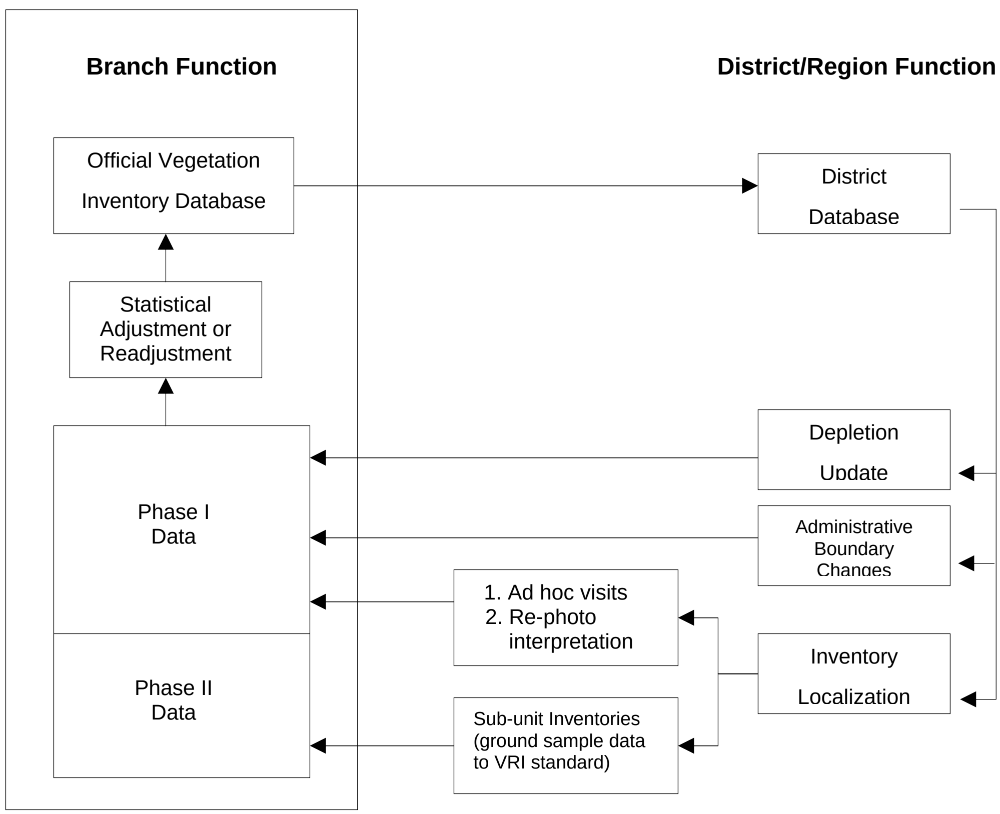

Figure 1. Vegetation inventory data update process.

All the inventory localization transactions (except the ground sampling data) will be treated as estimates (Phase I). Any modifications to the original photo-interpreted or adjusted database through inventory localization will be filed in the "unadjusted" database until the regular or requested re-adjustment is conducted. The district inventory officer (with the guidance of Resources Inventory statistical staff) will assign a reliability rating to the attributes which are modified through localization. These attributes will be adjusted less during the next round of re-adjustment.

The data will be held at the district within the “raw database” until a scheduled or requested adjustment is conducted. The re-adjustment process will take into account the reliability rating in the new information. It is expected to be done once every year, or on request by the district. The ground sampling data may be included in the Phase II database and used to derive new ratio or regression relationships if consistent with the VRI standards.

The district can change the official VRI file through inventory localization to suit their own purposes, such as the ability to identify and locate polygons with specific resource attributes for various applications. However, the file changed by the district cannot be used for timber supply analysis until the file has gone through the formal statistical re-adjustment process (see Section 5).

1.7 Impact

Just like regular car maintenance, inventory localization extends the useful life of the inventory and reduces the need for re-inventories. In the past, re-inventories were conducted every 10 to 15 years. With inventory localization, re-inventories may occur only every 20-25 years, if at all. More importantly, the database is kept more current and is customized for the users.

2. Localization by Ad-Hoc Observations

2.1 Purpose

The purpose of ad-hoc observations is to collect data on species composition, stand height, age and density, and to allow the alteration of these attributes on an individual polygon. The districts and the regions will collect the data and make interim alterations. The Resources Inventory Branch will adjust the data during the statistical re-adjustment process to create an official database.

2.2 Example Situations

Quite often silviculture and planning staff in the district conducting harvesting reconnaissance surveys for the British Columbia Timber Sales (BCTS), and licensee staff using ' forest cover maps, encounter polygons where there are obvious map label errors. It should be possible for these staff to collect sufficient information in the field to correct the map label information on specific polygons.

With the ad-hoc method, information is gathered mostly by inventory information clients who happen to be working in an area. If they find a discrepancy and collect some data, it may be accepted, provided they follow some basic principles in data collection. The FDSs may also collect such data if they encounter inaccurate inventory information. Any corrections are restricted to the polygons that are visited on the ground.

Under the ad-hoc approach, a district FDS will provide tools (maps, forms, etc.) and data collection instructions to anyone willing to collect data. The instructions should be simple and straightforward and should require minimum fieldwork effort. The individual collecting the data and the FDS should sign-off the new data to give it credence. The FDS should also make an effort to randomly check the accuracy of the incoming ad-hoc data.

2.3 Field Procedures

Collecting ad-hoc data involves establishing ground calls. Ground calls are ground plots that are subjectively established in the "typical" or "representative" locations in a polygon for calibrating photo interpreters. The ground calls are established as follows:

1. Use a photo or a map to confirm the identity of the questionable polygon.
2. When navigation information is obtained, measure and record the bearing of the starting point to a recognizable location on an access route and include it as part of the collected data.
3. Establish four prism plot locations in a square pattern within the target polygon. The distance between prism plots should be at least 25 m apart.
4. Provide the reasons for choosing a given starting point within a polygon of interest.

At each prism plot location:

1. Use variable radius plots with basal area factor (BAF) selected to include 6-8 live trees in each plot. Once a BAF is determined, the same BAF must be used at all locations within the polygon.

2. Measure diameter to breast height (DBH) on all trees, live and dead, to a minimum of 4 cm.

3. Measure or estimate the heights of all trees.

4. Measure DBH, height and age of the largest DBH tree for the leading species within a 5.64 m plot based on the definition provided in the VRI standards and procedures.

5. Record tree species for each tree.

6. All measurements are to be recorded in the appropriate columns of the VRI cards.

2.4 Data Processing

The field data is summarized to provide stand average and per-hectare values, and is used to correct the polygon attributes. The attribute data collected will be treated as unadjusted estimates, and the correction based on these ad-hoc data will affect only the polygons from which the observations were made. A high confidence index will be assigned to the new attributes. There will be no extrapolation of the results to other polygons. These indices currently range from one to nine, a nine being high reliability and a one being very low reliability.

3. Localization by Re-Photo Interpretation

3.1 Purpose

The purpose of conducting new photo interpretation is to redefine the vegetation cover strata when map label information and polygon boundaries are no longer accurate. Some ground data collection may be necessary to obtain calibration information.

3.2 Example Situations

During regular inventory update, an FDS may identify a stratum that was consistently miss-typed or a stratum for which attributes were consistently under- or over-estimated. The problem may have arisen due to poor ground calibration by one interpreter. Procedures should be available to allow the FDS to collect sufficient data to correct the problem. In this option, the problem is perceived to be more extensive than in the ad hoc single-polygon situation. A quick and inexpensive solution is required. The FDS should do the re-photo interpretation if possible. Contract work should not be necessary.

3.3 Field Procedures

This option is appropriate if the area affected is small—say, one or two map sheets. Under these circumstances, the FDS should take a week or two to conduct ground calls or air calls on 10 to 30 randomly selected polygons from the affected stratum. Air calls involve aerial descriptions of polygons using a helicopter and, sometimes, landing to subjectively establish ground plots in the "representative" locations in a polygon (similar to ground calls). The comparison of the information from ground or air calls to the map label data will confirm if indeed a problem exists. If so, then a blanket re-photo interpretation of the target attributes for all the polygons in the stratum would be done using the information from the established ground calls and the new ground or air calls.

Procedures for re-photo interpretation are as follows:

1. Obtain a list of all the polygons belonging to the affected stratum.
2. Use PPSWR to select the desired number of sample polygons. If stratification is required, volume or basal area sub-strata may be created to improve the efficiency of the design. Refer to the VRI manual *Preparing a Sampling Plan for Ground Sampling* for the polygon selection methodology.
3. Identify the selected polygons on maps and assess accessibility to each of them.
4. If some polygons require helicopter access, plan the work to ensure that two or three polygons can be visited in one day.
5. For the road access polygons, plan to visit two or more per day until the work is completed.
6. Establish ground calls or air calls. The procedures for ground calls are outlined in Section 2.3. The procedures for air calls are described below.

7. Compare the new information to the existing map labels and decide whether re-photo interpretation is needed.
8. Conduct re-photo interpretation of all the polygons on the target map sheet.

The procedures for air calls are as follows (refer to air call procedures for more details):

1. Pre-designate field calibration locations and consider access issues, permission (if entering private land/parks) and equipment, as specified in the air call procedures.
2. Observe the air calibration points through a stereoscope and make preliminary estimates for the attributes to be collected.
3. Prepare a flight plan. Air calls should be flown in such a way as to cover as much of the polygon as is feasible.
4. Conduct air calls. All information collected is to be recorded on the appropriate air call form. Air call information includes general data, tree specific data, and non-tree data. Occasionally, set the helicopter on the ground to collect ground information to calibrate the air estimation.
5. Transfer the air call information to the reverse side of the appropriate aerial photos. The air calls are to be referenced to Geographic Positioning System (GPS) locations.

3.4 Data Processing

The field data is summarized to provide stand average and per-hectare values. These data are used to evaluate the existing map labels and to re-calibrate the photo-interpreter. The photo interpreter updates all the polygon labels and areas in the map sheet. A reliability rating is assigned to each attribute and polygon depending on the quality of calibration information used to make the attribute estimates.

4. Localization by Sub-unit Inventories

4.1 Purpose

The purpose of sub-unit inventories is to collect detailed ground-based information to facilitate the adjustment of a large, management unit-wide stratum for special purposes, such as allowable annual cut (AAC) determination. The planning for sub-unit inventories will be part of the overall VRI district plan.

4.2 Example Situations

Sub-unit inventories are created within the district to control sampling error and sampling intensity for specific attributes to meet particular stakeholder business needs. The sub-units may be portions of the district or specific forest types. For example, as a result of a timber supply review (TSR), the Chief Forester may require that more information be collected on a specific stratum within a management unit to assist in AAC decision-making at a subsequent time. The dense pine study undertaken in the Boundary Forest District is a good example of a sub-unit inventory. The objectives of the dense pine study were to check the quality of the dense pine inventory, to provide information to support the development of a management strategy to use this wood, and to investigate opportunities for increasing its contribution to the timber supply.

4.3 Inventory Plan

The information collected during sub-unit inventories usually has significant long-term implications. For this reason, a high degree of statistical rigor is required to ensure that mistakes are not made. An inventory plan, including a detailed sampling plan, is required prior to initiation of the fieldwork. The inventory plan typically consists of the following elements (refer to VRI sampling plan procedures for more details):

1. Objectives: a statement of the sub-unit inventory objectives indicating the attributes of interest and the target sampling error (and probability) for the key attribute.

2. Target population: a description of the target population and the database for the sub-unit inventory.

3. Sampling unit: a description of the kind of plots to be used (e.g., they could be timber emphasis plots (TEPs) of the VRI.

4. Sample selection: an explanation of how the samples will be selected from the target population. Typically, the samples are selected using the standard sampling with Probability Proportional to size, with replacement (PPSWR) sampling design.

5. Sample size: setting the number of sample plots needed to meet the project objectives.

6. Supporting activities: identify what supporting activities are needed. These include net volume adjustment factor (NVAF) sampling. The NVAF is needed to improve estimates of tree net volume from the net factoring process.

7. Implementation strategy: estimate costs, define roles and responsibilities for sample selection, prepare sample packages, conduct field work and quality assurance, perform data analysis, and provide project coordination.

4.4 Office Preparation and Field Procedures

Typically, the following tasks are carried out in preparation for the fieldwork:

1. Obtain a list of all the polygons belonging to the affected sub-unit.
2. Use PPSWR to select the desired number of sample polygons. If stratification is required, volume or basal area sub-strata may be created to improve the efficiency of the design. Refer to the VRI manual *Preparing a Sampling Plan for Ground Sampling* for the polygon selection methodology.
3. Obtain a pair of stereo aerial photos covering the sample polygons.
4. Determine accessibility of the sample polygons, classifying them as either ground access or helicopter access polygons.
5. For the ground access polygons, identify tie points which will be used as reference for accessing the polygon.
6. For helicopter access polygons, identify potential landing locations.
7. Obtain 1:5,000 or 1:10,000 enlargement maps of the target polygons.
8. Transfer the tie point determined on the photos to the map.
9. Follow the VRI plot establishment and tree measurement procedures as described in the VRI ground sampling manual. During the fieldwork, rigorous quality assurance procedures should be followed to minimize measurement error and to ensure good quality results.

4.5 Data Analysis

The Resources Inventory Branch will compile the data and provide advice on data analysis and reporting. Data analysis will usually be conducted by a contractor. The district staff will be responsible for writing the project report.

If the sub-unit inventory is a timber emphasis inventory, the data analysis procedures should include the following steps:

1. Estimate the sub-unit total volume.
2. Estimate the total area coverage of the attribute of interest.
3. Display and describe the sub-unit volume distribution by piece size or other attribute of interest.
4. Display and describe diameter distributions based on the sample.

5. Adjust polygon attributes and provide the spatial (map) distribution of the sub-unit after adjustment.

For sub-unit inventories, the existing inventory data will usually form the Phase I database. However, new estimates may be required if the existing database is outdated. The collected ground data will form the Phase II database, and the adjustment will occur as proposed in the Vegetation Resources Inventory adjustment process. The ground sampling for adjustment will form the basis for building ratio or regression relationships between the ground measured values and the Phase I estimates for each attribute destined for adjustment. The adjusted data will be merged into the provincial VRI database.

5. Integration of Inventory Localization Data into the Vegetation Inventory File

5.1 Vegetation Inventory File

The Vegetation Inventory File (VIF) is a relational database that will replace the old Forest Inventory Planning (FIP) file. It will consist of unadjusted VRI data as well as data from other sources. The adjusted data from inventory localizations will eventually be added to the VIF. The adjusted and unadjusted data in the VIF will be periodically updated through the statistical re-adjustment process.

5.2 Statistical Re-Adjustment

Statistical re-adjustment is a formal process implemented by the Resources Inventory Branch. It occurs after data collection for updating the inventory for depletion due to harvesting, fire, or pest damage. It will also occur after inventory localization whereby new information is collected to improve the accuracy of the inventory. The essential elements of the statistical re-adjustment process are depicted in Figure 2.

The steps in Figure 2 are described as follows:

Initial Inventory Adjustment

1. New or existing map label attribute data in the vegetation inventory files will be considered to be the Phase I data.
2. The Phase I data are paired with the ground measurements.
3. Regression relationships are developed where possible.
4. The regression equations are applied to the Phase I data to produce the official adjusted vegetation inventory file.

Re-adjustment

5. Periodically, or as required, the official adjusted file is updated by replacing the adjusted values with the newer information from inventory localization and other sources. The updated file is forwarded to the Resources Inventory Branch where it becomes the new Phase I.
6. The re-adjustment process starts by repeating Steps 2 to 5 above.

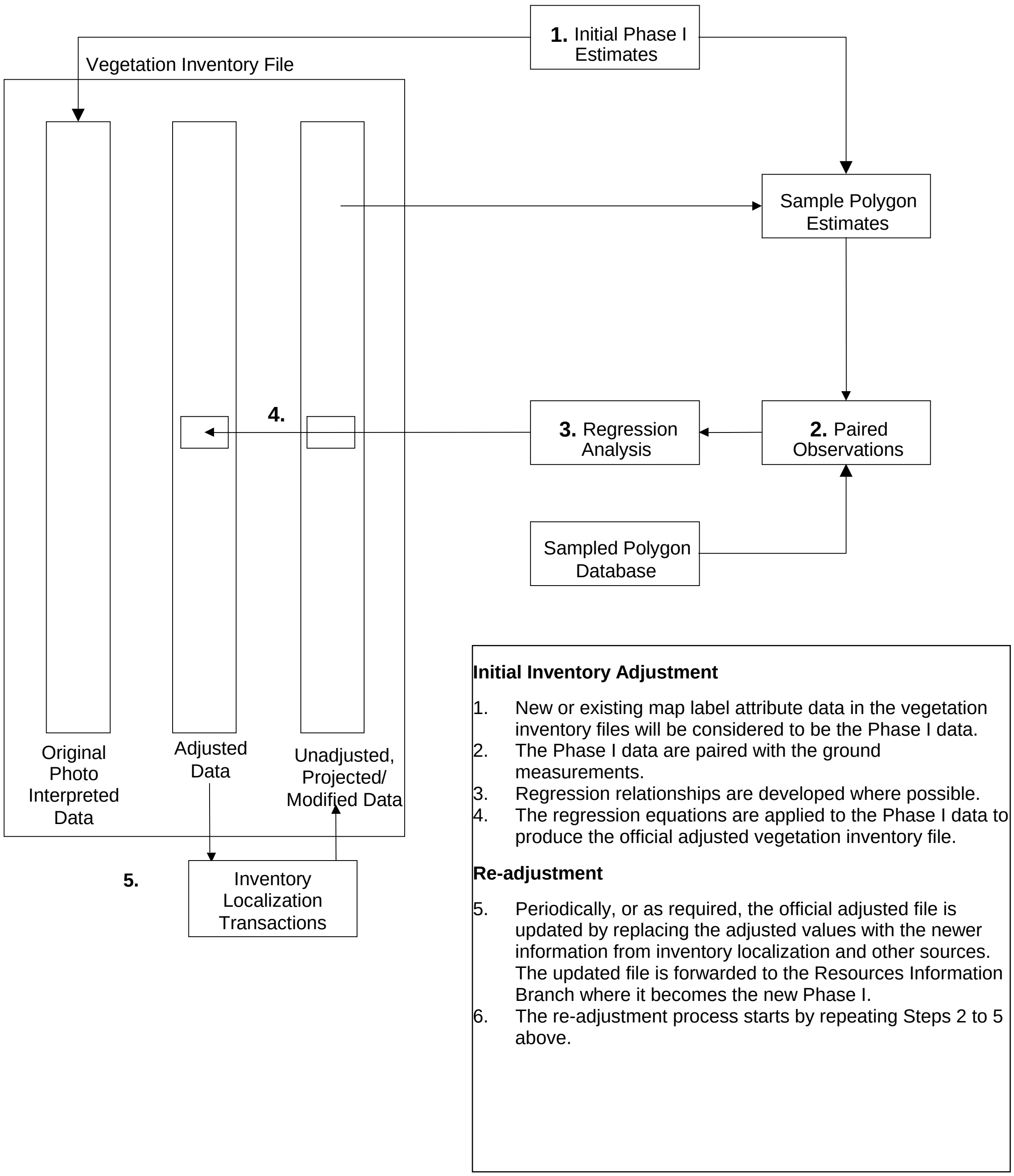

Figure 2. The statistical re-adjustment process.

Note that in the original Phase I, all the inventory localization transactions and all the regression equations will be preserved to allow a check on subsequent inconsistencies. The number of re-adjustments and the reasons for re-adjustment will be tracked to allow data quality control. Note also that if the new ground sample data collected during inventory localization is collected to the new Phase II data standards, it will become part of the Phase II database. The new data for a sub-unit may be combined with the projected initial ground data to form the basis for creating new adjustment factors for that stratum.

5.2 Re-inventory

In the past, inventories were repeated every 10 to 15 years and were called re-inventories. The difference between a re-inventory and inventory localization is that a re-inventory re-evaluates the entire inventory with emphasis on problem areas, while inventory localization evaluates one specific stratum or watershed. In the long run, the re-inventories will no longer be necessary and will be replaced by inventory localization.