Citation for the published paper:
Göran Ståhl, Emil Cienciala, Gherardo Chirici, Adrian Lanz, Claude Vidal, Susanne Winter, Ronald E. McRoberts, Jacques Rondeux, Klemens Schadauer and Erkki Tomppo. (2012) Bridging National and Reference Definitions for Harmonising Forest Statistics. *Forest Science*. Volume: 58, Number: 3, pp 214-223.
http://dx.doi.org/10.5849/forsci.10-067.

Bridging National and Reference Definitions for Harmonising Forest Statistics

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Abstract: Harmonisation is the process of making information and estimates comparable across administrative borders. The degree to which harmonisation succeeds depends on many factors including the conciseness of the definitions, the availability and quality of data, and the methods used to convert an estimate according to a local definition to an estimate according to the reference definition. Harmonisation requires the availability and use of common reference definitions and

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methods for converting from estimates based on national definitions to estimates based on reference definitions. This article focuses on conversion methods which are characterised as ‘bridges’ because they can be seen as means of crossing from islands of local definitions to the mainland of a reference definition. A structured approach is proposed for constructing bridges of three kinds: reductive, neutral, and expansive bridges. A hierarchical decision tree is presented to guide users and to summarise the propositions, and case examples with different types of bridges illustrate the concepts. Although the article addresses harmonisation of forest information, the results are relevant for harmonising a broad variety of area statistics.

Keywords: forest resource assessment, statistics, harmonisation, national forest inventory, standardisation

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Challenges in utilisation of natural resources and mitigation of environmental problems call for increased international collaboration. The response to these challenges is manifested in multilateral agreements such as the United Nations (UN) Framework Convention on Climate Change (UNFCCC 1992), the Convention on Biological Diversity (CBD 2007), the Ministerial Convention on the Protection of Forests in Europe (MCPFE 2003), and the Montréal Process (Montréal Process 2005). These agreements require substantial amounts of information from the parties to assess overall progress, to evaluate compliance with obligations, and to determine next steps within the frameworks of the agreements (e.g., Corona et al., 2002; Corona & Marchetti, 2007, Irland 2010). In this context, meaningful comparisons among parties require that information and estimates be harmonised. For this purpose, common reference definitions generally are proposed, and parties that do not collect data according to these definitions must develop conversion methods. The criteria for a reference definition are given in Vidal et al. (2008). In this context, it should be noted that not only the harmonised estimates as such are important but also the corresponding uncertainty estimates. For example, the agreements under UNFCCC require parties to deliver uncertainty estimates of the reported annual greenhouse gas emissions.

Köhl et al. (2000) distinguish between harmonisation and standardisation. Whereas standardisation requires that all parties use the same definitions, and possibly even identical measurement protocols, harmonisation requires only a final conversion of estimates from the local to the reference definition (Vidal et al., in press). Thus, harmonisation permits parties to use existing time series of data and locally adapted methods, rather than establishing new or parallel data acquisition systems. This freedom is important in times of expanding international information requirements, because construction of standardised protocols for every new agreement would be time consuming, costly, and most likely impossible to achieve. Further, information requirements tend to change over time, and it is often easier for parties to change only the final conversion step than their entire data acquisition protocols. On the other hand, harmonisation may sometimes leave too much freedom to parties with the result that information may be inaccurate and of poor quality, or harmonisation is only partially possible (e.g. FAO 2006); thus, harmonisation is not a solution to all problems related to obtaining comparable information.

Within the area of forest statistics, the UN Food and Agriculture Organisation (FAO) has an important role in proposing common definitions in connection with their global forest resources assessments (e.g. FAO 2001, FAO 2006). These assessments have been conducted in collaboration with countries from all parts of the world, and because they have been conducted at 5-10 year intervals, the process has become an important driver towards global harmonisation of forest statistics. However, the latest report (FAO 2006) indicates that many problems remain to be solved before forest statistics from different countries are truly comparable.

The UNFCCC, with its Kyoto Protocol, has become another important driver towards global harmonisation of information. According to the agreements, information should be provided annually from many different sectors of which one is land use, land-use change, and forestry sector. Cienciala et al. (2008) demonstrate the importance of forest inventory information for this sector and point to promising ongoing harmonisation efforts. Within the framework of the CBD (CBD 2007), the European Environmental Agency (EEA) has coordinated an initiative with the objective of reducing the rate of loss of biodiversity in European forests (EEA, 2008). To evaluate temporal forest biodiversity trends, a set of indicators has been defined (EEA, 2007). Many of the indicators relate to components of forest biodiversity and can be calculated using information already acquired by national forest inventories following successful harmonisation (Winter et al., 2008).

The inventory, monitoring, and assessment working group of the North American Forestry Commission (including Canada, Mexico, and USA) has explored methods for harmonised reporting (McRoberts et al., 2009) by aggregating national forest inventory (NFI) data to the continental level within a broad-scale ecological framework (Gillis et al., 2004). An analysis of the inventory databases of the three countries revealed compatibility among several primary variables including area and stem volume on forest land.

For harmonisation to be successful, several factors must be considered. Firstly, both the local and reference definitions must be concise, so that differences between them are clear. Secondly, local data or information with adequate accuracy must be available. Thirdly, methods to convert estimates from the local to the reference definition must be available or be established. This article focuses on conversion methods which are characterised as 'bridges' because they can be seen as means of crossing from islands of local definitions to the mainland of a reference definition.

The objective of this study was to propose a structured approach to constructing bridges and to illustrate the concepts with case examples. The results are based on work on harmonising information from European NFIs conducted during 2004-2008 by Action E43 *Harmonisation of National Forest Inventories of Europe: Techniques for Common Reporting* of the European program *Cooperation in the field of Scientific and Technical Research* (McRoberts et al. 2009, Tomppo and Schadauer, in press). Although the case studies are taken from Europe the basic findings are general and not restricted to European conditions. The conclusions are summarised as a hierarchical approach to the proper choice of bridges.

A Methodological Framework for Constructing Bridges

A harmonisation bridge can take different forms, from mere recalculations based on existing data to advanced statistical functions to convert from existing definitions to reference definitions. Sometimes it involves a combination of different methods. In general, each party to an agreement must construct its own bridges, at least as long as each party acquires basic data differently. When constructing bridges from a local to a proposed reference definition, an important issue is the kind of national data available to support the assessment. From this point of view, we distinguish among *reductive*, *expansive*, and *neutral* bridges.

- For reductive bridging, national data are available in ‘surplus’, i.e. the reference definition is narrower than the national one. For example, a country may have a national definition whose scope is wider than that of the reference definition, and thus the bridge must only identify the portions of the national data that should be excluded to satisfy the reference definition.

- For expansive bridging, the opposite situation is encountered. In this case, the scope of the reference definition is wider; i.e. there is a lack of data for a simple recalculation and conversion factors may require auxiliary data.

- With neutral bridges, the scope of the reference and national definitions is the same, although different subdivisions between features may have been used. For example, in a country where the national and the reference definition of forest correspond perfectly, the national definition of forest types may deviate from the reference. In this case bridges for conversion between forest types are needed.

We define different types of variables involved in the construction of bridges. Firstly, the *target variable* is the variable in focus for harmonised reporting. A bridge is needed when the national definition of the target variable deviates from the reference definition. Secondly, there may be one or more *core variables* involved in the definition of the target variable. For example, definitions of *forest* generally use the core variables height and crown cover (at maturity, in situ). Thirdly, *auxiliary variables,* which may be correlated with the target variable and/or the core variables, are often available to facilitate derivation of functional relationships. Auxiliary variables may be of many different kinds, and the utility of a specific variable depends on the context. Data for auxiliary variables may also be obtained from inventory systems other than the one whose data are used to calculate the estimates according to the national definition.

Level of application

Bridges can be applied at different levels in an inventory system. In many cases, it is straightforward to apply the bridge at the level of individual sampling units (trees or plots) and then aggregate the units in a standard manner to obtain an estimate according to the reference definition at national or sub-national level. This approach is straightforward for reductive and neutral bridges, and also for expansive bridges when auxiliary data are available from all potential land units to be included under the reference definition.

In case auxiliary data at the level of sampling units are not available, the bridging procedure generally would imply application of a conversion factor or function to the aggregated estimate according to the national definition. Thus, depending on the data available, bridges are applied at different levels. In general, bridges applied at the level of sampling units result in the best accuracy, although this cannot be taken as a rule.

Further, the possibilities to assess the uncertainty of the harmonised estimates depend on at what level bridges are applied. For example, with a reductive bridge applied at plot level the possibility for, e.g., variance estimation remain the same, which is not the case if an expansive bridge is applied at an aggregate level.

In Figure 1, the two main levels where bridges can be applied are illustrated, i.e. at the level of individual measurement units (e.g. sample plots) or at an aggregate level.

< Figure 1>

Reductive bridges

Reductive bridges are generally easiest to construct. Data are available and the bridging procedure, in the simplest case, only requires use of new threshold values. Straightforward bridges can be constructed when the core variables in the national and reference definitions are identical. For example, definitions of *forest* typically use crown cover and height (at maturity, in situ). If data for these core variables are acquired, a country can adopt new thresholds and thus satisfy the reference definition through reductive bridging. Another straightforward example regards sizes of trees to be included in assessments of growing stock (Tomter et al. in press). If a country includes all tree sizes in the growing stock estimate but the reference prescribes a specific threshold diameter, the country easily can make assessments according to the reference definition through reductive bridging.

Reductive bridging becomes more difficult if no core variables are involved or available or if a country applies non-standard definitions of the core variables. In such cases, reductive bridging requires use of conversion factors or functions obtained from case studies or from neighbouring regions. Available auxiliary variables may be used either to predict the target variable directly according to the reference definition or to predict the core variables whereby the target variable can be assessed in a subsequent step (Fig. 2).

<Figure 2>

Case example – a reductive bridge for biodiversity in European forests

Whittaker (1972) defined three spatial types of biodiversity: alpha diversity, which refers to ecosystem diversity; beta diversity, which refers to the change in diversity between ecosystems; and gamma diversity, which refers to the overall diversity for different ecosystems within a region. Forest structural diversity is further characterized with respect to three components: species composition, often assessed using the Shannon index (H') as an indicator; horizontal diversity, often assessed using the standard deviation of diameter (σ_d) as an indicator; and vertical diversity, often assessed using number of height layers (Pommerening 2002, Varga et al. 2005).

For alpha diversity, McRoberts et al. (in press) demonstrated the sensitivity of both H' and σ_d to minimum diameter and plot radius. Previous works by, e.g., Magnussen (1998) and Garcia (2006) have reached similar conclusions. Therefore, harmonisation of estimates of these indicators requires a reference definition that specifies a minimum diameter and a plot radius. In this case, selection of reference definition thresholds for the two core variables depends on the ability or inability to construct bridges. In particular, although expansive bridges may produce acceptable conversions in aggregate for large areas, they are too imprecise and possibly biased for predicting numbers of individual trees and their species, diameters and heights which is required for alpha forest structural diversity assessments. Therefore, the thresholds for the core variables for the reference definition must be the greatest minimum diameter and the least plot radius among the NFIs whose estimates are to be harmonized. It follows, then, that bridges to convert between national definitions and the reference definition must have two components, one to accommodate differences in minimum diameter and one to accommodate differences in plot radii. Because the reference definition minimum diameter is the greatest minimum diameter among the NFIs, bridges for this component are all reductive, i.e., simply disregard data for each tree whose diameter is less than minimum diameter in the reference definition. Bridges to accommodate differences in plot radii are likewise reductive, i.e., simply disregard data for each tree whose distance from plot centre is greater than the reference definition for plot radius. However, whereas no additional information is necessary for the minimum diameter component of the bridge, accommodating differences in plot radii requires information for an auxiliary variable, namely distance between individual trees and plot centre.

For harmonizing estimates among European NFIs, the reference definition would include a diameter corresponding to the largest minimum diameter and a plot radius corresponding to the smallest plot size. Because reference definition thresholds for both these core variables are at the extremes of their respective distributions, progress toward standardization would greatly enhance the credibility of harmonized estimates for this type of information.

Expansive bridges

Expansive bridging is generally more complex than reductive bridging because core variables are not fully available. Auxiliary variables may, however, be available. Further, expansive bridges may be particularly complex when multiple, interdependent, target variables are involved. An expansive bridge may be needed to estimate forest area according to the reference definition. But growing stock may also be a target variable and the bridge for growing stock must include estimates of the number of trees on areas for which there may be none or very limited auxiliary data available.

In constructing expansive bridges, comparable information from areas similar to the target area is often needed. Such information can be obtained from pilot studies within the country or data may be available from countries or regions with similar conditions. If auxiliary data are available, perhaps from other inventories, expansive bridges may be constructed through developing predictive models. For example, logistic regression functions may be applied to estimate the probability that a particular plot belongs to a specific land-use category. Area estimates can then be obtained by adding probabilities, given the sampling design used (e.g. Yu and Ranneby 2007). In many cases imputation schemes (e.g. Tomppo and Halme, 2004) could be efficient because they provide entire suites of variables to sample plots or other units where only auxiliary data are available. Following imputation, all units in the dataset will include the same variables and thus data processing will be simplified.

If auxiliary data are unavailable or insufficient, expansive bridges must be based on simple conversion factors. As for reductive bridges, expansive bridges may involve either direct prediction of the target variable or prediction of core variables followed by subsequent assessment of the target variable (cf. Fig. 2).

Case example 1 - an expansive bridge for total forest area in Sweden

The Swedish National Forest Inventory (Ranneby et al. 1987) is a landscape level inventory in the sense that plots are laid out on all land cover categories. On the plots, assessments of ‘forest’ are made both according to a national definition[1] and according to FAO’s reference definition (e.g. FAO 2006). Thus, estimates of various quantities can be derived for different forest as well as non-forest categories. However, in the mountain range in the northwest part of the country the accessibility conditions are very poor. As a consequence, in areas at high altitudes, known to be all non-forest according to the national definition, assessments are only made using air photos or maps. Thus, in order to obtain an estimate of total forest area in Sweden according to FAO’s reference definition, there is a need to develop an expansive bridge since the air photo and map based assessments cannot be used for distinguishing between forest and non-forest land.

The National Inventory of Landscapes in Sweden (NILS; Ståhl et al. 2011) covers the entire country with a sparse network of sampling units. Each unit consists of (i) a 5*5 km square where basic landscape composition and configuration data are acquired, (ii) a 1*1 km square where detailed air photo interpretations of land cover, land use, and several other features are made, and (iii) 12 plots and lines within the 1*1 km square which are inventoried in the field.

In NILS, the core variables height and crown cover are recorded on all the field plots, and because the mountain birch forests are not managed, the conditions are considered to represent the state ‘at maturity, in situ’, as required for the FAO

[1] The national definition (until 2009) states that the growth potential has to be at least 1 cubic metre per hectare and year. From 2009 onwards, Sweden will apply FAO’s definition as the national definition in order to simplify international collaboration.

definition of forest. All field plots from NILS within the target area in the mountain range were evaluated; an expansive bridge for total area was developed simply by estimating the proportion of the plots fulfilling the forest category thresholds and multiplying with total area. The estimate obtained regarding forest in the mountain area was 1.03 Mha and thus the total area of forest in Sweden was 28.32 Mha (in 2008).

Case example 2 - an expansive bridge for growing stock of beech in Wallonia, Belgium

In Wallonia, by tradition trees conventionally are measured at 1.5 m rather than at 1.3 m height. Further, circumference (girth) rather than diameter is acquired, and the threshold circumference used is 20 cm. To convert from the Wallonian estimate of growing stock (which includes only trees with a circumference above 20 cm at 1.5 m height) to an estimate according to a reference, which includes all trees above 1.3 m (e.g. Tomter et al. in press), there is a need to develop an expansive bridge.

The Wallonian NFI sampling units comprise 3 concentric circular plots; the plot radii are 18 m (for trees above 120 cm circumference at 1.5 m height), 9 m (trees above 70 cm), and 4.5 m (trees above 20 cm). Volume models are available to predict the volume of a tree from circumference measurements at 1.5 m height (Dagnelie et al., 1999).

Based on estimates from the NFI, regression analysis was applied to predict the total number of beech trees by circumference class within the entire Wallonian region. The model was then applied to predict, by extrapolation, the number of small trees for which no information was available in the NFI. The regression model obtained was:

$$E[\ln (N)] = -1.2059\ C_{1.5}^{3} + 5.2465\ C_{1.5}^{2} - 8.434\ C_{1.5} + 15.349 \qquad (1)$$

Here, N is the number of trees in a specific circumference class (1 cm width) and $C_{1.5}$ is the girth (m) at 1.5 m height. The model, and the data, is shown in Fig. 3; the approach is further described in Rondeux (1999).

<Figure3>

By applying Eq. 1 the total number of trees in each class below 20 cm was estimated, assuming that the chosen model form would provide fair predictions (cf. Rondeux 1999).

Further, for the small trees new allometric models were developed based on existing data. The individual tree (excluding branches) volume model obtained was:

$$E[V] = 0.822 * C_{1.5}^{\ 2.342} + 0.0005 \qquad (2)$$

Here, V is volume in m^3 and $C_{1.5}$ is circumference in m. By applying Eq. 2 the average volume of a tree in each class was predicted and the total volume in a class was estimated through multiplication by the predicted number of stems. This procedure was applied to each class below 20 cm and the corresponding volume estimates were summed to obtain an estimate of the total volume of small trees.

Following this, only the trees between 1.3 m and 1.5 m height remained to be included. Although this could have been done using a procedure similar to the one described above, after converting from circumference at 1.5 m to circumference at 1.3

m by applying taper models, an expert judgement was made that the total volume of trees in the interval 1.3-1.5 m would be extremely small in comparison to total growing stock. Thus, this small fraction of the growing stock was not included in the expansive bridge.

The estimates of beech growing stock obtained were 13.887 Mm^3 according to the Wallonian definition and 14.027 Mm^3 according to the reference definition. Thus, the expansive bridge resulted in a very modest (1%) increase of the growing stock.

Further examples of expansive bridges for growing stock are presented in Tomter et al. (in press).

Neutral bridges

Neutral bridges represent the special case in which data are equally abundant under both the national and reference definitions. Typical cases involve definitions related to trees where the reference may include other subdivisions such as between aboveground and belowground parts. This type of bridge generally would involve development and application of allometric functions that can be applied to the basic auxiliary data that are available (e.g. diameter data when biomass should be estimated). Another kind of neutral bridge is required when different classification schemes have been applied to subdivide forest area. In this case, a neutral bridge is required to transit from the national to the reference classification. Because there is a 1:1 relationship regarding which data are available, neutral bridging typically involves re-labelling categories based on the core variables involved.

Case example – a neutral bridge for forest type classification in Italy

A forest type is a category of forest defined by its composition and/or site factors, as categorized by each country in a system suitable to its situation (Montréal Process, 1998). In Europe, a set of 35 Pan-European indicators has been endorsed under the Ministerial Conference on the Protection of Forests in Europe to measure progress towards sustainable forest management in the region. Seven indicators should be reported by forest types (Barbati *et al.*, 2007).

The European forest type system (EEA, 2006) is a hierarchical classification scheme consisting of 14 categories subdivided into 76 types. In Table 1, a selection of reference categories defined by EEA, as well as categories currently used by the Italian NFI, is provided. There are clear links between the Italian and the European systems, and thus neutral bridges could be constructed to transfer between the two systems based on the characteristics of each forest sample plot.

<Table 1>

A decision tree

A simple hierarchical decision tree is provided as a tool for providing general support and an overview of the kinds of bridging options that are available (Fig. 4).

Discussion

Harmonisation is becoming increasingly important as the demands for information to support international processes continue to increase. Procedures for converting from estimates according to national definitions to estimates according to reference definitions are crucial in this context. The proposed framework is intended to assist users in the construction of bridges for making these conversions. However, the framework only provides generic guidance and thus all the necessary details need to be provided in each specific application, as illustrated in the case examples. Bridges will likely be rather different in different applications, especially in cases where expansive bridges are developed based on auxiliary information. Also, in many real cases, mixtures among the different types of bridges are likely to be constructed. Further, in addition to providing guidance, the proposed framework is intended to strengthen the harmonisation process because it provides a standardised scheme for the development of bridges.

The quality of an estimate obtained using a specific bridging procedure depends on many factors. In the case of reductive bridges, estimation of variances in general should be straightforward because standard procedures should apply. In this case, use of a bridge is not likely to reduce the accuracy of the estimate. However, in some cases results obtained based on direct assessments of categorical variables may differ from estimates obtained based on *a posteriori* classification using core variables. This is an area where additional research would be motivated. Neutral bridges may require only that new allometric models or new classification schemes be applied to existing data. Provided that these models are properly developed, there is no reason why the accuracy of estimates should be reduced. However, whenever models are applied to predict variables, both sampling and model errors ideally should be incorporated into variance estimates (e.g. Ståhl et al. 2011).

When expansive bridges are used, the accuracy of estimates will likely decrease because the necessary model relationships or direct conversion factors will generally be rather coarse. In such cases, variances might be estimated using stratified approaches for which one stratum consists of sampling units where target data are directly available and a second stratum consists of the remaining units (e.g. Gregoire & Valentine 2008). For the latter stratum, approximate variance estimation methods may be available; e.g., when imputation techniques are applied.

From a qualitative perspective, external reviewers could evaluate the adequacy of the selected bridges. An example would be in connection with bridges applied for reporting to the UNFCCC and the Kyoto Protocol, because these procedures must be carefully described in national inventory reports which are scrutinized annually by external reviewers. In the future, increased quality demands most likely will require similar formal quality assessment procedures in many other cases as well.

Harmonisation, rather than standardisation, allows parties to maintain their national data collection protocols and their time-series according to national definitions. This is important because many users operate only at the scale of individual countries and benefit from being able to use information according to 'known' definitions. Further, many international processes demand forest information and the demands from different processes vary. Thus, unless a number of parallel inventories are conducted, there will always be a need to harmonise information so that the requirements under different agreements are satisfied. Nevertheless, application of standardised protocols for acquiring data for core variables that often are used in international definitions greatly simplifies construction of bridges. Thus, inventories that concentrate on acquiring high quality data for standardized core variables would be well prepared for diverse reporting requirements.

For these reasons, NFIs should direct future developments towards providing data that can be harmonized using neutral or reductive bridges as a means of avoiding uncertainties associated with expansive bridges, independently of the international reference adopted. Thus, NFIs should aim for good geographical coverage and standardized measurements of all major core variables.

When expansive bridges rely on case studies, existing information from similar regions or extrapolation, potential sources of bias must be carefully evaluated. If case studies are conducted, they could be directed to the specific areas from which data are needed. Careful selection and application of protocols are necessary so that potential selection bias does not cause bias in the resulting estimates.

Increased collaboration among countries opens possibilities for construction of adequate bridging methods as data from different regions become available. In Europe, the European National Forest Inventory Network (ENFIN 2011) provides such opportunities. At the international scale, FAO is likely to continue to be a driver towards harmonised forest statistics through the periodic forest resource assessments conducted.

Finally, whereas this article has focused on the development of bridges for applications using forest data and information, the generic results should be applicable for harmonization of area statistics in other cases as well.

Acknowledgements

We thank Anna Barbati, who contributed to the Italian case example, and Camille Bonhomme, for technical assistance in preparing the manuscript.

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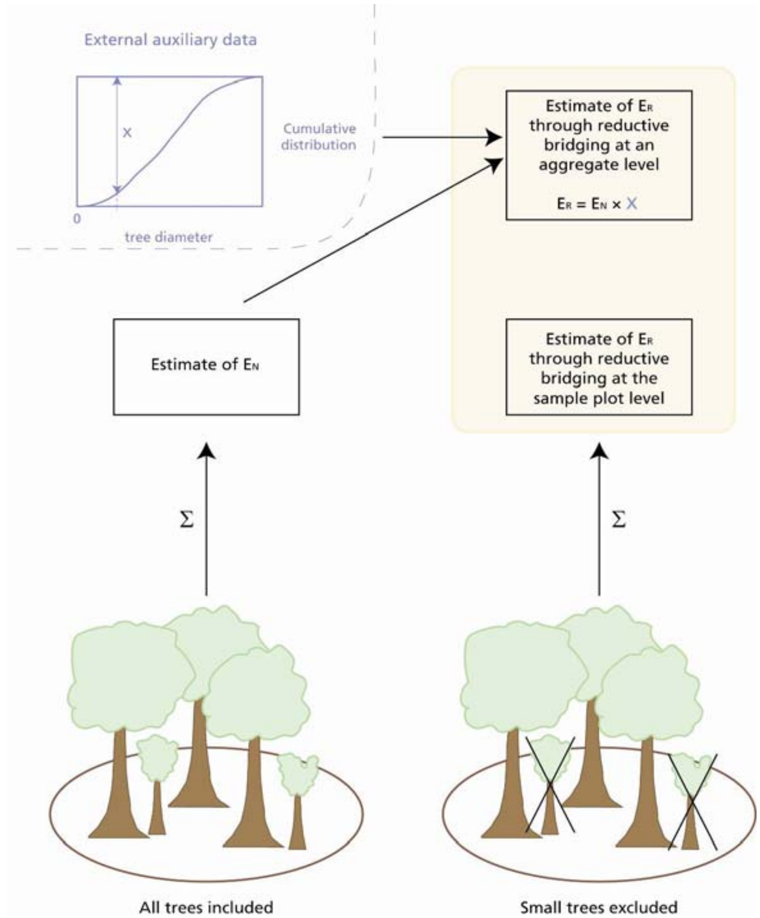

Figure 1. Application of a bridge (reductive) at the level of individual sampling units (right) and at aggregate level (left); E_N is the target quantity according to the national definition and E_R the corresponding quantity according to the reference definition.

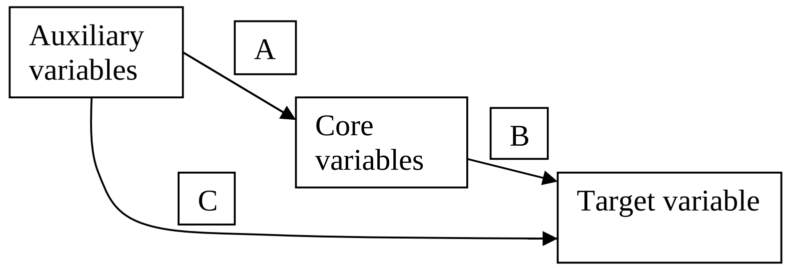

Figure 2. Reductive bridging when no core variables are immediately available. The arrow A indicates that core variables are predicted using auxiliary data and that a standard reductive bridging then is performed (arrow B). Alternatively, conversion factors based on auxiliary data can be used directly (arrow C).

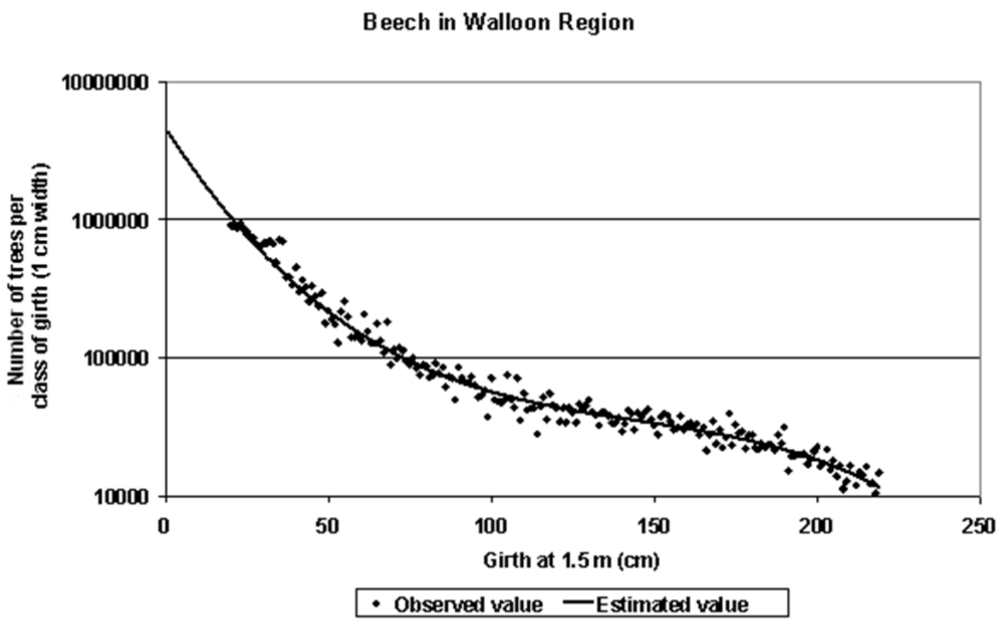

Figure 3. The observations and the fitted regression curve for predicting the total number of beech trees for a given circumference class (cm); R^2=0.978; the coefficient of variation for the estimated intercept was 2.7%.

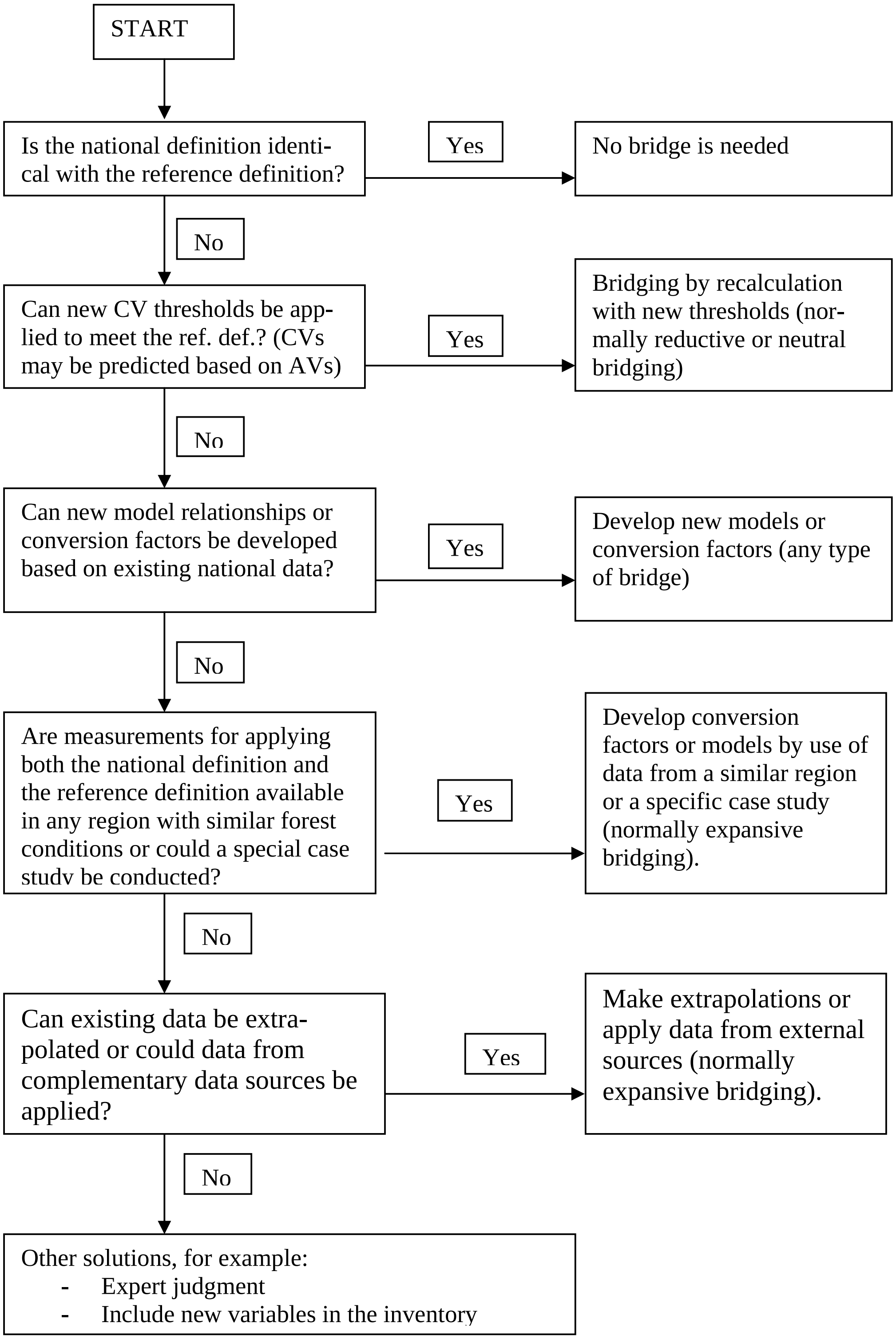

Figure 4. A hierarchical decision tree to guide users in the construction of bridges (CV=core variable, AV=auxiliary variable).

Table 1. Examples of conversions from the Italian forest type classification system to the reference system endorsed by EEA (2006). In this case the bridging functions are obtained by linking the classes in the Italian system directly to the corresponding EEA categories. (Note that this conversion system is not officially implemented in Italy).

CATEGORY (EEA, 2006)	***TYPE*** (EEA, 2006)	***CLASS (code). Dominant species*** (INFC, 2003)
3. Alpine coniferous forest	3.1 Subalpine larch-arolla pine and dwarf pine forests	1. Larch and arolla
		4. Scots pine and mountain pine (mountain pine dominated)
	3.2 Subalpine and montane spruce and montane mixed spruce-fir mixed forests	2. Spruce
		3. Fir
	3.3 Scots pine and Black pine forests	4. Scots pine and mountain pine (scots pine dominated)
		5. Black pine
5. Mesophytic deciduos forest	5.2 Sessile oak-hornbeam forest	12. Horn-beam
	5.8 Ravine and slope forest	14. Other broadleaves forest (Maple, lime)
6. Beech forest	6.3 Subatlantic submontane beech forests	8. Beech dominated forest (Beech pure)
7. Montane beech forest	7.3 Apennine-Corsican montane beech forests	8. Beech dominated forest (Beech and fir)
12. Floodplain forest	12.1/2 Riparian/fluvial forest	13. Hygrophil forest (Alders dominated)
	12.1/2 Riparian/fluvial forest	13. Hygrophil forest (Aspen dominated)
	12.1 Riparian forest	13. Hygrophil forest (Willow dominated)
	12.3 Mediterranean and Macaronesian riparian forest	13. Hygrophil forest (Plane tree)
13. Non-riverine alder, birch or aspen forest	13.2 Italian Alder forest	14. Other broadleaves forest (Italian alder dominated)
	13.4 Southern boreal birch forest	14. Other broadleaves forest (Birch dominated)