Section 6

Survey Methods for Kyoto Protocol Monitoring and Verification of UK Forest Carbon Stocks

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6. Survey Methods for Kyoto Protocol Monitoring and Verification of UK Forest Carbon Stocks

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6.1. Summary

This report details progress that has been made in the development of inventory-based methods for Kyoto Protocol monitoring of forestry based LULUCF activities. A methodology for providing estimates of carbon stocks and stock changes in forest biomass is described together with a detailed description of how verification will be undertaken using data collected as part of the National Inventory of Woodland and Trees. A demonstration of carbon stock and stock change assessment is presented for Alice Holt forest Hampshire, while examples of the verification process are detailed for a range of UK Intensive Forest Monitoring (Level II) plots. The description of the verification process includes an analysis of uncertainty associated with the quantification and use of biomass expansion factors/functions. Tree and stand level (above-ground) biomass expansion factors of 1.35 and 1.31, respectively, are proposed for beech under growing conditions in the UK. The current status of the National Inventory of Woodland and Trees is also presented, with implications for reporting carbon stocks and stock changes in woodland discussed.

6.2. Introduction

The Kyoto Protocol (UNFCCC, 1998) contains a number of stipulations concerning the reporting by participating countries of net changes in greenhouse gas emissions by sources and removals by sinks resulting from direct human-induced land-use change and forestry activities. The Protocol places restrictions on precisely what sources and sinks should be counted as part of a national greenhouse gas balance (notably in terms of any forestry activities initiated before 1990). However there is an implicit requirement for participating countries to develop the capability to periodically monitor and report carbon stocks and stock changes associated with national forests. In particular, countries are required to provide data to establish the level of national forest carbon stocks in 1990 and to enable an estimate to be made of changes in carbon stocks in subsequent years. The Protocol further stipulates that all such monitoring must be undertaken in a transparent and verifiable manner.

The purpose of this report is to report on progress made in developing a national forest carbon inventory, including the current status of the National Inventory of Woodland and trees (NIWT: see Smith, 2004) and how this may affect the proposed scheme. Detailed protocols are described for those measures relevant to estimating carbon stocks in NIWT sample squares. A demonstration of the application of BSORT to provide estimates of carbon stocks and stock changes in tree biomass is presented for Alice Holt forest, Hampshire. Finally, an approach to the derivation and verification of carbon stocks is explored for a number of plots comprising the UK Level II network. This approach is based on a nested design in which national-scale surveys are used to provide input data to carbon stock/change models, while smaller numbers of research plots are measured more intensively to provide data for validation of models and verification of estimates (Matthews & Broadmeadow, 2003). Particular emphasis is placed on the application of biomass functions to derive carbon stocks from the yield and inventory models, including an assessment on uncertainty that they may introduce.

6.3. Update on carbon stock assessment protocols associated with the National Inventory of Woodland and Trees (NIWT)

6.3.1. General description of NIWT

The Forestry Commission has carried out six national woodland inventories for Britain since 1919. The sixth national inventory, the National Inventory of Woodland and Trees (NIWT1), was started with a pilot survey of Grampian in 1994, and the fieldwork in Scotland was completed in early 1997, and by late 1999 in England and Wales. These GB national inventories have been carried out at roughly 10-15 year intervals, and have typically taken 4-5 years to complete. With successive inventories, the emphasis has moved from being purely an assessment of the timber resources to take in wider environmental aspects. It is intended that future cycles of NIWT will also provide data for verification of carbon stocks and stock changes.

Once the first cycle is complete the system will provide annual inventory updates in all countries every year. Available resources will dictate the length of the cycle. Many countries have already adopted this system, including USA, Canada, and all the Nordic countries, while France, Italy and some other European countries are currently converting to the system. Twenty four European countries are currently (2004–2008) discussing ways to harmonise inventories, including carbon stock assessments, through COST Action E43 (www.metla.fi/coste43).

6.3.2. Current status

The current National Inventory of Woodland and Trees (NIWT2) is planned for 2006-2015, with an ongoing rolling programme to continue. A pilot exercise was carried out during the summer of 2003, to provide indications of costs and resources required for the full programme of measurements, including options for additional measurements. Discussion of the final details of the protocol and intensity of sampling are still ongoing, and it is unlikely that field measurements will begin until 2006. However, some decisions have been taken, and these are outlined below.

6.3.2.(a) Woodland map

Digital, ortho-rectified aerial photos will be used to update the digital woodland map. Polygon boundaries to will be adjusted to match OS MasterMap where appropriate, potentially giving better fit with other data-sets. The digital photography data-set has been obtained for England and Wales. Coverage is not yet complete for Scotland, but should be by the end of summer 2005. A woodland cover map has been prepared for two pilot areas; a 20 x 20 km tile in southern England, to the south of Alice Holt, and a 100 x 100 km tile in central Scotland. The woodland cover map will include all woods greater than 0.5 ha in area, contrasting with NIWT1 in which the threshold was 2 ha.

6.3.2.(b) Survey cycle

Rather than conduct a periodic survey, a continuous national woodland inventory will be adopted. The cycle is likely to be 10 years to accommodate the expected level of funding.

6.3.2.(c) Sample plot selection

A 1 km by 1 km grid, with 1 ha within each grid square being selected as a sample plot where it lands on woodland. Sample plot numbers will be reduced (for budgetary reasons) by limiting sample squares to those in which at least 50% of the 1 ha patch has woodland cover on the basis of the woodland cover map.

6.3.3. Preliminary assessment of protocols to be implemented in the two pilot areas

A derivation of carbon stocks and stock changes from data collected as part of NIWT2 can only be satisfactorily achieved if mensuration data are collected as part of the core protocol. Soils information are not as essential as mensuration data, although they would provide a valuable verification step and improve the uncertainty estimate associate with soil carbon stocks. At present it seems likely that mensuration data will be collected as part of the core protocol; the situation for soil data is equivocal, and still under discussion. However, whatever the outcome of the consultation process, both mensuration and soil data will be collected in the pilot area to demonstrate the value of both data-sets and how they would be used to derive estimates of carbon stocks and stock changes.

The delay in the start of NIWT2 has implications for the proposed work programme for this contract. Field sampling in the sample squares (as part of NIWT2) will now not take place during the timeframe of this contract. Carbon stock assessments will therefore be made for NIWT sample squares as a separate exercise to NIWT2. Only the core measurements required for carbon stock assessments will be undertaken, as described below. It is therefore proposed that this demonstration phase is restricted to a single pilot area, for which the woodland cover map is already available, and presented as Figure 6-1.

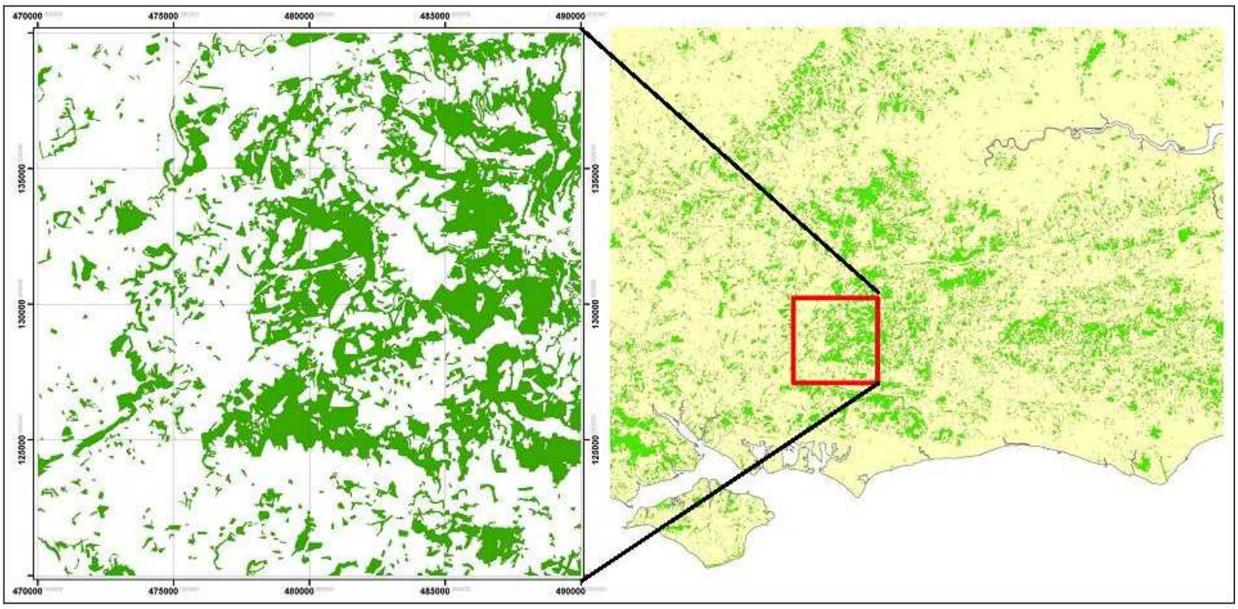

Figure 6-1Woodland cover map (woodland greater than 0.5 ha) for the 20 x 20 km tile in southern England that will be used to test the proposed methodology for the national forest carbon inventory. Maps based on Ordnance Survey Mapping, crown copyright, licence number GD2723882003.

6.3.4. Methodology for deriving carbon stocks in NIWT sample squares

For production woodland, carbon stocks of standing timber will be assessed from conventional yield models underlying BSORT, using the abbreviated mensuration measurements described below as input. Generic models for non-productive woodland are also available. Deadwood assessments and additional measurements made as part of the soil assessment described below will provide an evaluation of carbon stocks associated with litter, but foliage and small diameter branchwood litter will not be accounted for outside modelled estimates from BSORT based on allometric relationships. Soil carbon will be estimated on the basis of broad (detailed FC: Pyatt, 1982; Horne & Whitlock, 1984 – see below) soil type, using modal values for each soil type based on the National Soil Inventory and other available data-sets, including the proposed Biosoil project.

Estimates of carbon stocks will only be made for the central element of the NIWT2 squares where mensuration and soil data are available. These estimates will thus not be comparable with the wider assessments made within NIWT2, and this should be acknowledged in any interpretation of the results. However, scope remains to extend the analysis within the pilot areas to provide a qualitative comparison of woodland carbon stocks based solely on the central elements and one based on all elements recorded within the 1 ha sample square. This assessment would contribute to the verification and uncertainty analyses described elsewhere.

6.3.4.(a) General plot attributes

A range of attributes that would be recorded as standard within the NIWT protocol will be recorded. These may have no immediate relevance to the forest carbon inventory, but could be used to inform associated studies, including the availability of woody biomass for bioenergy production (see McKay, 2003).

- Forest type
- Thinning history
- Extractability
- Silvicultural system
- Rotation
- Spacing at establishment
- Recent silvicultural treatment
- Species
- Approximate planting year
- Stocking %
- Health assessment
- Timber potential
- Planted originally
- Timber quality assessment

6.3.4.(b) Soil assessment

Soils will be classified according to the ‘detailed soil-type’ classification given in Horne and Whitlock (1984), enabling verification of information on soil type held in the SCDB. Although the title ‘detailed’ implies a time-consuming assessment, this is not the case, and it is estimated the procedure will take no more than 15–20 minutes. Soil type will be assessed at three locations, basing the classification on soil extracted using a combination of spade and auger; properties necessary for soil classification will be recorded in the field with further chemical analysis in the laboratory not required. Guidance is available in Kennedy (2002). Sampling will take place at the two ends of the linear mensuration transects and their intersection.

In addition to the identification of soil type, the following variables will also be recorded to provide further information for deriving soil carbon content:

- Depth of litter layer
- Depth of ‘O’ horizon (F and H)
- Depth of A horizon

It should also be noted that more detailed soil analysis to 1 m (or bedrock) will be carried out during 2006 as part of the EU (Forest Focus) co-funded Biosoil project. Sampling will take place across the trans-national grid: in the UK, this will be based on the national grid (subject to EC approval), and NIWT sample squares will thus coincide with the ‘Biosoil’ plots. 167 plots have been identified in woodland of greater than 2 ha on the basis of the NIWT1 woodland cover map (see Figure 6-2). The number of plots may rise further (to over 200 plots), once the new woodland cover map is generated, including woodland between 0.5 and 2 ha in area.

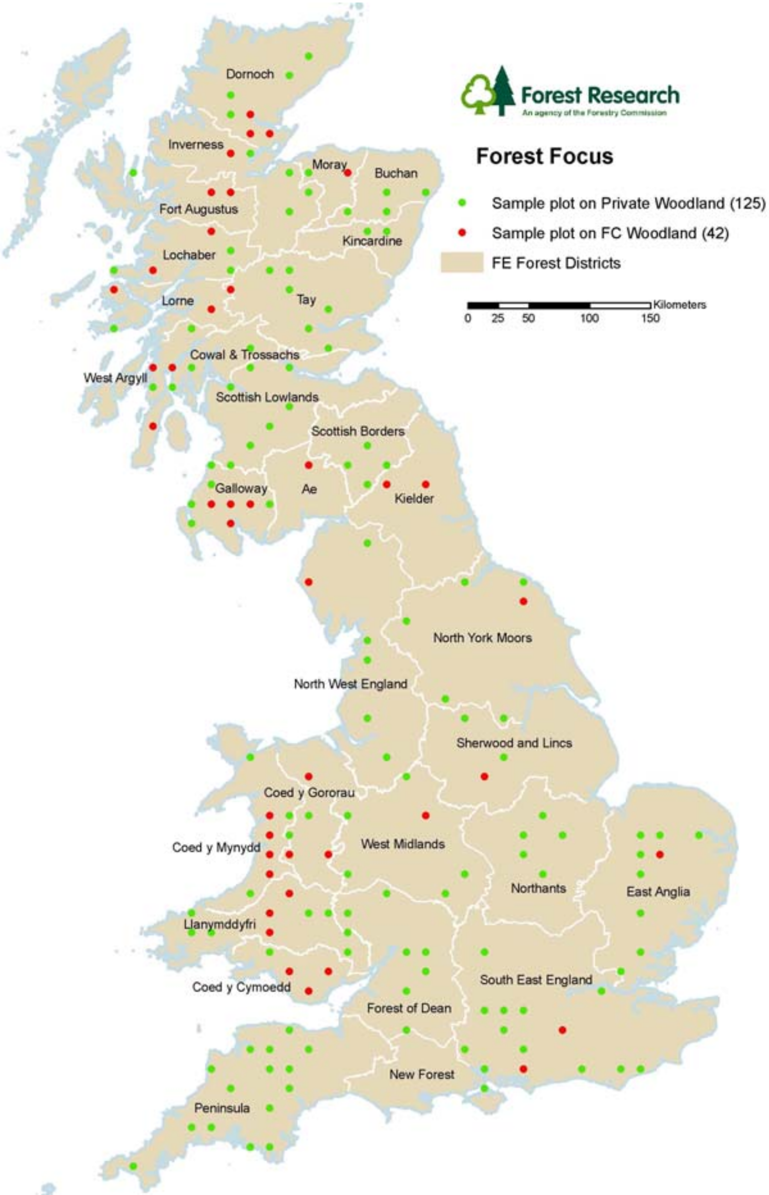

Figure 6-2 Proposed Biosoil network, aligned to the transnational 16 km grid.

6.3.4.(c) Mensuration assessment

The assessment protocol for mensurational variables is still being developed, because of the need to balance essential data requirements for forecasting and carbon stock estimation against available funding. Under the current draft of the protocol, the approach for assessing standing biomass in the central element will not be restricted to a small, defined plot. Instead, linear transects will be employed to provide a more representative assessment of standing biomass. Two transects will be arranged at right angles (an ‘L-strip’), to allow for differences between within and between row spacing to be accounted for in planted woodland.

Definition of L-strip

An L-strip consists of a sequence of 25 living and measurable trees along a straight line, followed by a second sequence of 25 living and measurable trees along a straight line falling at right angles to the first sequence. In practice, the surveyor would make assessments along an initial transect forming the first sequence, starting at an initial tree and proceeding until the 25th tree is reached. This tree would be taken as the 'corner' of the 'L' and would also serve as the first tree in the second sequence. At this point the surveyor would continue along a second transect at right-angles to the first until the final sample tree was reached.

In stands with clearly defined rows of trees, the initial transect should go along a row, with the second transect going across rows. In other stands the direction of the initial transect should be selected at random.

Protocol

- All measurable trees in the L-strip are assessed for dbh.
- Every 4th measurable tree is assessed for total height until there are 10 height sample trees.
- The lengths of the two transects (initial tree to corner, corner to final tree) are also assessed.

6.3.4.(d) Deadwood assessment

A deadwood assessment will be carried out, although it is uncertain whether, at this stage, the assessment will be transect or plot based in the full NIWT protocol. The current preference for carbon stock assessment is for the protocol to be transect based to be compatible with the mensuration assessment. A transect-based assessment will therefore be adopted in the pilot area work programme.

In order to qualify for inclusion, any deadwood must have a minimum mid-diameter of 5 cm and a minimum length of 0.5 m, at least part of which must fall within the plot with the exception of standing trees. The following attributes will be recorded:

Lying deadwood

- Species (or Conifer/Broadleaved/Unknown)
- Mid-diameter
- Length
- Reason for death
- Degree of decomposition

Standing dead trees

- Species (or conifer/broadleaved/unknown)
- Diameter at breast height
- Height
- Reason for death
- Degree of decomposition

Stumps

- Species (or Conifer/Broadleaved/Unknown)
- ‘Top’ diameter, measured overbark
- height to ground level
- degree of decomposition

6.4. Demonstration of application of BSORT to carbon stock change assessment

The majority of models that report woodland carbon stocks and stock changes are based on production, or growth and yield models. This is also the case for BSORT (Matthews & Duckworth, 2005), which additionally incorporates detailed biomass functions (based on a range of published values) for branchwood, stem-tips, foliage and roots. It is thus an improvement on most models which base estimates of non-merchantable biomass on simple biomass expansion factors and root:shoot ratios. The value of diameter, stemwood volume or height-related biomass functions is further demonstrated in below.

The application of BSORT to carbon stock and stock change has assessment has been tested for Alice Holt forest, Hampshire. Alice Holt forest is FC woodland managed for both timber production and amenity. It covers an area of approximately 850 hectares and is planted with both broadleaf and conifer species. There are also significant areas of ancient semi-natural woodland, with some stands over 200 years old. Data are held within the SCDB for individual sub-compartments, with the following attributes relevant to this assessment reported:

- Planting year
- Productivity class (GYC: $m^3\ ha^{-1}\ yr^{-1}$)
- Principal species
- Area planted with principal species
- Total area of sub-compartment

As indicated above, only the area in each sub-compartment planted with the principal species in that sub-compartment is assigned. It was therefore necessary to account for the difference between total sub-compartment area and the area planted with the principal species using the following guidelines:

- If the area planted with the principal species was between 90 and 100% of the sub-compartment area, the balance was assumed to be unplanted.
- If the area planted with the principal species was less than 100%, stock maps were used to identify the identity and planting year of the secondary species; in this case, yield classed was assigned as the average for the species reported for Alice Holt forest.
- If the secondary species was reported as a species mixture, then the balance was assigned to the first named species.

The models available within BSORT do not cover the full range of species and stand ages reported for Alice Holt forest, and the following assumptions were made:

- If stand age was less than the minimum age of the model, then biomass was calculated on the basis of a linear increase in total above ground biomass between planting and the minimum age in the yield model.
- GYC0 was assigned to GYC1
- A nominal planting year of 1953 was assumed for all ‘research plots’ where information was not available; where not stated, mixed broadleaf yield class 4 was assumed.
- Other than for ‘research plots’, where yield class was not given, GYC 2 was assumed.
- Christmas trees plantations were assumed to be GYC 8 Norway spruce planted 5 years before the date of assessment (1995 or 2002).

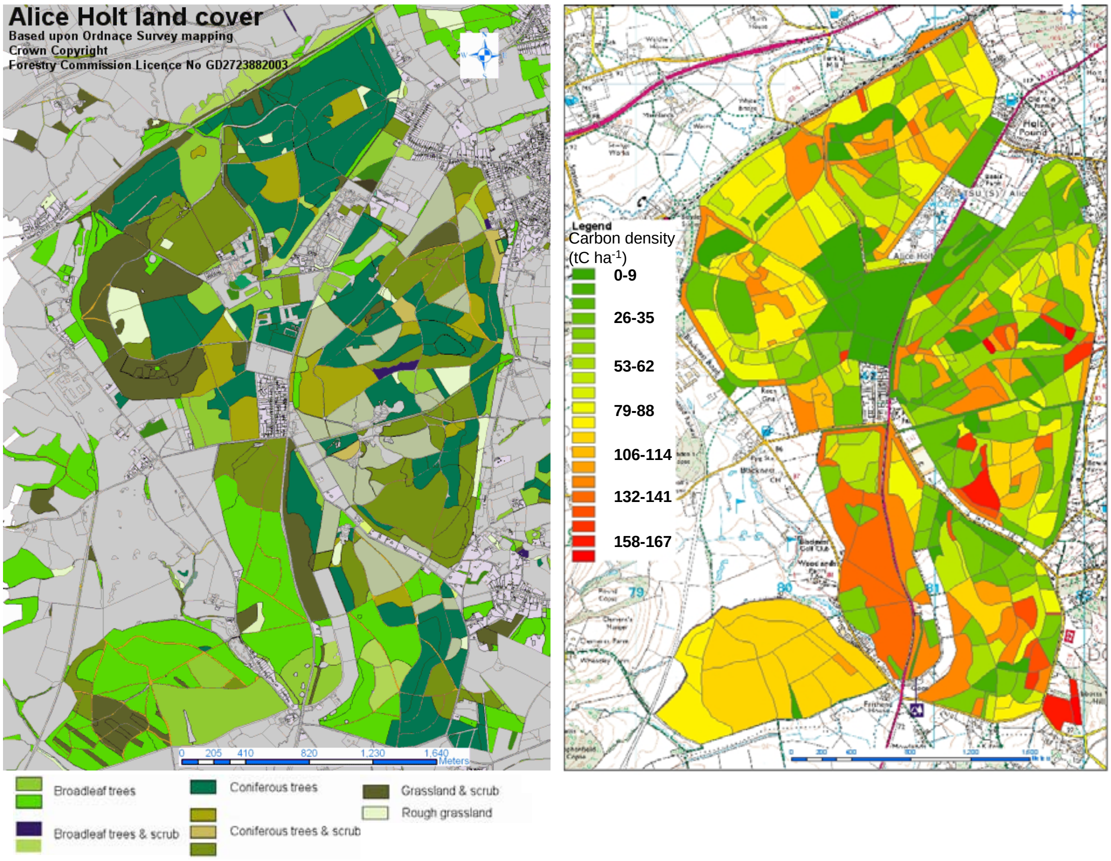

Figure 6-3 (a) Landcover map for Alice Holt forest, (b) map of carbon stocks in woodland biomass for Alice Holt forest, Hampshire. Maps based on Ordnance Survey Mapping, crown copyright, licence number GD2723882003.

Carbon stocks were calculated as total woody biomass (stemwood, branches, branch tips, roots) with an assumed carbon content of 50% (Matthews, 1993). Spatial variation in carbon density are shown in the form of a carbon density map in Figure 6-3. Results shown in Table 6-1 indicate that although the area of woodland fell by 38 ha between 1993 and 2002, there was an increase in total carbon stocks of Alice Holt forest of 11.6 kt C, with the average carbon density of woodland rising by 11.6 tC ha^{-1} from 69 to 81 tC ha^{-1}. This increase equates to an annual increase in carbon stocks in biomass of 1.3 tC ha^{-1} yr^{-1}, agreeing with the estimate of Milne *et al*. (2004), that the carbon stock of woodland in the UK is increasing at a rate of approximately 1 tC ha^{-1} yr^{-1}. The rate of deforestation represented in these data is 0.55%, assuming that no new planting took place between 1993 and 2002. If this rate of deforestation was replicated nationally, it would represent an annual rate of 14800 ha yr^{-1}, at the high end of the range proposed by Levy (2003) but not unreasonable.

Table 6-1 Estimates of changes in standing biomass in stemwood, branchwood, brash and roots in Alice Holt Forest between 1993 and 2002. Average carbon stocks of woodland at each time-point are also given.

	Area (ha)	Standing biomass (tonnes)						Carbon stock (t ha^{-1})
		stem	Branch	Brash	foliage	roots	**total**	
1993	765.5	52148	20789	1648	4165	26898	**105648**	69
2002	727.6	61045	21572	1457	4473	28737	**117284**	81
2002-1993	-37.9	8897	783	-190	308	1839	**11636**	11.6

It is apparent from the assumptions required to carry out the analysis described here that manipulation of the SCDB will be required, before the data held within it can be used for national carbon stock assessments. To accomplish this guidelines, will need to be drawn for default values to complete the driving data-set.

6.5. Derivation of a tree level biomass expansion factor for beech growing in the UK

Eleven of the twenty sites comprising the UK Intensive Forest Monitoring (Level II) network were thinned for silvicultural reasons in 2005. At each of these sites, ten sample trees were selected from across the full diameter range and subjected to detailed mensurational analysis. Results are presented for the six plots planted with beech (*Fagus sylvatica*).

6.5.1. Methodology

The ten sample trees were felled, and conventional mensuration measurements taken: total height; timber height; timber volume to 7 cm diameter. In addition, sawlog volume (>16 cm diameter) was measured. Trees were then separated into five components: stemwood; branchwood (>7 cm diameter); brash; saddle, stump and non-merchantable stemwood; standing deadwood. Each component was weighed separately, using a 50 kg balance (Salter) suspended from a tripod. For each component, three separate samples were taken (where sufficient material was available) and cominuted using an arboricultural chipper. Sub-samples (> 1 kg) were taken off-site in polythene bags for moisture content determination, with additional sub-samples retained for subsequent chemical analysis. Moisture content was determined gravimetrically after drying at 105^{o}C for 48 hours.

6.5.2. Results

Above-ground stemwood biomass was calculated as the product of measured timber volume and specific density (0.55 for beech: Lavers & Moore, 1983). Corrections were not applied for the difference in density between bark (~0.40: ref) and stemwood, to maintain consistency with the approach adopted in the current LULUCF methodology using CFLOW (R. Milne, per, comm.). Total biomass was calculated as the sum of the five components with component specific moisture contents applied to measured fresh weight. Tree level biomass expansion factors were then calculated as the ratio of total measured biomass to estimated stemwood biomass. Figure 6-4 presents the results as a function of measured stem volume, with individual trees across the six sites plotted as individual data points.

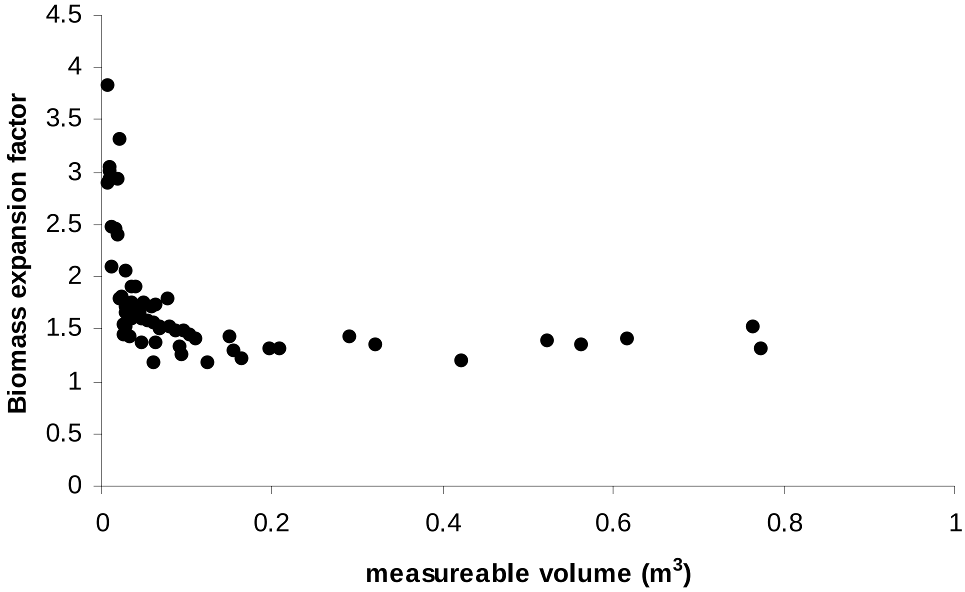

Figure 6-4 Biomass expansion factor plotted as a function of measured stem volume for beech (Fagus sylvatica) in six plots of the UK Level II network.

The data presented in Figure 6-4 clearly demonstrate that the use of a single biomass expansion factor is inappropriate where it is applied to young trees. However, this analysis does indicate that for individual trees of measurable volume greater than 0.1 m^3 (of the order of 15 cm dbh, total height 15 m), the application of a single BEF may be appropriate. A value of 1.35 is calculated as the average BEF for all trees of measurable volume greater than 0.1 m^3. However, it should be noted that the data-set is restricted (16 points), but does include trees from five of the six sites sampled. The value differs markedly from the value of 1.18 that is assumed for broadleaf species in CFLOW (Dewar & Cannell, 1992).

6.5.3. Derivation of plot level biomass expansion function

For each of the six plots, the data described above were used to derive a plot specific relationship between above-ground biomass and basal area. This relationship was then applied to the full diameter distribution reported for the ~0.1 ha mensuration permanent sample plot. A single biomass expansion factor was then calculated for each plot based on all trees present within the sample plot. This value is thus representative of the entire plot and not restricted to the ten sample trees which may not be fully representative of the plot. If plot 1827 is excluded from the analysis on account of the small volume of the individual trees and thus the inappropriateness of the single biomass expansion factor (see above), a mean plot level biomass expansion factor of 1.20 is calculated. It should be noted that the BEFs given in Table 6-2 are based on measured specific density (mean value of 0.59), which is higher than most published values (typically 0.55: Lavers & Moore, 1983). Alternatively, if stemwood biomass is calculated as a product of measured volume and the default specific gravity for beech (0.55), the BEF for the five plots (excluding 1827) rises to 1.31. This is more in line with the value derived from the individual tree analysis described above. This latter value is appropriate if estimates of stemwood biomass are based on measurements of stemwood volume; the lower value of 1.2 is appropriate if measurements of stemwood biomass are available.

Table 6-2 Plot level estimates of stemwood biomass, above-ground biomass and biomass expansion factors for the six beech plots in the UK Level II network. Values of dbh and volume are means of all trees in the sample plot, while estimates of biomass are totals for the sample plot (~0.1 ha).

Plot No.	dbh	Volume	Stemwood biomass	Above-ground biomass	Biomass expansion factor
	cm	m^3	Tonnes	tonnes	
1827: Cannonteign	14.2	15.7	8.7	13.6	(1.53)
1829: Covet Wood	32.5	27.5	15.1	21.4	1.25
1831: Wangford	20.4	34.7	19.1	23.0	1.12
1833: Wykeham	20.5	33.8	18.6	25.3	1.29
2316: Brechfa	21.5	29.3	16.1	21.6	1.24
3766: Kelty	26.0	33.5	18.4	22.3	1.13
Mean					1.20

6.6. Comparison of plot level estimates of above ground biomass – an approach to carbon stock assessment and verification

A number of different options are available for calculating above-ground biomass. These options broadly mirror the range of options that will be applied in a nested scheme to carbon stock and stock change assessment, verification and model parameterisation. At the most basic level, summary patch-level data (age of crop, species and yield class) will be input to inventory or carbon accounting models (BSORT or CFLOW, respectively). This approach will be used to derive carbon stock and stock change assessments from the forest cover map together with associated data from the SCDB or assigned data from the private sector production forecast. The next level of detail involves the input of stand level data in the form of diameter distribution and stocking density. These data will be derived from mensuration data collected as part of NIWT. Upscaled plot-level data using this approach will form the basis of the verification process for national carbon stocks and stock changes. The most detailed level of data input involves the approach described in the preceding section, in which measured biomass in branchwood and other non-merchantable fractions are available. Data input of this intensity is only required to parameterise and/or validate the models that are used for either stock (or stock change) assessment or its verification.

Estimates of carbon stocks in standing biomass are given for the six Level II plots analysed in the preceding section in Table 6-3. It is clear that these estimates encompass a large range of values with, for example, CFLOW predicting only 46% of measured standing biomass, on average. This result is not unexpected, since it is widely acknowledged that the forest management prescriptions assumed in standard yield models do not always reflect actual practice. Local management of stands is known to be a significant influence on standing biomass and consequent carbon stocks (Robertson *et al.*, 2003). Recent developments in computer-based yield models could offer an opportunity to address this issue (www.forestry.gov.uk/forestry/INFD-5XSC7R). A brief description of the approach used to derive each of the estimates of standing biomass is given below:

CFLOW model: Standing volume predicted on the basis of conventional yield models (Edwards & Christie, 1981), with 'default' values for specific density (0.55) and BEF (1.18) assumed to derive standing biomass.

BSORT model: Standing volume predicted on the basis of integral yield models. 'Default' value for specific density (0.55) applied together with detailed, species group biomass functions to derive standing biomass.

CFLOW plot: Sample plot measurements of standing volume converted to estimates of standing biomass using 'default' values for specific density (0.55) and BEF (1.18).

BSORT plot: Standing volume predicted from plot-level diameter distribution, and height-diameter relationship. 'Default' value for specific density (0.55) applied together with detailed, species group biomass functions to derive standing biomass.

SPLOT: Plot level standing biomass calculated as described in the preceding section.

Table 6-3 Comparison of estimates of standing biomass (t ha^{-1}) on the six Level II plots planted with beech.

Plot no.	LYC	P-year	Plot measurements			Model estimates	
			SPLOT	BSORT	CFLOW	BSORT	CFLOW
1827: Cannonteign	10	1972	113	133	85	118	47
1829: Covet Wood	8	1950	201	172	168	168	140
1831: Wangford	7	1955	230	237	225	153	104
1833: Wykeham	8	1957	203	169	176	138	112
2316: Brechfa	6	1952	205	236	180	118	95
3766: Kelty	4	1958	222	215	216	78	47
Mean			196	194	175	129	91
% of SPLOT			100	99	89	66	46

6.7. Outlook for 2005-6

Since the NIWT consultation process is unlikely to be finalised before late 2005, the conclusions of the fieldwork undertaken for this project during summer 2005 will be in a position to influence the final methodology adopted for NIWT2. The success, or otherwise, of the protocols described here can therefore optimise relevant protocols, based on practical experience; this will be particularly important for determining whether a soil assessment can be adopted as part of the core NIWT2 protocol, within budget. Based on experience gained in the pilot site assessments, together with the adoption of a final NIWT methodology, a detailed manual for forest carbon stock and stock change assessment will be completed.

Biomass functions will be derived for the remaining 9 Level II plots that were not thinned during 2004–5, enabling the biomass functions used by BSORT to be updated and made fully representative of UK conditions. Other functions relevant to carbon stock assessment will be updated and optimised where appropriate, using data collected in FR forest monitoring programmes.

The development of modelling and assessment methodologies during the past two years will enable carbon stocks in the pilot area to be estimated. Pilot area field assessments will allow upscaled carbon stocks to be calculated, thus demonstrating whether the proposed approach to a nested assessment – verification procedure is achievable.

6.8. Acknowledgements

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