

Forest Inventory and New Technological Developments

Last December the second National Forest Inventory was published and the main findings were highlighted in this newspaper on the 14th January. As a national inventory it provides invaluable information about Ireland's forest estate at the macro level, and one of the telling statistics is that 56pc of the entire estate is still less than 20 years old. That said, with every passing year many more thousands of hectares of private forest enter the harvesting stage, consequently taking stock and preparing an inventory at the micro, individual private forest level becomes a vital component of sound forest management.

Good management requires knowledge. The amount of available knowledge has a direct bearing on the quality of management, and allows informed decision making. Knowing the extent of the assets owned by and available to the owner or manager is fundamental to a successful business.

A woodland inventory should be prepared once a first thinning has been completed when it is possible to "see the wood for the trees". A well prepared inventory gives the owner a snapshot of the stock of timber in his woodland, and is therefore an essential component of a woodland management plan. The inventory must be updated regularly to take stock of the growth in volume, and as a matter of course should be updated following each harvest. Over time the emphasis with many of our even aged and predominantly spruce plantations will be to convert them to more uneven aged forests with greater species diversity and inventories will become an increasingly important part of management planning.

The Woodland inventory

An inventory is best set out in the form of a table (an Excel spreadsheet or equivalent is ideal). Depending on the size and age structure of the woodland it should be separated into compartments, and possibly sub-compartments too, if necessary, and an example is included in the table below:

Cpt	Area	Species (pc)	P. Year	Age	DBH	Top Ht	Yield Class	Stems/ha	Mean Vol	Vol./ha	Total Vol	Notes
1	3.3	SS	1995	19	16	10.5	20	1920	.092	176	581	
2	2.41	SS (70) JL (30)	1999	15	13	7.4 8.2	22 12	2300	.067	154	371	

The notes column should include any pertinent points relevant to the compartment in question, for example other minor species, open areas, or a description of biodiversity, archaeological or other features that should be noted.

To get as accurate a picture as possible it is important to take sample plots throughout the plantation. The number necessary will vary, but as a guide for areas of two to ten hectares the recommendation is for eight plots for uniform crops and twelve where there is greater variability.

Of course it is also important to choose plots at random and evenly spaced throughout the plantation.

The information gathered not only gives an indication of what the woodland contains at a particular point in time but is essential in planning a thinning, and more specifically as a tool to help with thinning control. Second and subsequent thinnings need to be carefully controlled if the crop is to realise its full potential, and therefore maximum value.

Yield Class

The concept of yield class is often mentioned by foresters but not always understood by the layman. The growth of a tree may be measured in terms of height, diameter, volume or weight, but volume is the most meaningful for management purposes. In an even-aged stand the cumulative volume production divided by the age of the stand is referred to as the mean annual increment (MAI), but the growth curve of a tree is not a straight line. During the early years growth is vigorous, it reaches a maximum and then declines with increasing age. The point at which the MAI curve reaches its maximum is the maximum average rate of volume increment which the stand can achieve and this number is the yield class. Therefore a stand with a maximum MAI of 20 cubic metres per hectare has a yield class of 20.

Fortunately there is a close correlation between cumulative volume production and the top height of a stand so yield class is relatively easy to measure. In actual fact, most crops in Ireland never reach their full potential yield class as almost invariably they are harvested before the age of maximum MAI, but yield class remains an important item in the management tool box, not least because the second and subsequent thinnings should aim to remove 70 pc of the yield class. Thus, on a 5 year thinning cycle, for a plantation of yield class 20 the aim should be to harvest 70 cubic metres per hectare ($YC20 \times 5 \text{ years} \times 70pc = 70 \text{ cubic metres}$).

Technological developments

For much of the last 100 years forest measurement techniques changed very little, and to take accurate measurements from a sufficient number of sample plots is inevitably labour intensive. Typically the tools of the trade consist of a girthing tape to measure diameter at breast height, a hypsometer to measure tree height, and more recently electronic calipers connected to a portable computer which speeds up the recording process.

A year ago I wrote in these pages of the Cork-based forest technology company Treemetrics Ltd. Treemetrics has been developing a completely new system of forest measurement that is now gaining international recognition for its considerable accuracy. Using sophisticated laser scanning equipment, the company can measure both the volume of timber in a stand and also assess tree form, taper and stem straightness before a saw goes anywhere near it. Previously these features could only be established after the tree was cut.

Forest Mapping & Monitoring (The Forest Mapper™)

Traditionally, maintaining informative and accurate maps has presented a challenge to foresters. As the forest grows and closes canopy it is increasingly difficult to maintain a picture of productive area, and frequently the forest manager can only make an informed guess regarding the percentage that is unproductive. Treemetrics is the first system that integrates satellite imagery with aerial and terrestrial laser scanning, thus allowing accurate mapping of the forest into all categories of productivity.

Treemetrics, in partnership with the European Space Agency, have just announced the development of a new global forest mapping and monitoring product called **Forest Mapper™**

This has now been released in Ireland to assist private owners to understand their forests better. According to Enda Keane of Treemetrics “the Irish forest industry is entering a new exciting phase with the ever increasing emergence of private timber harvesting. Forest owners and buyers are now asking key questions about the quality, quantity and value of available timber. In addition, forest owners with younger plantations wish to know when their forests will be suitable to harvest.”

Treemetrics have developed the system to provide an independent method that also assists the valuation of a forest. Utilising the latest satellite images and global mapping technology, and image analysis software, Mr Keane says they are able to obtain new insight into the quality of the forest. The technology enables them to count the individual trees as the crop matures, providing owners, foresters and sawmillers with key planning information to assist in optimum decision making.

Mr Keane says Treemetrics can also assist with the ongoing automated monitoring of the crop. Forest disturbance caused by storms, disease and the increasing threat of theft can be monitored remotely.

While sample measurements still need to be undertaken on the ground, the system calculates the minimum number of sample plots required and their most suitable locations, thus reducing the cost associated with this operation. A phone application has been developed with accurate GPS technology to help navigate the forester to the right locations to collect the measurements and the resulting data is automatically sent to the online system where it can be stored and analysed.

Treemetrics will be announcing key partnerships to assist with the roll out of the system nationally and internationally over the coming months, and the company can be contacted at info@treemetrics.com or by phone at 021 7304630.

Unmanned Aerial Photography

Another Cork-based technology company, Baseline Surveys Ltd, has been pioneering the use of unmanned aerial vehicles (UAVs) to photograph and map standing crops of trees to an astonishing degree of accuracy. In many respects, this technology is complimentary to, rather than in competition with, Treemetrics.

Paudie Barry, the managing director of Baseline Surveys, has a 25 year background in surveying for the civil engineering industry, setting out bridges and roadworks, mapping development land and resolving boundary issues. Two years ago Mr Barry invested in drone mapping equipment and since then has published papers on the accuracy of this equipment which, he claims, show that his system has produced the most accurate aerial maps in the world. He has presented his findings to Engineers Ireland, and also internationally at the Royal Military Academy in Brussels. Mr Barry has a permit to operate his UAVs in Irish airspace from the IAA.

Using this equipment, Baseline Surveys can locate, count, itemise and measure the height of every single tree within a plot of woodland. According to Mr Barry, “this has the potential to provide the owner with unprecedented knowledge of his forest plot to an accuracy that is previously unsurpassed. Having this knowledge allows the forest owner to plan ahead with economic certainty and to negotiate with the timber mills, absolutely certain of his forest’s monetary value. We provide actual planted area, tree location with height and tree count with average tree height per plot.”

The drone helicopter Baseline Surveys uses for this work is small enough to fit into the boot of a car and can be launched in under 3 minutes. It can map up to 100 hectares in a single one hour flight, so while its use is primarily aimed at the larger forest owner, or at least larger blocks of forest, Mr Barry says it can also be applied to clusters of owners with smaller areas.

Up to 2500 aerial photographs are processed to produce an orthophoto, which is a rectified aerial photo similar to google earth, but with far higher resolution. It will also provide height information to an accuracy of within 1pc. The orthophoto can then be further processed to produce tree locations, tree count with tree heights, and actual planted area. The photography can also be used to assess loss of trees due to storm damage, theft and disease.

Baseline Surveys Ltd have recently carried out a number of trials for Coillte, and as one Coillte area manager commented to me, their technology provides 60pc of the forest inventory before anyone has to step foot into the forest, and to a far greater degree of accuracy than was ever possible, even with an army of foresters on the ground.

For further information contact Baseline Surveys at paudie@baselinesurveys.ie and 086-2535285.

William Merivale is national secretary of PEFC Ireland and a forestry consultant based in Cork. Email: william@cjandco.net