CAN TREES BE DEPRECIATED LIKE PLANT?

A DEPRECIATED REPLACEMENT COST SOLUTION TO THE ADJUSTED TRUNK FORMULA ANOMALY IN CTLA'S TRUNK FORMULA METHOD.

ABSTRACT

With regard to the Council of Tree & Landscape Appraisers' (CTLA) Trunk Formula Method (TFM) of amenity tree valuation, this paper proposes an alternative procedure to that of the Adjusted Trunk Area Formula (ATAF) in consideration of large trees (>750mm stem diameter) and their costs or values. The ATAF seeks to regulate intuitively the accelerating costs of larger diameter trees, by applying a quadratic equation to their area increments. The proposed alternative will be more consistent with a Cost Approach to value: adjustments are no longer made to the cost metric, but are instead encompassed explicitly within the process of depreciation by assessing the comparative age of a tree, as well as its current condition. Such a broader definition of an asset's Physical Deterioration is in keeping with universal appraisal practice.

DEFINITIONS

Depreciated Replacement Cost (DRC): The current cost of replacing an asset with a modern equivalent asset less deductions for physical deterioration and all relevant forms of obsolescence and optimization (RICS 2006)

Trunk Formula Method (TFM): a CTLA method for scaling available unit costs for notional tree replacement up to estimated unit costs for larger trees for which data is unavailable (and thereafter depreciating under Species, Condition and Location factors to an estimate of value) (CTLA 2000)

Adjusted Trunk Area Formula (ATAF): a method of scaling down those costs for large trees based on the premise that large, mature trees do not increase in value as rapidly as trunk area increases (ibid).

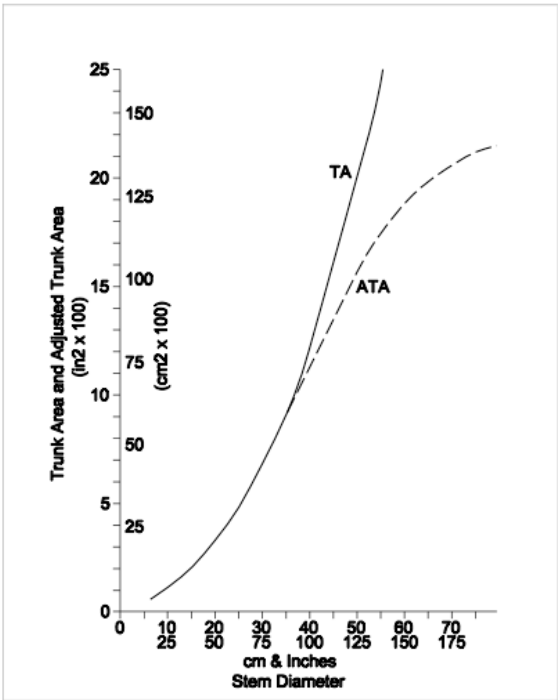
Optimisation: a process of adjusting the replacement cost to reflect that an asset may be technically obsolete or over-engineered, or the asset may have a greater capacity than required (RICS 2006)

Accountant's Depreciation: the writing off of an asset or plant over a given service life (ibid).

INTRO

Currently within the TFM, an adjustment (ATAF) is made for the rapid increase in value of larger tree sizes: because the cost metric is based upon Trunk Area, even small increments of annual growth in maturity can have large effects on final tree value (see Figure 1 below):

Figure 1 Profile of adjusted trunk area



According to the principles of *Optimisation*, there may be diminishing returns beyond a certain point of engineering (RICS 2006). So, trees reach an economic and aesthetic maturity from which increases in size will not necessarily correspond to a proportional increase in contributory value to their environment (CTLA 2000). Notwithstanding the logic of scaling up costs under TFM, the end value of the appraisal process, still needs to correspond with an amount the hypothetical buyer would be prepared to pay: the modern equivalent is defined by its comparative performance and output, not its physical characteristics (RICS 2006). Similarly, a veteran tree is not defined by its age or size, but by its ecological function – comparative habitat provision, such that an early mature tree may be deliberately *veteranised* for management purposes.

Selecting an alternative cost metric to area does not solve the problem, as each choice may have its own bias: basing the system on diameter may increase the value of smaller trees, disproportionately. Moreover, much historic effort has already been expended in the US over choice of metric. (Chadwick 1980) affirmed that "Values" based on sectional square inches of trunk area in 1951 and 1979 corresponded closely with the average cost of transplanting trees by commercial arborists, and were not hypothetical as others had indicated. This assertion is supported by a more recent comparison of actual and TFM-generated costs in the UK (Hollis 2007).

However, the reference betrays a historic misconception in CTLA methods: “the misconception of the period was that this was a "value" number. We have now embraced that it is a cost number related to value through depreciation. It is a cost metric and only tangentially or incidentally based on an allometric relationship (Cullen 2008 pers comm).

The task then, is to relate that cost metric to value through latter depreciation in such a way as to factor in the optimisation of size or the diminishing returns of maturing trees intuited by CTLA methods and inferred from universal appraisal logic. NB there is no assertion that large or veteran trees do not achieve considerable values or that they are broadly comparable with early mature trees; the assertion is that within the logic of DRC, they do not *accelerate* in value indefinitely and *in virtue* of replacement cost alone. Like all assets considered within a Cost Approach, they are subject to depreciation: even ecological function has its own optimisation and obsolescence, of necessity, in so far as it is a function. Certainly, the ATAF has a depreciating effect, but it is applied in the wrong place in the appraisal process; its *a priori* logic is intuitive, but inconsistent with explicit appraisal theory.

THEORY

The ATAF adjustment could occur within the CTLA depreciation process, but in practice, options are currently limited, as the *Species, Condition & Location* factors do not allow for depreciation on grounds of actual tree size: Species currently depreciates for genetic fitness, Condition for physiological and structural defects, and Location for site contribution and placement (Hollis 2007).

Condition is the most obvious conduit for this exercise, but at face value, the physiological and structural condition of a tree may be only explicitly related to size many years into maturity; i.e. immense trees are generally more debilitated than small ones. Implicit depreciation under the ATAF begins at the prime of maturity for many large growing tree species (750 mm stem diameter). Such mature trees may remain in fine condition for many years beyond attainment of this size-threshold and therefore, no depreciation under Condition is evidently possible (i.e. where percentages are principally deducted for disease, infestation, dieback and other debilitation).

However, recourse to wider appraisal theory may prove illuminating: CTLA's Species, Condition and Location factors are rudimentary equivalents to IVS Functional Obsolescence, Physical Deterioration and External Obsolescence (Cullen 2000). Although the original similarity was perhaps serendipitous (i.e. only exposed by Cullen), the legitimacy of that link was further recognised by the Valuation Standards Board of the Royal Institution of Chartered Surveyors (RICS pers. comm.) in their review of the UKI-RPAC Supplementary Guidance Note 1 (Hollis 2007).

In standard appraisal practice, Physical Deterioration considers the *comparative age* of an asset as well as its *current condition*, thus including an element of accountants' depreciation (RICS 2006); i.e. the writing off of the asset over time, as well as the more immediate structural debilitation considered within CTLA methods. Physical deterioration considers not only the result of wear and tear over the years, but also compares the decline in value of an asset of a similar age for which there is a market with the value of new assets in that market (RICS 2006)

Thus, although the accountants' specific depreciation of assets over time is different to the more general financial depreciation to reflect current obsolescence, there is no reason that the former cannot be utilised within the latter: though the definitions are separate the processes are not exclusive. Indeed, it could be argued and has been (Price 2004) that CTLA methods are deficient in not recognising this time-related obsolescence.

The hypothesis of this paper is that the explicit link between age and size can be exploited to translate the ATAF formula into an accountant's depreciation curve: the diminishing returns on incremental growth can be correlated with the diminishing asset life of a tree as it ages and dies.

METHOD

The sequential, depreciative effect of the ATAF on individual tree sizes can be plotted as a curve and then compared with various optional depreciation curves. Before the visual comparison of the ATAF and depreciation curves can be made, it is necessary to translate tree sizes into tree ages and *vice versa*. Although the science is unavoidably inexact, this paper relies on Mitchell & Wilkinson (2001) for the purpose of correlation.

It might be argued that the environment in which a tree grows will affect the rate of growth, thus distorting such comparisons, especially in urban conditions, where conditions may be sub-optimal. Against this argument, it should be understood that foresters frequently speak of "physiological age"; i.e. the demographics of forest plantations are determined with greater reference to biomass production than to chronological data (Savill & Evans 1986). Mitchell's rule-of-thumb is also based upon the law of averages. Figure 2 below plots the diameter growth of an average oak tree against Mitchell's criteria over 500 years.

Figure 2 Comparison of tree size and age

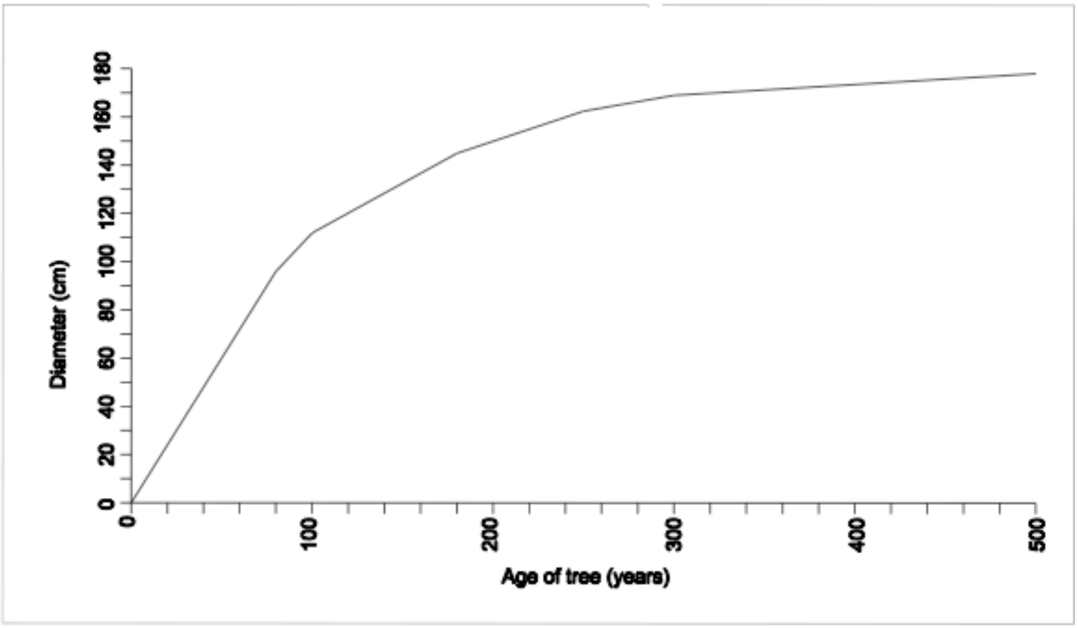
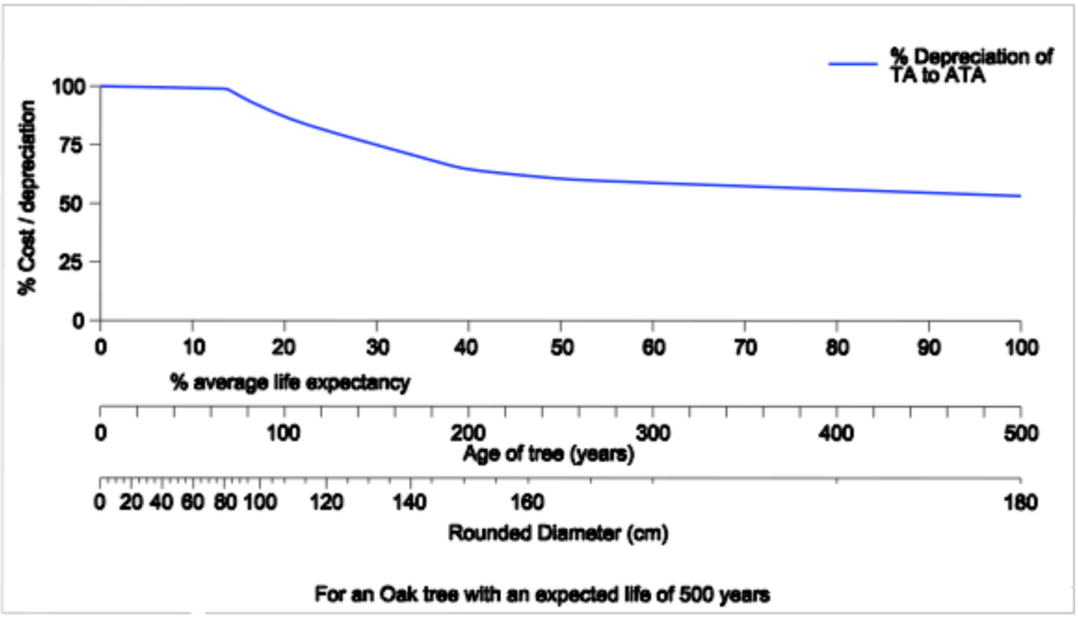


Figure 3 shows the depreciative effect of the ATAF on tree size and cost plotted as a curve to 2000mm diameter and cross-referenced to Figure 2 above to correlate with 500 years growth of an oak tree. Granted, few oak trees will achieve this longevity, especially in an urban situation, where many of these valuations will be carried out. On some special sites, oaks may achieve 700-1000 yrs life spans. However, the graph can be extrapolated to suit the circumstances – the local averages. Mitchell (2001) states a generic average 200-300 years for Common oak (Quercus robur) in the UK.

Figure 3: Profile of ATAF depreciation curve

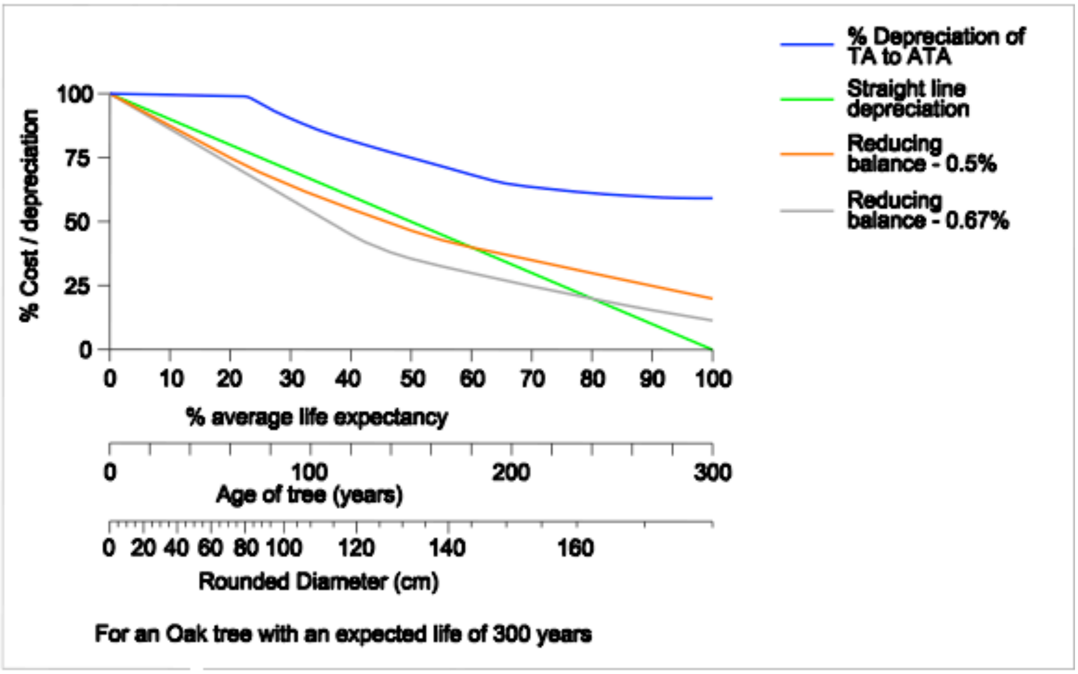


For an Oak tree with an expected life of 500 years

It is now possible to compare the ATAF curve with a variety of depreciation curves and see which is the closest fit, and whether on that basis any conclusions can be drawn. In selecting a depreciation curve, it is not necessary to choose the closest fit for the sake of it – other considerations will apply. However, if a sensible depreciation curve can be chosen and that curve fits the ATAF curve, then there will be a congruence of referenced methodology to support that choice.

Figure 4 shows the ATAF curve plotted against a standard straight line and a reducing balance curve for a tree of 300 years life expectancy. The straight-line method simply divides the depreciation evenly over the time frame. The reducing balance is conventionally calculated at 1.5 and 2 times the rate of the straight-line balance.

Figure 4: Profiles of straight line and reducing balance depreciation



Both curves are steeply concave and do not at all fit the ATAF curve. Moreover, intuition tells us that trees do not depreciate typically – they do not lose half their value when they leave the nursery floor. Intuition suggests a less steep or more convex curve, which points towards a variable reducing balance method or S curve. The latter is recommended where sufficient data is available to be confident that the curve represents the likely reality. The percentage deducted for any given year will depend on decisions made as to the rates of depreciation at different times and when these change. In the absence of empirical evidence in support of these inputs, the exact pattern of the curve may be dependent on subjective inputs (RICS 2006).

The question arises though, as to where to find sufficient data to support such a subjective input? The answer may lie with discounting criteria (which assess the current value of future expectations): the curves of discounted expenditure have more of a convex profile, though their profiles are highly sensitive to the discount rate that is selected for any given scenario (Hart 1995).

Figure 5 Profiles of cost of tree loss

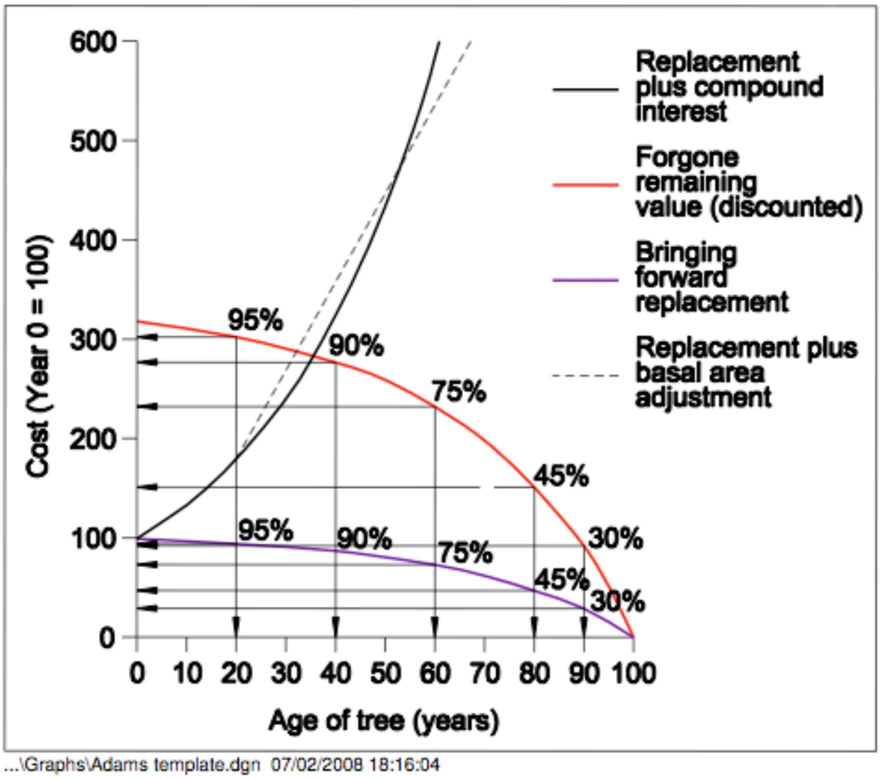


Figure 5 (from Price 2004) suggests such discounted cost profiles (in which the cost values expressed as percentages are herein overlain). Price uses the graph to criticise CTLA methods for failing to consider the cost of *bringing forward* the cost of replacement, which might in any case have taken place at the end of the tree's life and of the loss of the benefit that might have been enjoyed, had the tree survived - measures which move in opposite directions to standard replacement costs as the tree ages. In essence, time-related constraints upon the benefits of retaining the appraised tree are not being recognised in the depreciation process.

Price uses an idealised depreciation curve to describe these time costs: both curves are of identical curvature, but different quantities. They can therefore, be analysed as one within this paper, in terms of discount rate. As discussed above, it is critical which percentage rate is selected for discounting purposes. It is not clear from the paper and personal correspondence, whether or not the author had a specific rate in mind. However, when a range of discount curves are plotted against Price’s curve(s) (Figure 7), it becomes clear that a 3% discount rate most closely fits the model(s).

A 3% discount rate seems an appropriate rate to inform a variable reducing balance depreciation of a tree’s asset life in the UK, because it corresponds with social time preference rates for similar public assets: the Forestry Commission is set a 3% target return on all its woodlands from upland conifer plantations to lowland amenity woods (Hart 1995). Property development aside, amenity tree planting and maintenance are not commonly perceived as activities undertaken for a high financial return (Hart 1995).

Alternative discount rates could be selected for alternative end users (private, corporate or state ownership). The purpose here is not to dictate a rate but merely to explore the possibilities

To use the selected discount rate in our accountants’ depreciation, it can simply be converted into its equivalent variable reducing balance interest rates over the life of the tree.

Figure 6 Foregone remaining value (3% discounted) expressed as a variable reducing balance over 100 year life expectancy

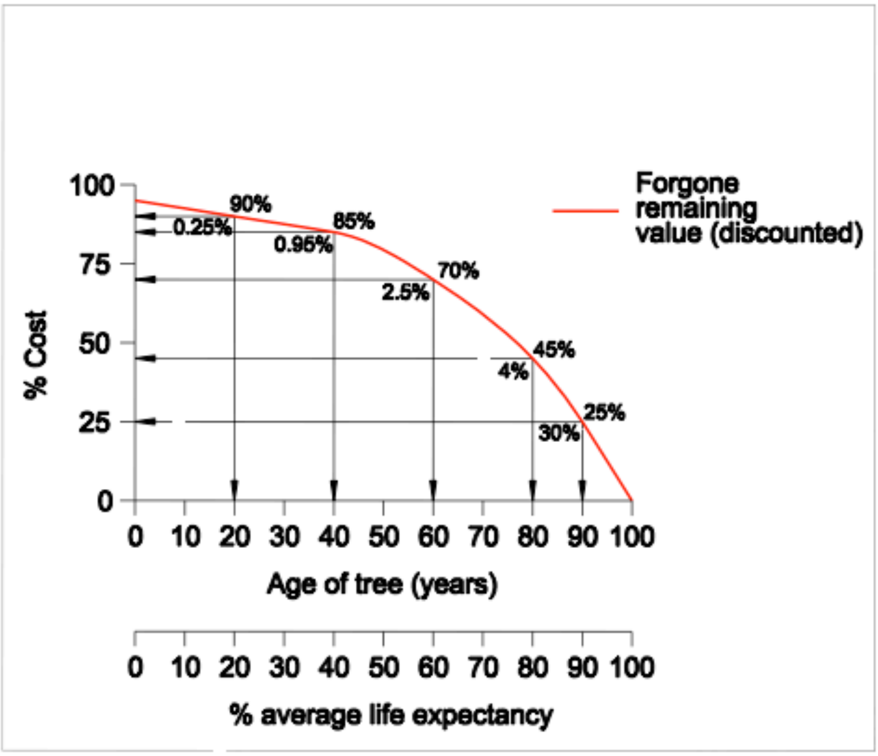
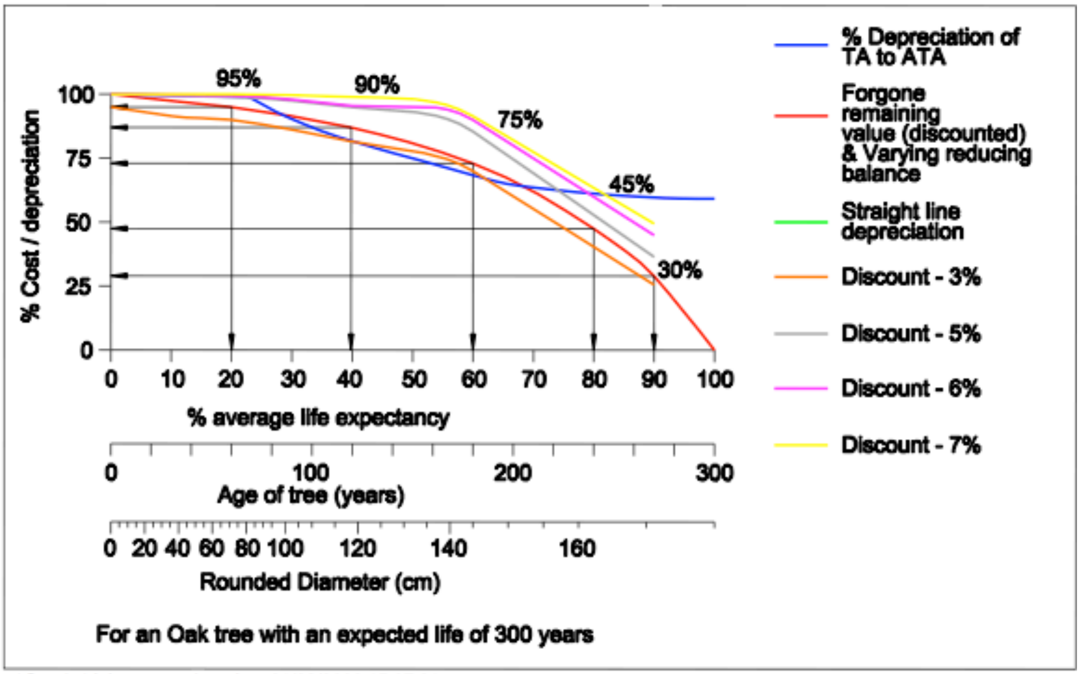


Figure 6 above shows the 3% discount curve expressed as variable interest rates over 100 years. The variable interest rates are written below the curve and the foregone remaining values are written above the curve. These variable rates (below the curve: 0.25% - 30%) can be converted into universal depreciation grades (above the curve: 25%-90%) over any given life expectancy by applying those grades to the percentage of remaining life expectancy (e.g. 40% of 100 years) rather than actual number of years (i.e. 40 yrs), so that the units along the graphs' x-axes are effectively substituted from one line to the other in Figure 6.

The 100-year curve can thus be extended pro rata over any reasonable life expectancy (100-500 years), as appropriate (see Figure 7 below). This substitution of exact units (years) for broader descriptors (percentages) seems an appropriate procedure given the confidence limits of our life-expectancy predictions.

Figure 7: Profiles of variable reducing balances modelled from 100 year discount curves and extended over 300 years



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Applying this process, Figure 7 confirms that Price's model(s), the 3% and the ATAF-derived curves are broadly similar for 70% of the asset life of an oak tree of 300 years life expectancy, and significantly distinct from curves calculated from the higher discount rates. Mitchell (2001) suggests a 200-300 year average life expectancy for English oak (Quercus robur). The main point of departure from the ATAF curve is at the end of the x-axis, where the discount curves drop away to zero. This departure is only to be expected, because the ATAF makes no assumptions of mortality and relates to a size metric only. The departure therefore, represents the mortality spiral of the tree.

CONCLUSION

Thus, using a variable reducing balance method of depreciation to assess the comparative age of a tree, in terms of its physical deterioration over time, has broadly the same effect as applying the ATAF to the costs of tree replacement in respect of size. However, the former is applied in the logically correct place – under depreciation for relevant obsolescence, whereas the latter is applied out of place, to the cost metric. The variable reducing balance, in this example, is based on a 3%-discount rate for foregone remaining value / premature replacement planting. In relocating the ATAF adjustment within the deprecation and in modelling the process on discounting criteria, the proposal not only brings the method back in line with universal appraisal practice, but also reconciles some of the missing cost implications, suggested by Price.

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