editorial
Stiff wood or stiff biccies...

"What do you think of New Zealand?" The classic question reputedly asked of so many visitors has provoked a variety of answers. John Lennon replied that after 10 minutes on the ground he thought the inside of the terminal was just fine. I returned to New Zealand with a freshly-minted forestry degree in 1975 after a globe-trotting childhood, and one of my colleagues at Kaingaroa waited a couple of weeks before posing the forestry equivalent, "What do you think of forestry in New Zealand?" I didn't hesitate: "You're not fully utilizing the site". There followed a careful explanation of what at the time made New Zealand plantation silviculture unique. Essentially, New Zealand silviculturalists trade volume production for value in a highly productive environment, leading them to some rather unusual silvicultural strategies with very low stockings. I explained this to an audience in the Southern USA earlier this year. When I got to the part about pruned regimes on low quality sites with final crop stockings of 80 stems/acre, an anonymous voice in the back of the room exclaimed, "Oh, that's ridiculous!" Many people still equate volume with value over there.

Until recently "value" over here was defined by large-scale log geometry, with small defect cores, large stem diameters, small branches on unpruned logs and minimal sweep paramount in the minds of decision-makers as they crafted their silvicultural regimes. We've witnessed a dramatic change in focus over the last few years, however. I recently took a group of first pro forestry students on a trek into the wilds of the Maruia, to the mainland island at St Arnaud and then on to Nelson where they learned about real forestry from staff at Rayonier Ltd., Weyerhaeuser Ltd. and Nelson Pine International. Nelson Pine sets a velocity limit for logs, measured with a resonance acoustic device, of 3.1 km/s. New definitions of value require changes in silvicultural thinking and new kinds of assessments.

The initial plea from log buyers was for longer rotations. Older trees, it was reasoned, would contain lower proportions of corewood, wood growing close to the pith. Compared to outerwood, corewood has lower density, higher microfibril angles (MFA), higher gradients in MFA and consequently higher gradients in longitudinal shrinkage. These features make it less stiff, and less stable during drying than outerwood. However, all good silviculturalists know that long rotations come at a large cost, and so there have to be better ways to improve value.

Breeders began to measure density and log velocity (thought to be a measure of average MFA), noting that many wood properties are highly heritable. Breeding and perhaps clonal forestry can be part of the answer, but silviculture is at least as important as genotype.

Arturo Bascuñán, a Chilean MForSc student at the New Zealand School of Forestry, showed that stems closer to stand edges had lower velocities, postulating that sway may influence MFA (see his article in this issue). JP Lasserre, another Chilean MForSc student, demonstrated that higher initial stockings of radiata pine promoted growth of corewood with higher acoustic velocities (see NZJF, August 2004), and more recently Matt Waghorn, also an MForSc

student, mapped log velocity up stems of different breeds at a range of stockings, noting that while the first 2 m of a stem often had the lowest velocity, the section from 2-4 m above ground level often had the highest velocity (Figure 1). Presumably, if high velocity logs are sufficiently more valuable than lower velocity ones, managers might increase crop value by lopping off the lower sections of stems before bucking. Mike Watt, of Ensis Ltd., noted that stem slenderness was often related to velocity at breast height, and pointed to a functional relation that might compel a slender tree to become stiffer in order to prevent stem buckling (see Annals of Botany 98: 765-775, 2006). Matt's results appear to show that the "avoidance of stem buckling" hypothesis cannot explain patterns of log velocity observed up stems. Some of my personal research indicated that distance to canopy might also influence velocity (Canadian Journal of Forest Research 36 (10): 2454-2463, 2006), corroborating some theories of P. R. Larson from the 1960s who suggested auxins exuded by new buds and foliage might influence MFA (and therefore velocity). One fascinating theme running through all our work so far is that genetic and silvicultural effects on velocity do not interact; they are additive. Whatever genotypes are doing to alter log acoustic velocity, it's unlikely to comprise the same processes that drive silvicultural effects.

Figure 1 - Modelled log velocity versus height and stocking in Matt Waghorn's study, for 19 year-old, 870 breed radiata pines growing on a dry site in Canterbury.
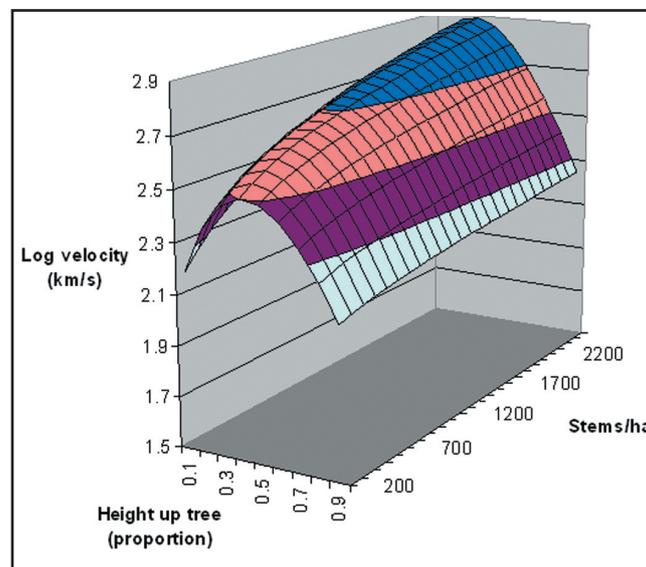
Why are we chasing all these explanations? Partly for the joy of discovery, but mostly because forest managers are asking two questions in the face of changing definitions of value for structural logs: a) "Where and which are my high velocity stems?"; and b) "How do I create higher velocity ones in future?". They need models that represent where their stiff wood is and decision support systems that give silviculturalists feedback about the nature of the wood they are creating. Moreover, in my view we need models of wood properties at a ring level, because gradients in MFA and

The experiment shown in the photo is designed to examine the impacts of tree sway and radial growth rate on microfibril angle, density and resin pockets. (Photo Euan Mason)

density affect stability of sawn lumber.

Why not simply include measured effects of stocking and genotype directly in the models? The reason why this might be misleading is that many candidate explanatory variables are collinear in stocking experiments, that is, they vary together. For example as stocking increases then radial growth rate drops, canopies move up stems more rapidly over time, wind loading on (and presumably sway of) each stem is less and stems become more slender. Suppose we build a ring level model of MFA development using radial growth rate as an independent variable, and a manager decides to reduce corewood MFA by retaining weeds on a site, thereby restricting radial growth. It would make sense, and the model would indicate that log velocity should increase. I recently measured time of flight velocities in a weed control experiment in Canterbury, and trees subjected to the most competition from grass had the lowest velocities! (See the CJFR article quoted above.) Clearly there's much we need to learn before we can deliver robust silvicultural models that include log velocity outputs, let alone estimates of stability during drying.

When we deliver such models, we'll need a Structural Log Index (SLI), equivalent in function to Jim Park's Pruned Log Index (PLI), that relates measurable log features to log value in a structural log market. Log velocity might give us an index of stiffness, but is it adequate as an index of stability during drying? We clearly need log and branch dimensions in the SLI, and I suspect we might need to add something more elaborate; for example, the volume-weighted mean gradient in MFA within 50 mm segments of radii within a log, given that much structural lumber is cut to 50 x 100 mm.

Plantation silviculture in New Zealand is changing, and it is timely to devote some copy to impacts of silviculture on wood quality. This issue of the journal contains some of what I hope will be many articles on this important topic.

What do I think of plantation silviculture in New Zealand? It's very exciting.