BACK BOX

Shrinking snow gums

If you are the skiing type, ponder the snow gum next time you indulge in your favourite pastime. Those little trees on the snow field are probably quite a bit thinner than they would be in warmer weather.

This rather unexpected fact came by chance from some CSIRO research into the ecology of snow gums. Mr Eddie Pook and Mr Terry Hall, of the Division of Plant Industry, were routinely measuring year-round the growth of the boles of 10 mature trees in south-eastern New South Wales at an altitude of 1250 metres.

At dawn on one particularly cold August morning, for example, when the temperature was −7°C, their trees had slimmed down by amounts varying between one-half and four times the additional width put on during the previous growing season. All the trees had more or less recovered their original dimensions when remeasured a week later under warmer conditions.

Actually, it's not only snow gums that contract in cold weather. Conifers and deciduous hardwoods growing in the cold high latitudes of the Northern Hemisphere have been known to do so for many years. But this was the first time this shrinking had been recorded in evergreen hardwoods.

Until recently, nobody has been able to prove why this phenomenon happens. Mr Pook and Mr Hall think that they have now satisfactorily done so—thanks to the rather more amenable type of bark found on snow gums.

Snow gums in the mountains.

This bark is live tissue almost all the way through. Only a very thin dead outer layer covers the living tissue, and making measurements of growth and interpreting them are relatively simple. By contrast, barks of cold-climate and deciduous hardwoods have a fairly thick corky outer layer of dead cells, which complicates things greatly.

To locate where the shrinkage was going on, the two scientists measured the thickness of the bark and the diameter of the woody cylinder. Shrinkage seemed to occur mainly in the bark, not in the wood.

To track down the source of shrinkage more closely, they then cut logs about 30 cm in diameter from sound mature trees. To maintain the logs' water content the researchers sealed their ends with waterproof silicone grease, wrapped them in plastic, and placed them in a cold room. With appropriate measuring techniques they were thus able to accurately follow what was going on in the bark and wood under controlled conditions of freezing and thawing.

To begin with, the dimensions of the logs remained unchanged as their temperatures dropped to freezing point. Water in the outer layers of the bark began to freeze only when the surface had cooled to about −4°.

The logs started to contract some time after ice formation began. Shrinkage occurred only in the bark; indeed when the sapwood froze it expanded slightly. If allowed to thaw out, the logs expanded once again practically to their original dimensions.

What was going on? Mr Pook and Mr Hall did further experiments in which they checked the changes in the dimensions of isolated pieces of living bark as these were frozen and thawed. As a result of their experiments they support an already-existing explanation that says that ice forms in the numerous small spaces between the cells of the live bark tissue.

It seems that when the tissue temperature fell to about −4°, ice began to form in the spaces, but not inside the cells. Ice formation and tissue shrinkage in the pieces of bark began at exactly the same time. Ice did not enter the cells. Rather, water diffused out through the cell walls and formed more ice in the spaces.

If the temperature rose again, then the process was reversed—and water vapour diffused back into the cells. The shrinking of the bark was thus caused by the cells becoming smaller as water diffused out of them. Water diffusing back into the cells made the bark thicken again as it thawed out.

This explanation isn't actually so surprising. One of the reasons for snap-freezing fruits and vegetables to preserve them in the best condition is that if they are cooled too slowly sap diffuses out of their cells and they shrink—just like bark.

The two scientists have now checked other species of gum trees in Canberra, and it appears that they too contract on some very frosty nights.

Studies of the volumetric response of snow gum bark to freezing. E. W. Pook and T. Hall. *Forest Science*, 1977, **23** (in press).