

## LETTER TO THE EDITOR

## PINE NEEDLES AND TREE STEMS

J. C. Grace (1987) showed that the projection of a sector of a circle, averaged over all directions, is  $1/\pi$  times the perimeter. In fact, by a theorem of Cauchy (Matérn 1956), this is true for any convex figure. The same theorem ensures that the expected diameter obtained by calipering a tree from a random direction equals that obtained with a diameter tape, regardless of the shape of the stem cross-section.

## References:

- Grace, J. C. 1987: Theoretical ratio between "one-sided" and total surface area for pine needles. *New Zealand Journal of Forestry Science* 17: 292–6.
- Matérn, B. 1956: On the geometry of the cross-section of a stem. *Meddelanden från Statens Skogsforskningsinstitut* Vol. 46, No. 11.

Oscar Garcia  
Forest Research Institute  
Private Bag  
Rotorua