Genetic diversity in *Eucalyptus globulus* is affected by hybridisation with the rare species *Eucalyptus cordata*

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Natural hybridisation between co-occurring species is fairly common within forest tree genera

*E. globulus* × *E. cordata*
If fertile, hybrids can act as a bridge for gene flow between species A and B (introgression)

Recombination between sister chromatids

Recombination locations are different in every meiotic event

Every gamete carries a unique mosaic of parental genomes

Result of back-crossing between hybrid and pure species A

Gamete from F<sub>1</sub>

Gamete from species A

F<sub>1</sub> back-crossed with species A

Back-crossed progeny have nuclear DNA predominantly from species A, and may resemble species A, BUT

• carry blocks of DNA from species B

• may have cpDNA of species B (depending on cross direction)

Further generations of backcrossing yield complex genetic mixtures
Significance of introgression in natural forest

- Gene introgression may be cryptic (not obvious from morphology)
- Now becoming more commonly detected in forest tree genera (*Quercus*, *Populus*, *Eucalyptus*) due to use of molecular markers
- Apparently under strong constraints – not all nuclear genes are able to pass between species
- Increases genetic diversity
- Even low levels of introgressed genes can significantly affect factors including leaf chemistry, associated insects, microorganisms and mammals

*E. cordata* western morph

*Eucalyptus globulus*: widespread species of SE Australia

Coastal sites/open forest

In wet forest

40 - 70m tall
**Eucalyptus cordata:** rare endemic of SE Tasmania

- High altitude, wet site
- Low altitude coastal site

Chloroplast DNA survey of *E. globulus* and *E. cordata* suggests gene flow between these species at mixed populations

- Analysed chloroplast (cp) DNA across full range of both species
- These species have the same cpDNA haplotype at 6 different mixed populations
- At 4 sites, they share a rare haplotype – highly unlikely to occur by chance
- Combined evidence indicates that *E. globulus* has acquired cpDNA from *E. cordata* (rather than vice versa)
Questions raised

• Is *E. globulus* also acquiring nuclear genes from *E. cordata*?

• Do the same nuclear genes introgress at different mixed populations?

• Do introgressed genes disperse into the wider *E. globulus* population?

• What are the effects of introgressed genes on phenotype and associated organisms?

↓

Study further using high genome coverage nuclear markers (AFLP)

Fine-scale study of *E. globulus* forest surrounding a population of *E. cordata* in the Meehan Ranges
Chloroplast DNA haplotypes in *E. globulus*

- **E. globulus** with same cpDNA haplotype as *E. cordata*
- **E. globulus** with other cpDNA haplotypes
- No data
E. globulus samples identified by AFLP markers as being of hybrid origin

- F2 hybrid (flagged in field)
- Backcross (F1 x E. globulus)
- Carry >1 marker typical of E. cordata
- No data

E. cordata population

Different E. cordata AFLP markers show different patterns of dispersal into E. globulus

- 257
- 132b
- 207
- 287
Conclusions

**Chloroplast DNA:**
- Chloroplast DNA in *E. globulus* matches cpDNA of *E. cordata* around the zone of contact with *E. cordata* and out to 1 km in this study; examples of up to 25 km in broader-scale study

**Nuclear DNA:**
- AFLP data indicate there has been introgression of several different *E. cordata* nuclear markers into *E. globulus* at this site
- Different AFLP markers show different patterns of dispersal away from the zone of contact with *E. cordata* (some localised, some > 1km)

**Overall:**
- Native gene pool of *E. globulus* is affected by its proximity to *E. cordata*
  — and probably other species with which it hybridises.

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