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

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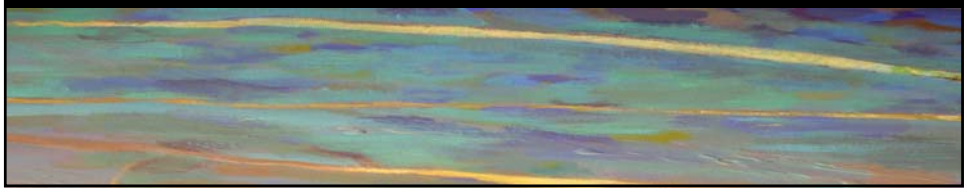
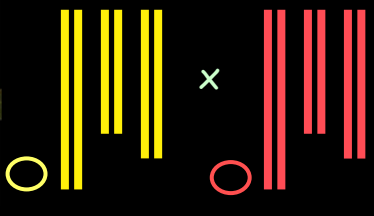


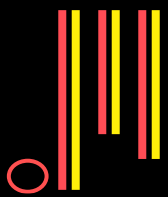
Natural hybridisation between co-occurring species is fairly common within forest tree genera

E. globulus

E. cordata

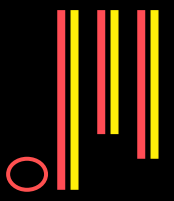


species A species B

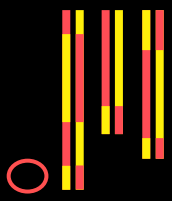


F_1 progeny with cpDNA of the seed parent

If fertile, hybrids can act as a bridge for gene flow between species A and B (introgression)



meiosis

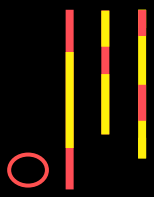


Recombination between sister chromatids

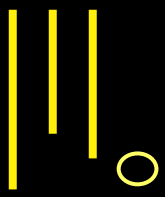
Recombination locations are different in every meiotic event

Every gamete carries a unique mosaic of parental genomes

Result of back-crossing between hybrid and pure species A



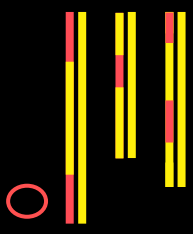
X



F_1 back-crossed with species A

Gamete from F_1

Gamete from 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, micro-organisms and mammals

Eucalyptus globulus: widespread species of SE Australia

In wet forest
40 - 70m tall

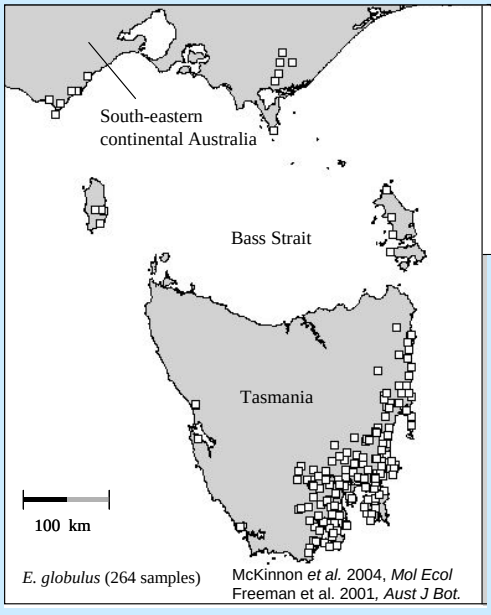
Coastal sites/open forest

Eucalyptus cordata: rare endemic of SE Tasmania

High altitude, wet site

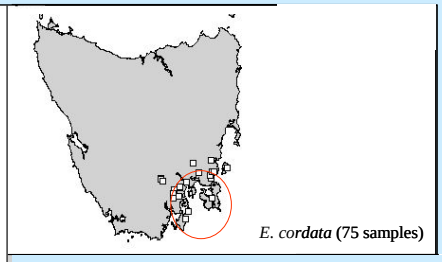
Low altitude coastal site

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



E. globulus (264 samples)

McKinnon *et al.* 2004, *Mol Ecol*
Freeman et al. 2001, *Aust J Bot.*



E. cordata (75 samples)

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)

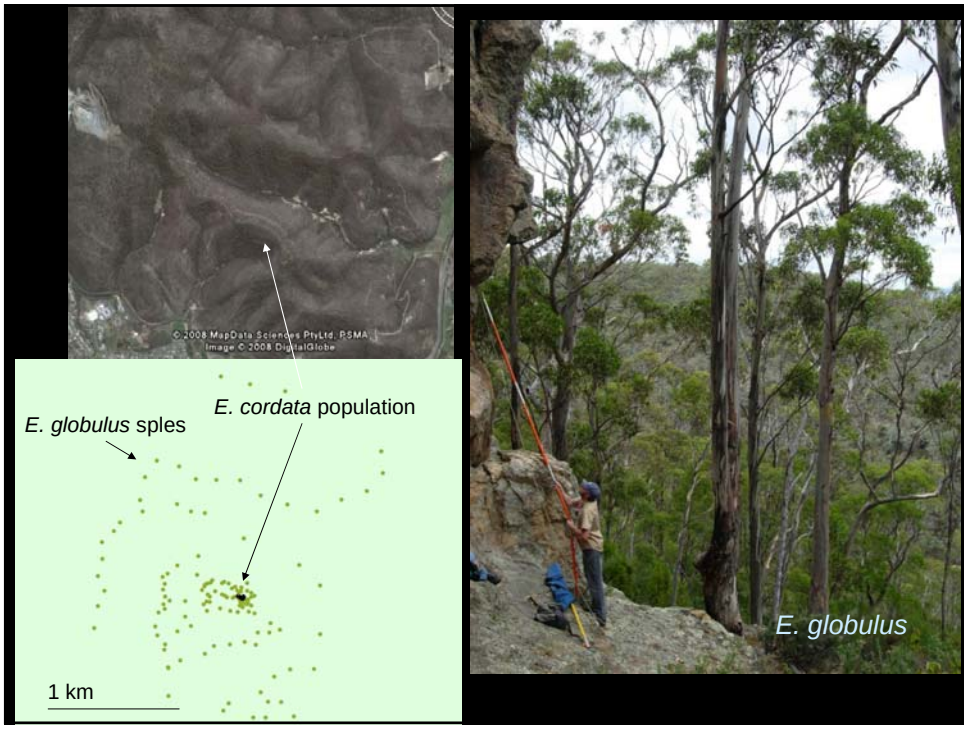
Questions raised

- 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?

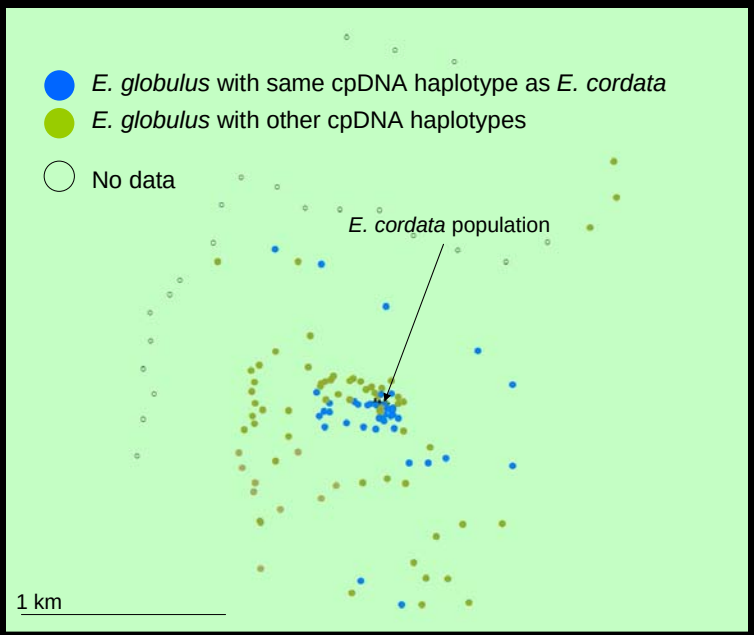
↓

Study further using high genome coverage nuclear markers (AFLP)

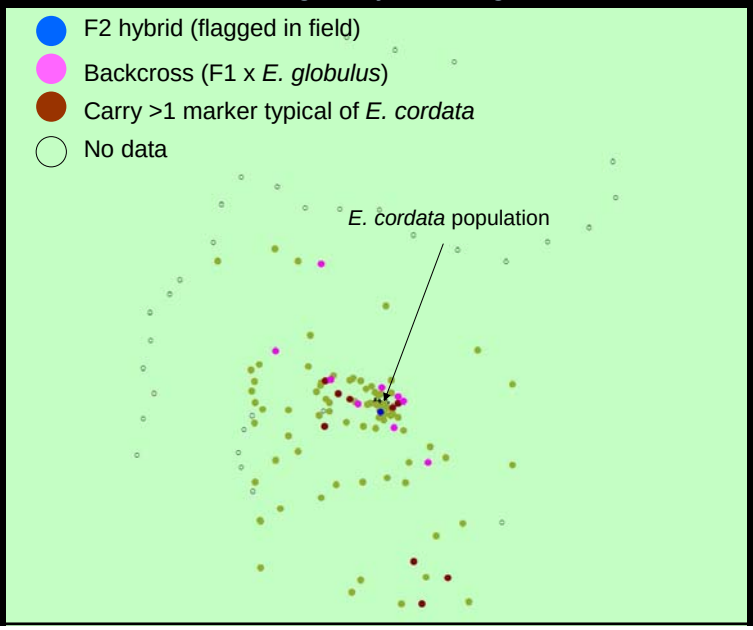
Fine-scale study of *E. globulus* forest surrounding a population of *E. cordata* in the Meehan Ranges



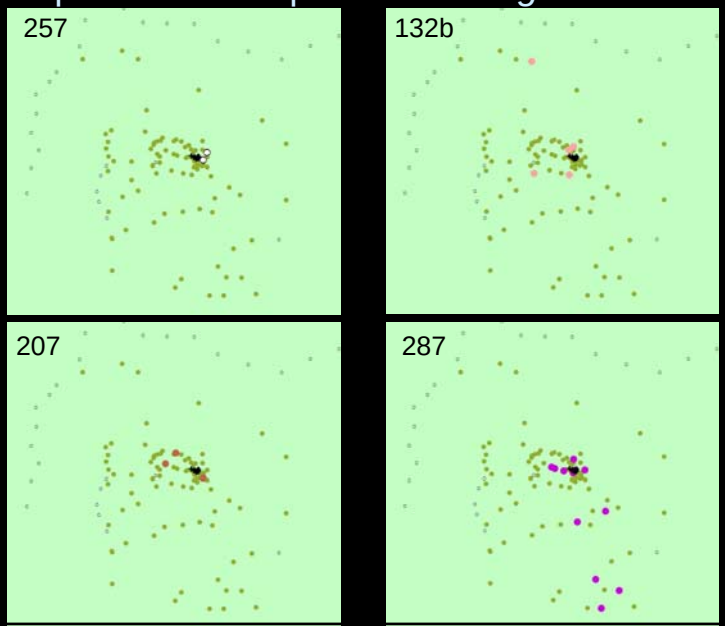
Chloroplast DNA haplotypes in *E. globulus*



E. globulus samples identified by AFLP markers as being of hybrid origin



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



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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