Rampant Taxonomic Inflation

Are multilocus genomic approaches to species delimitation the answer?

Arthur Georges

Institute for Applied Ecology
University of Canberra

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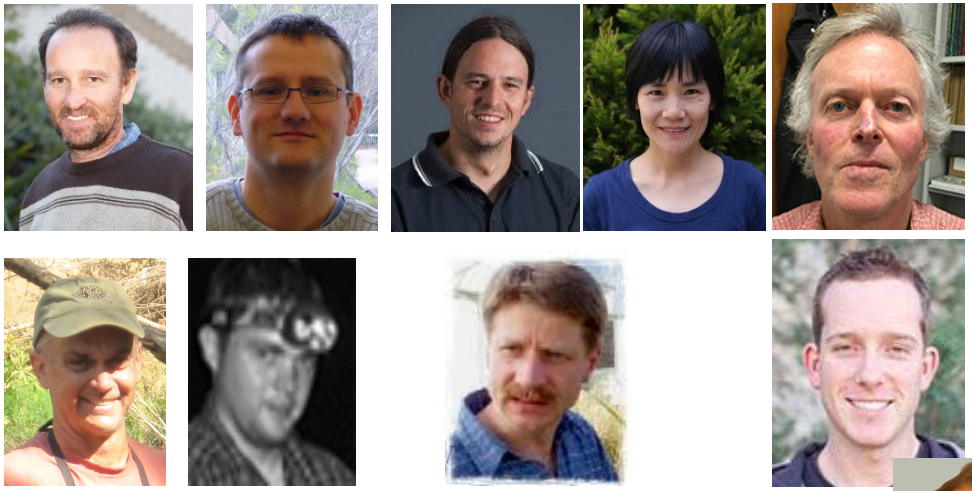


Arthur Georges

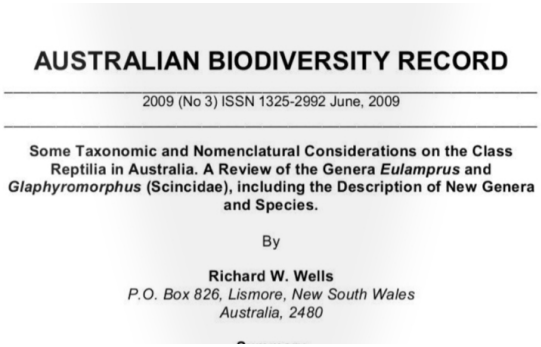
Institute for Applied Ecology
University of Canberra

Australian Government
Department of Education and Training

Australian Government
Australian Research Council

Big Name Hunting

Taxonomic inflation *refers to an excessive increase in the number of recognised species, owing not to the discovery of new species, but rather to changes to how species are delineated.*



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Some Taxonomic and Nomenclatural Considerations on the Class Reptilia in Australia. A Review of the Genera *Eulamprus* and *Glaphyromorphus* (Scincidae), including the Description of New Genera and Species.

By

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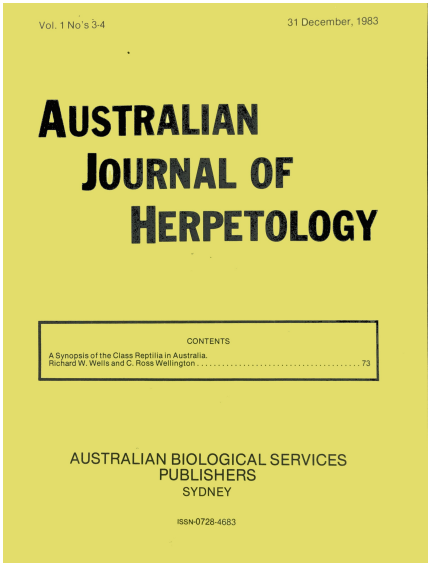

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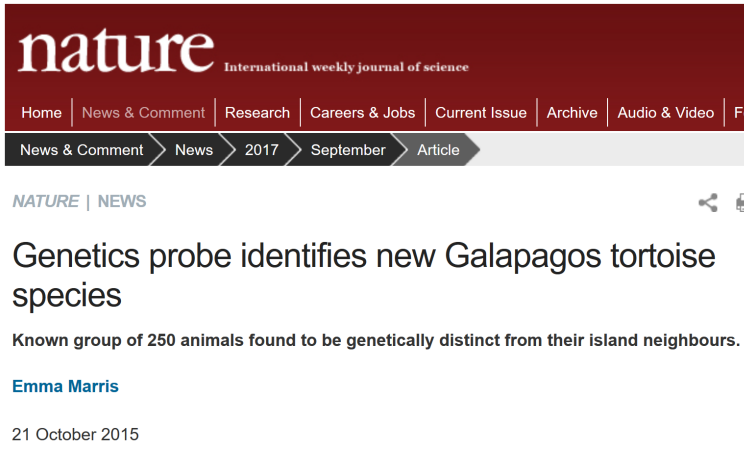
Big Name Hunting

Conservation Imperative

Taxonomic inflation *refers to an excessive increase in the number of recognised species, owing not to the discovery of new species, but rather to changes to how species are delineated.*

12-15 species of Galapagos Tortoise



Chaitra et al. (2004) The biodiversity bandwagon: the splitters have it. Current Science 86:897-899.

Taxonomic inflation *refers to an excessive increase in the number of recognised species, owing not to the discovery of new species, but rather to changes to how species are delineated.*

Are we our own worst enemy?

A species is the smallest aggregation of populations diagnosable by a unique combination of character states in comparable individuals.

A species is a lineage (and its descendant clade) that is on an independent evolutionary trajectory.

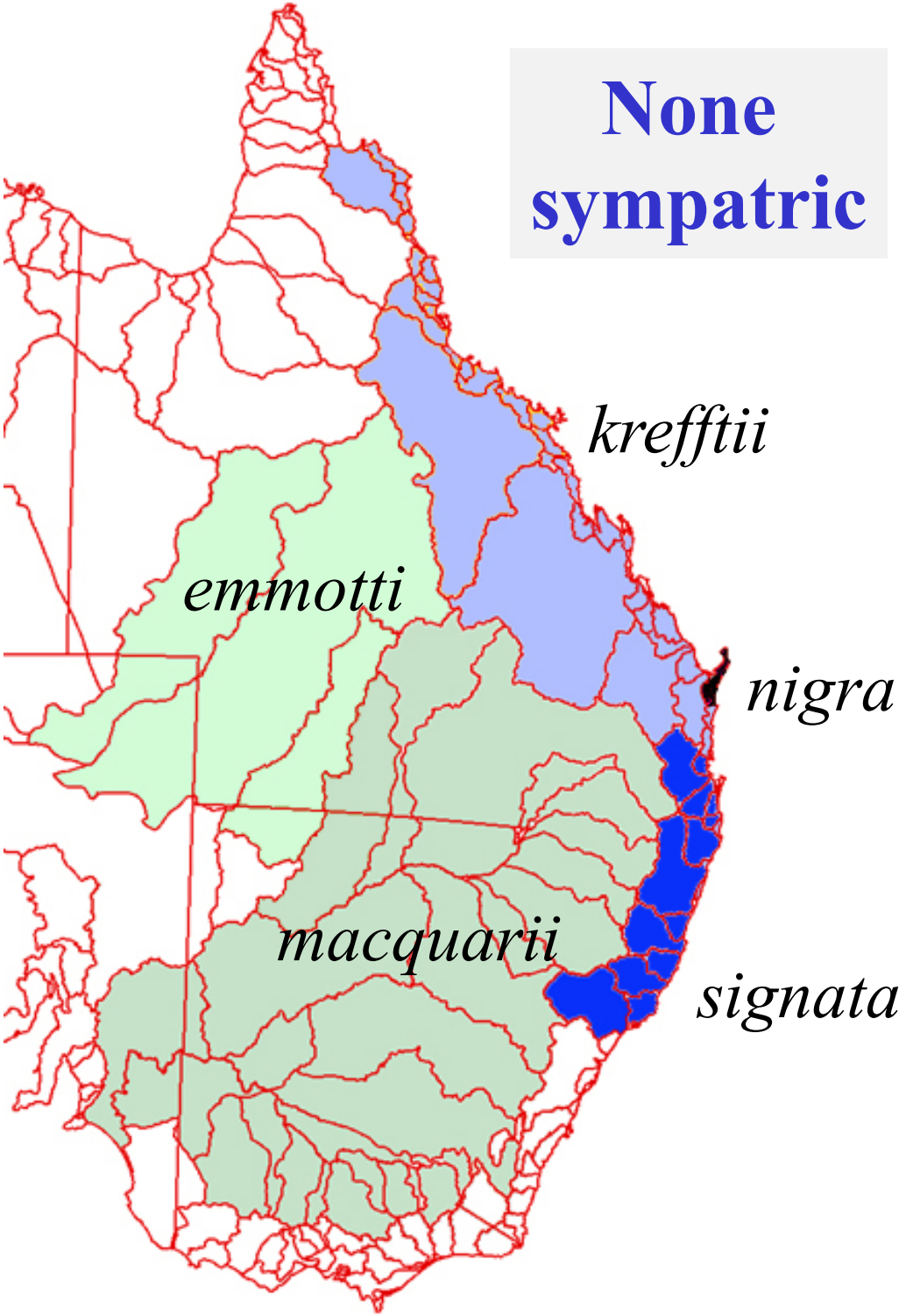
macquarii

signata

‘nigra’

krefftii

‘emmotti’

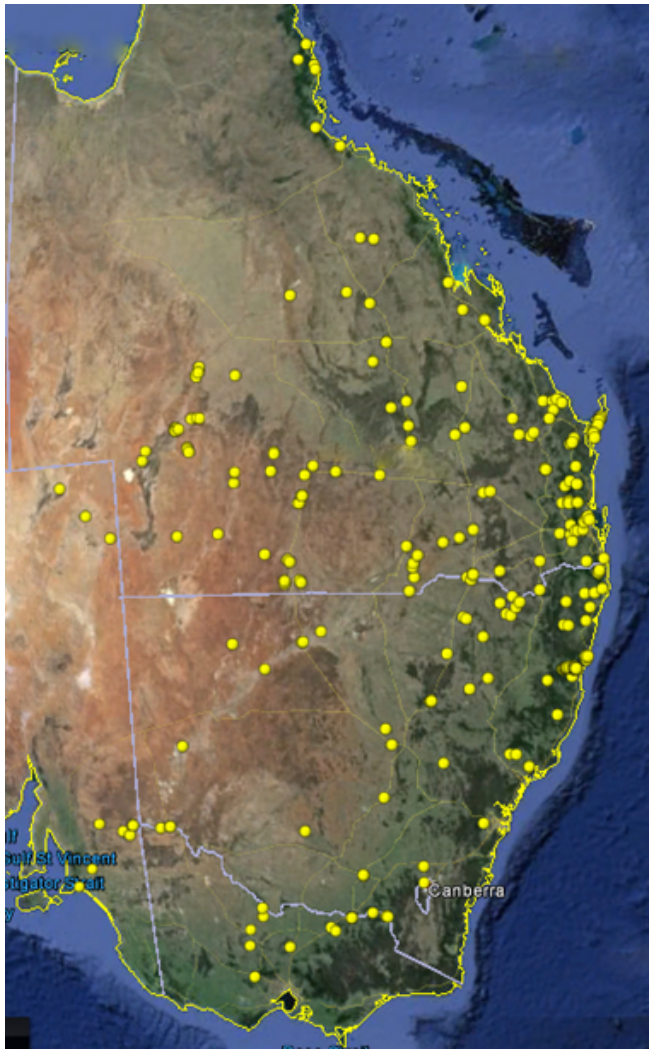


Cheap, effective representational genotyping by sequencing is breathing new life into species delimitation.

Diversity Arrays Technology
IT'S A BULLSEYE WITH DArT

Allows dense sampling across the range of the target taxa – multiple sites, 10 individuals per site

Brings population genomics to the table to complement phylogenomics.



macquarii

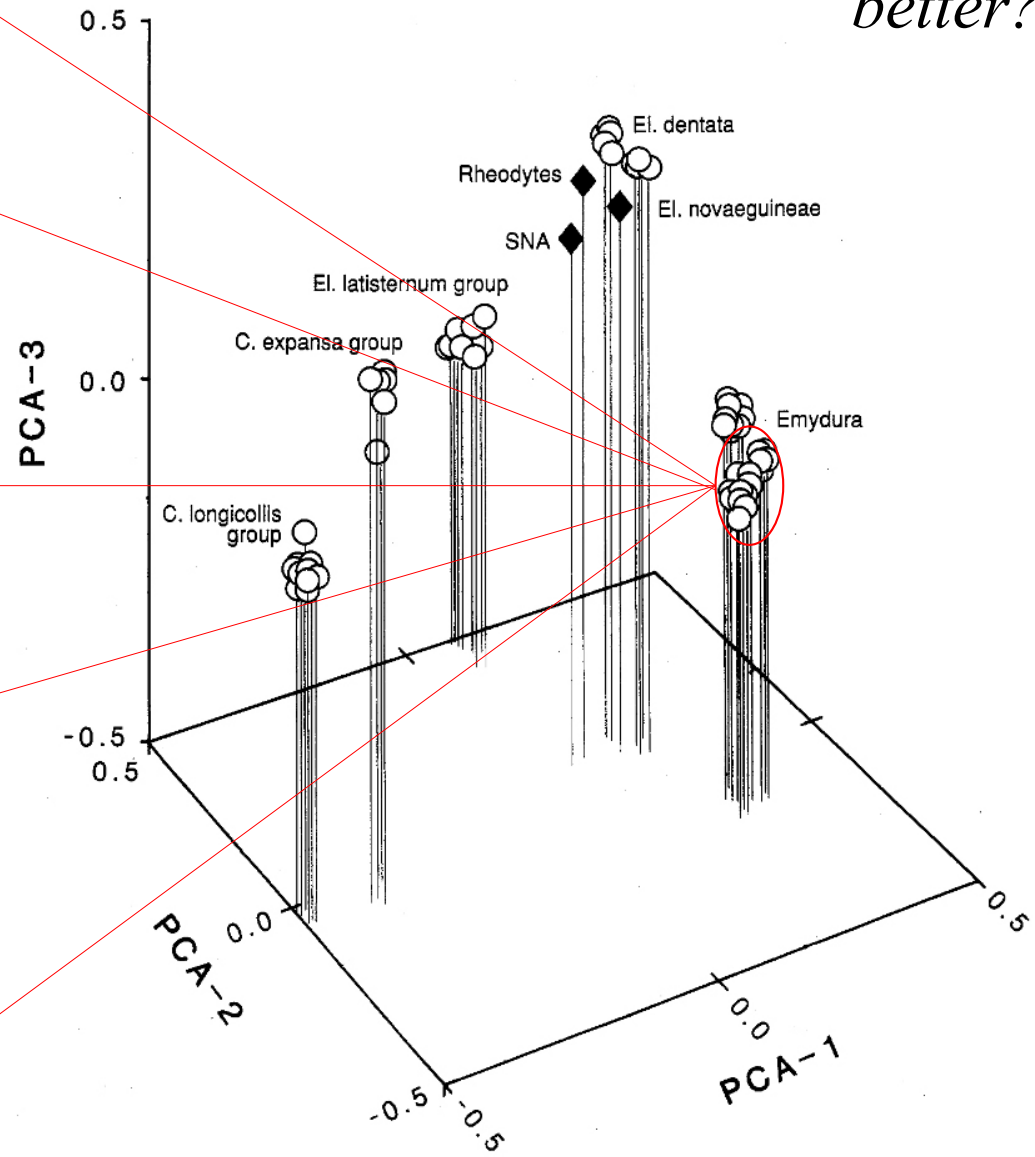
signata

'nigra'

krefftii

'emmottii'

Can SNPs do better?



54 loci, 275 individuals

Pipeline

Tissues plated out (blood, skin) → Diversity Arrays Technology (IT'S A BULLSEYE WITH DArT) → *42,000 SNPs (full coverage)*

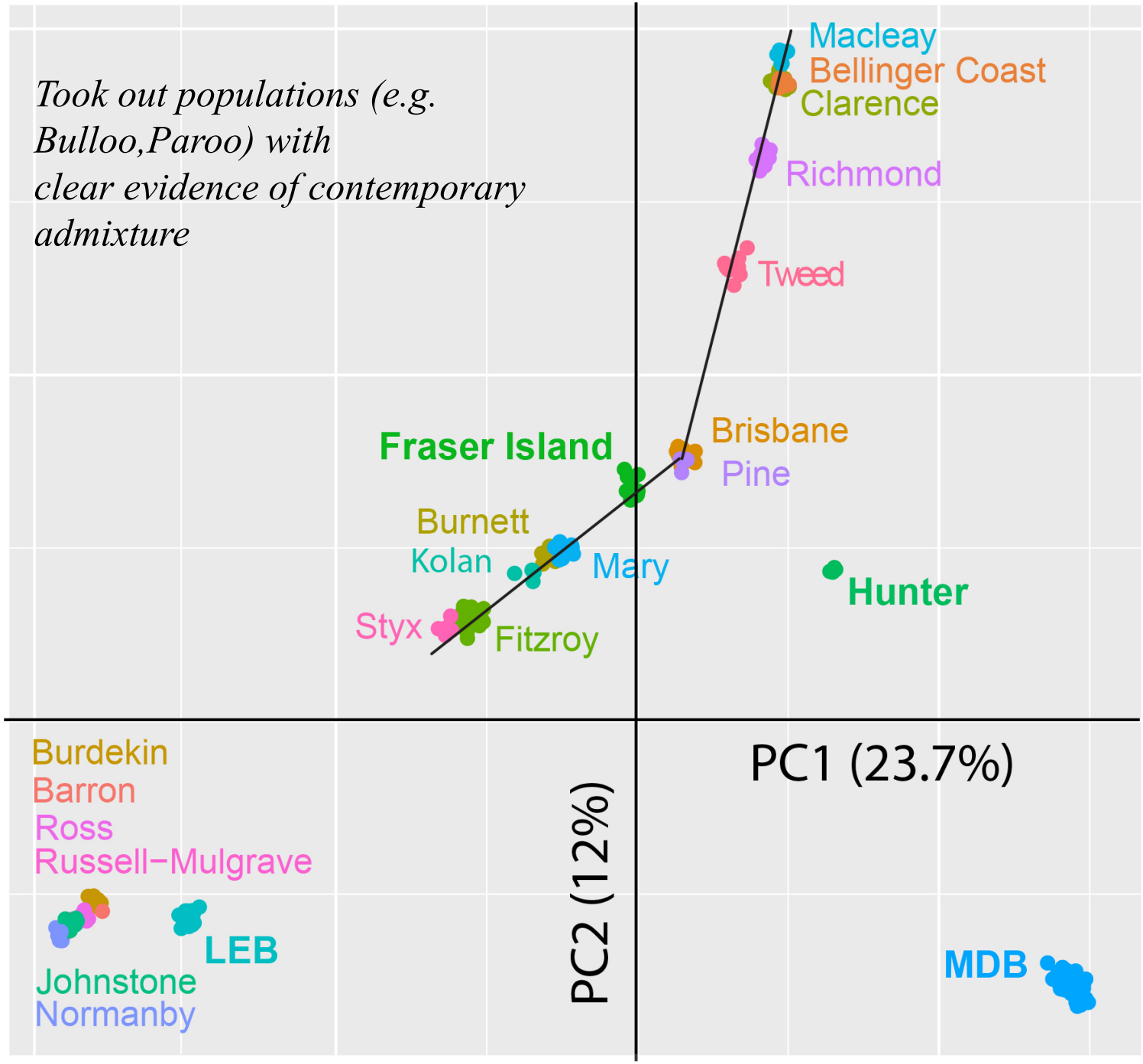
genlight object (R package {adegenet} → *Additional stringent filtering (repavg, callrate)*

Analyses

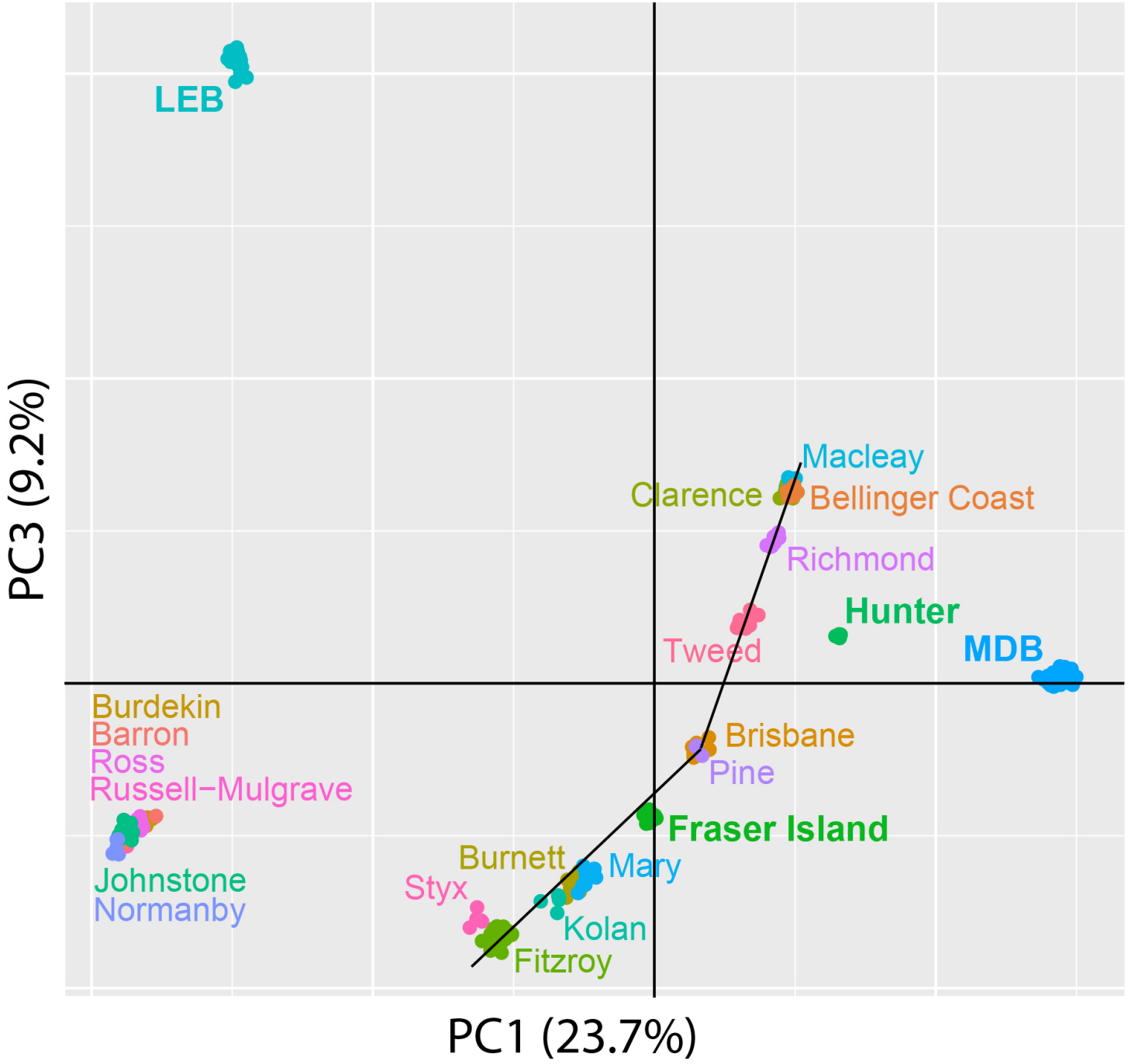
dartR

install.packages("dartR")

Results – PCoA

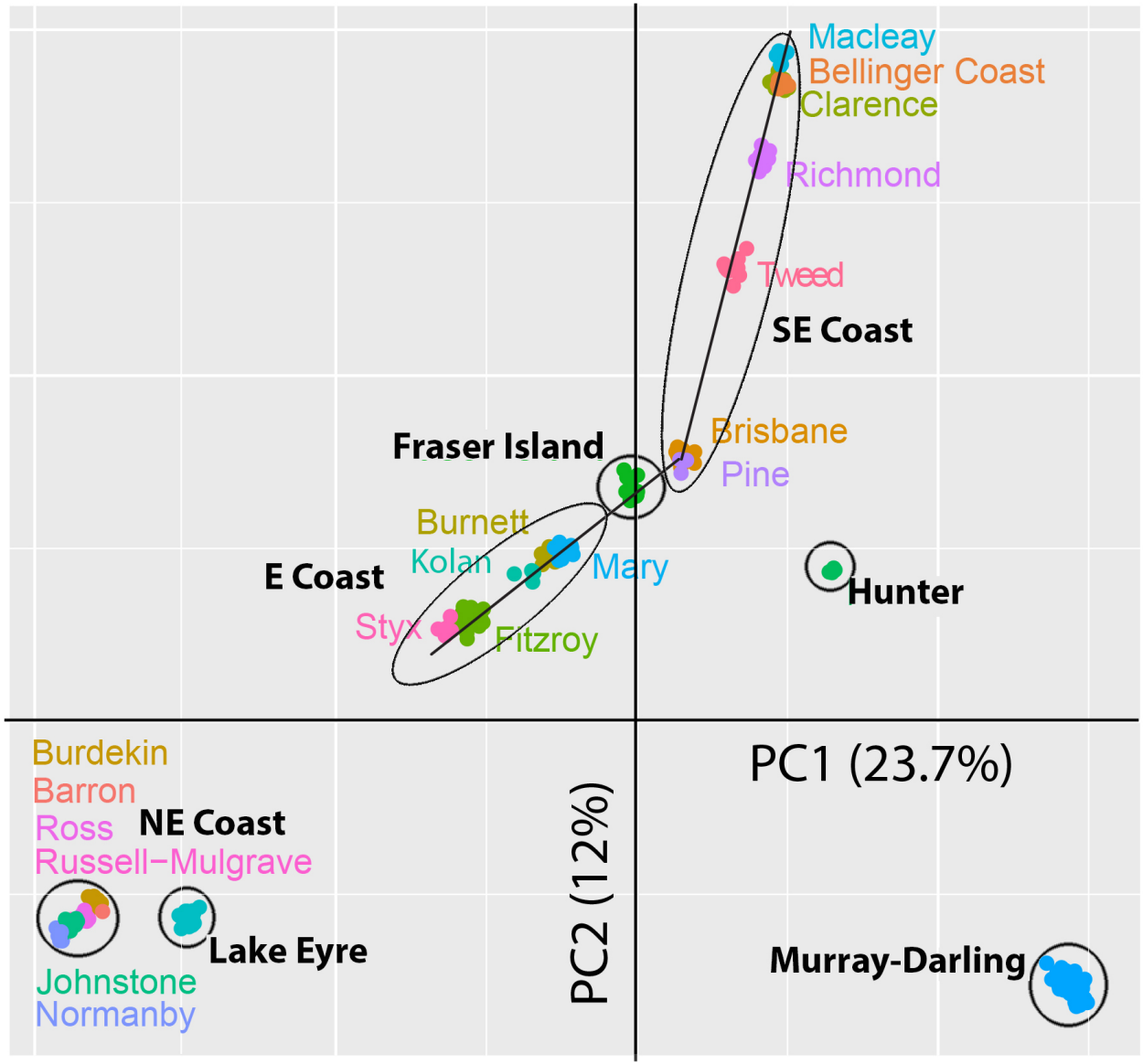


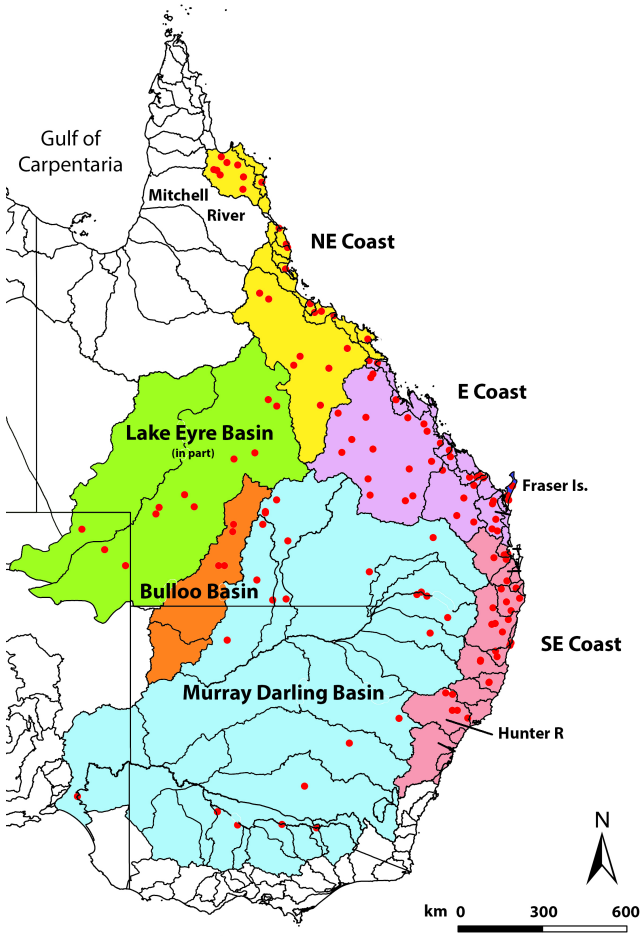
Results – PCoA



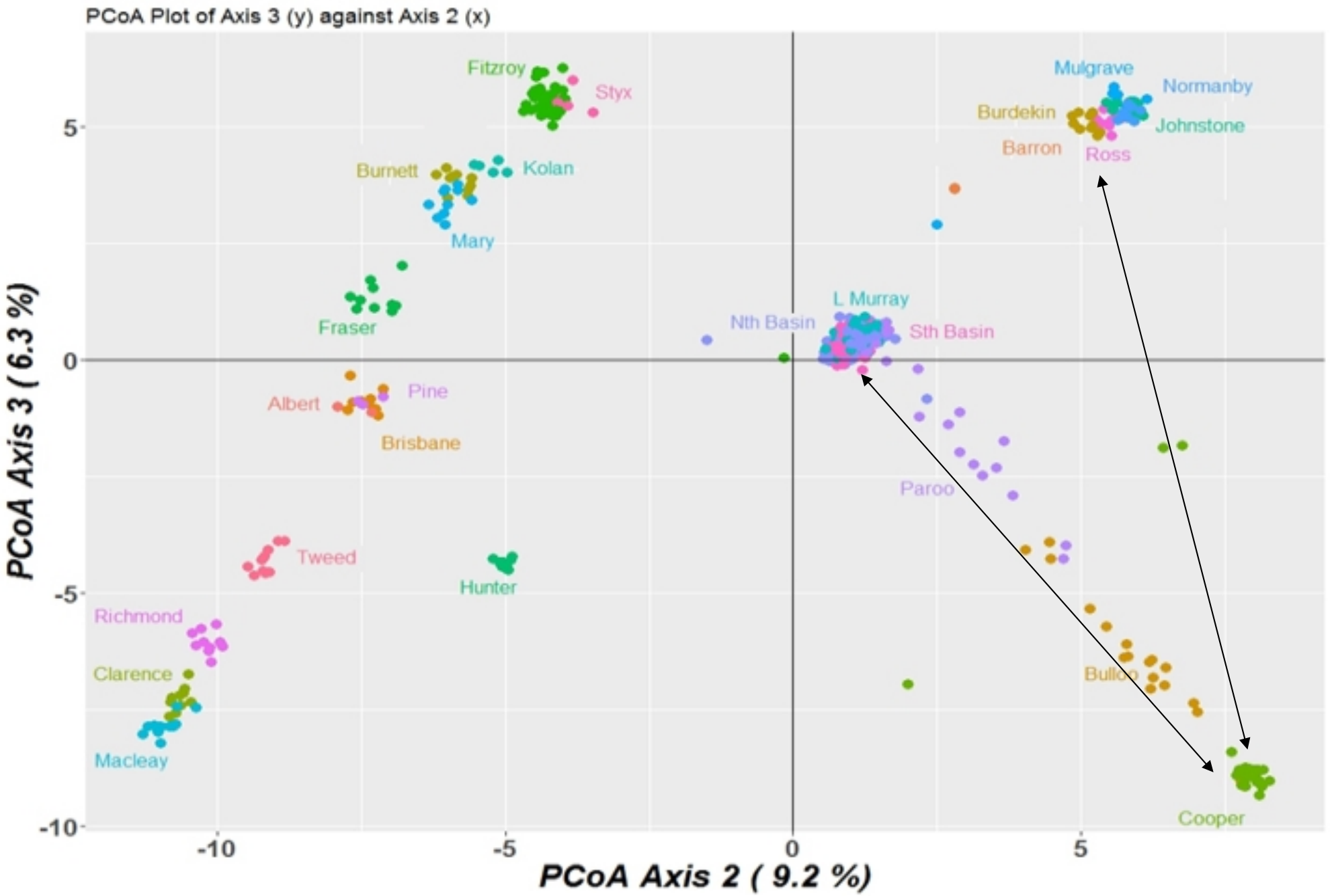
Results – Fixed Differences

14889 loci
(2-3, 100, 2,500)

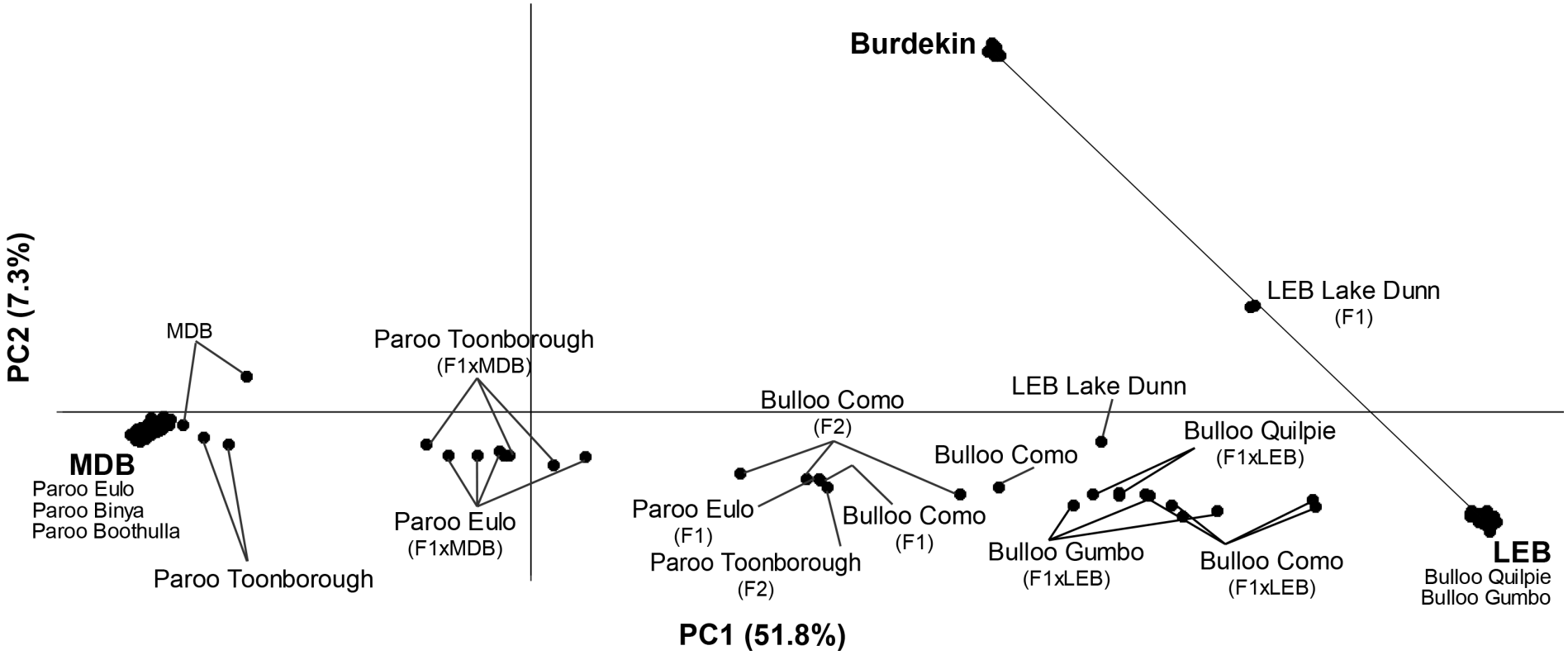




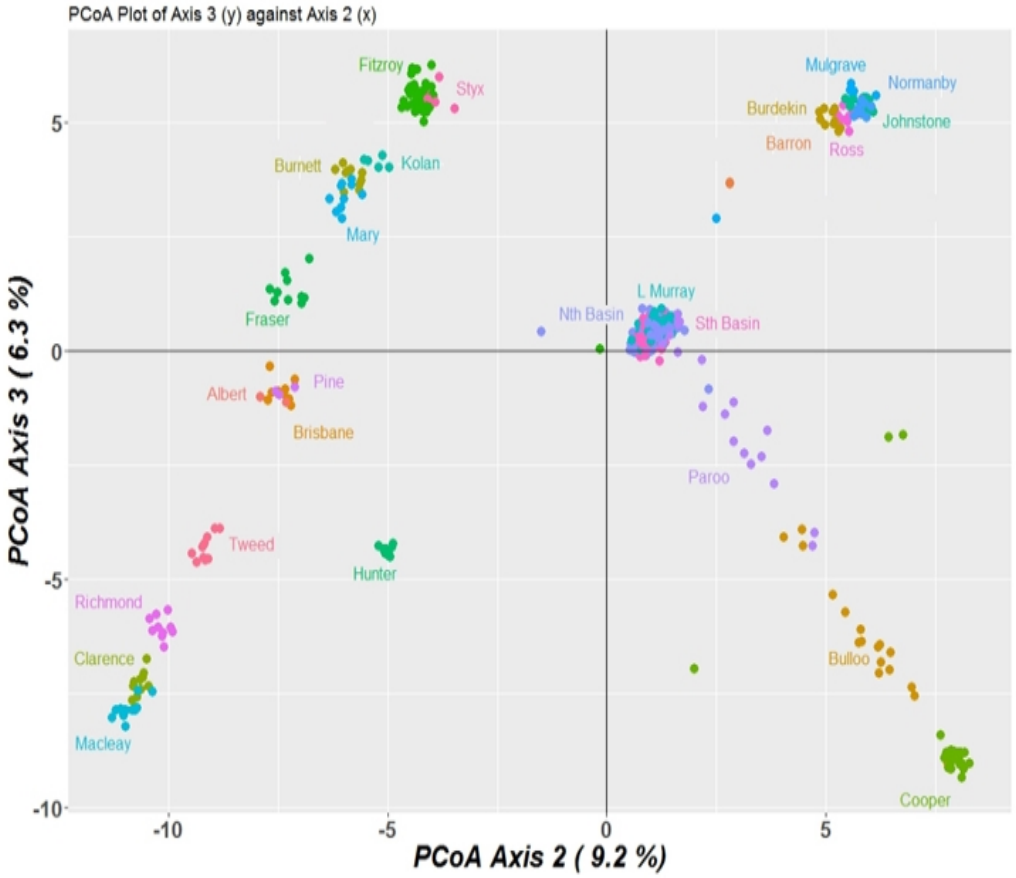
Results – Adding admixed populations

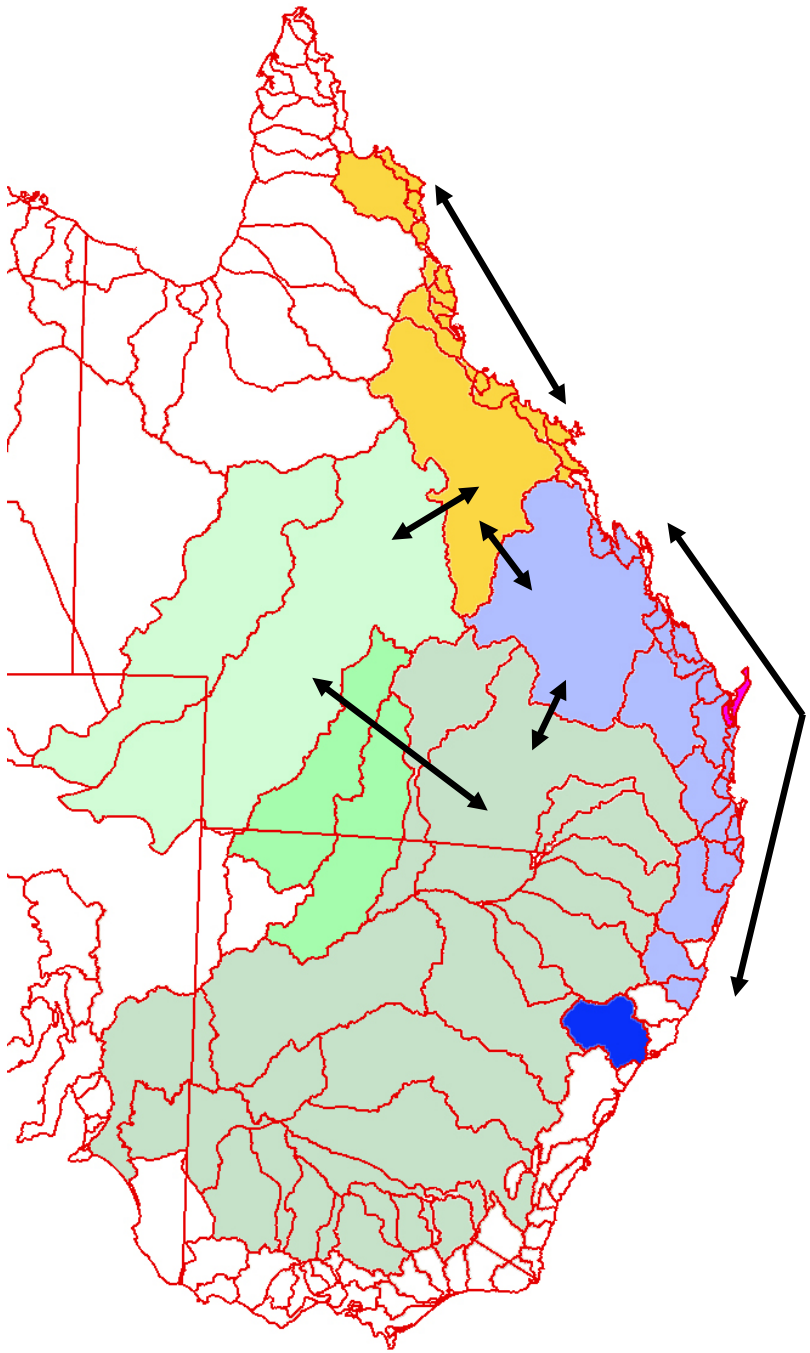


Results -- NewHybrids



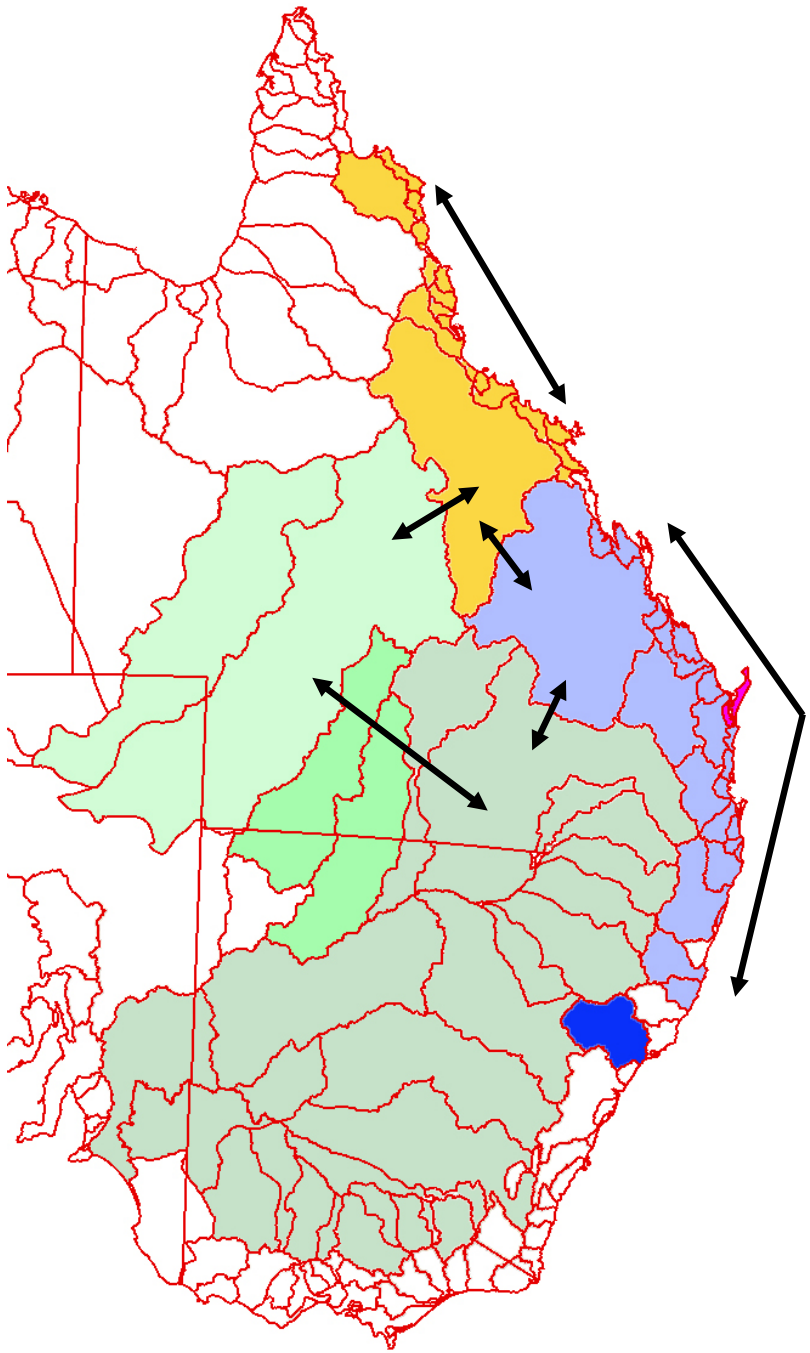
Results – Summary





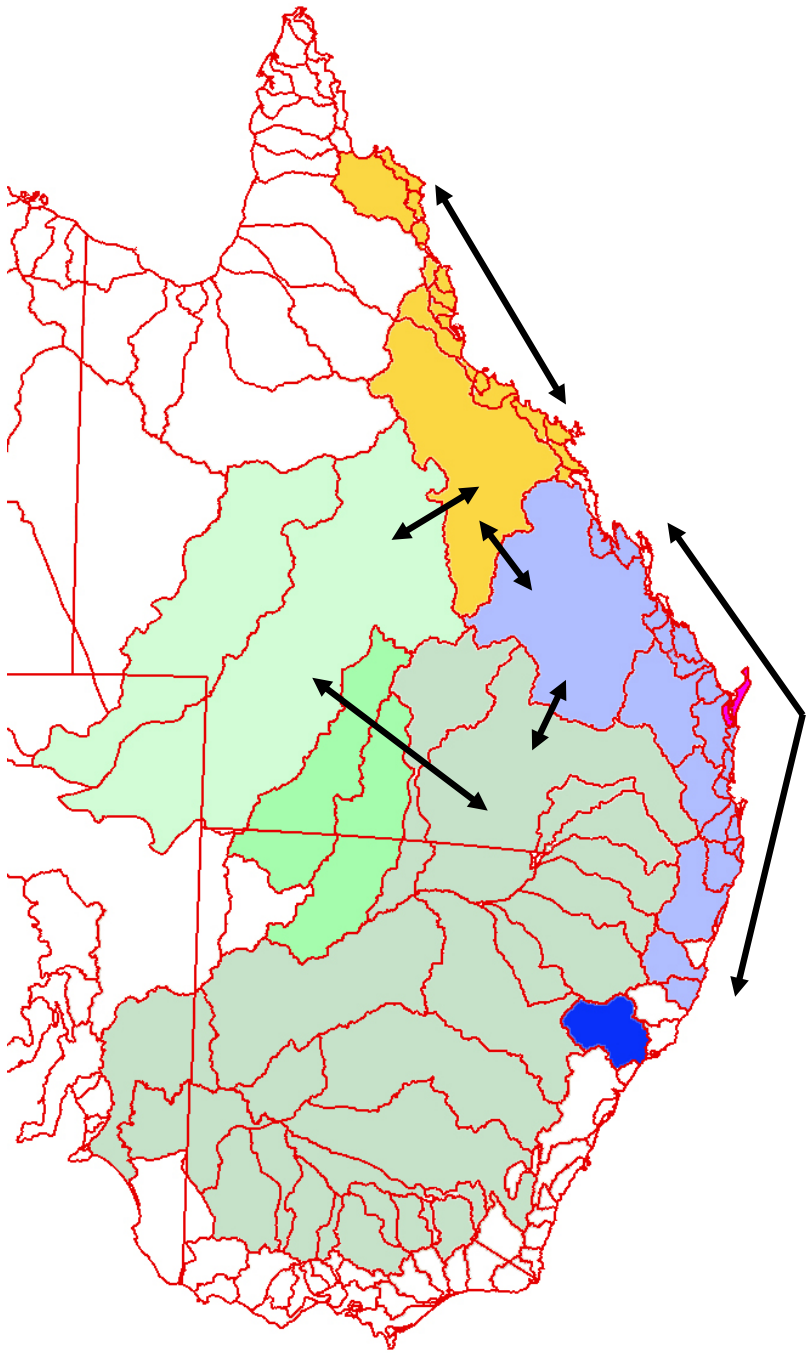
Speciation in action

- Divergence through isolation, leading to 7 putative ESUs
- End game impeded by low level and probably punctuated geneflow between adjacent drainages
- Outcome depends on future climatic trends
- Could define species from these data, but if we did it would be more as convenience than biological reality



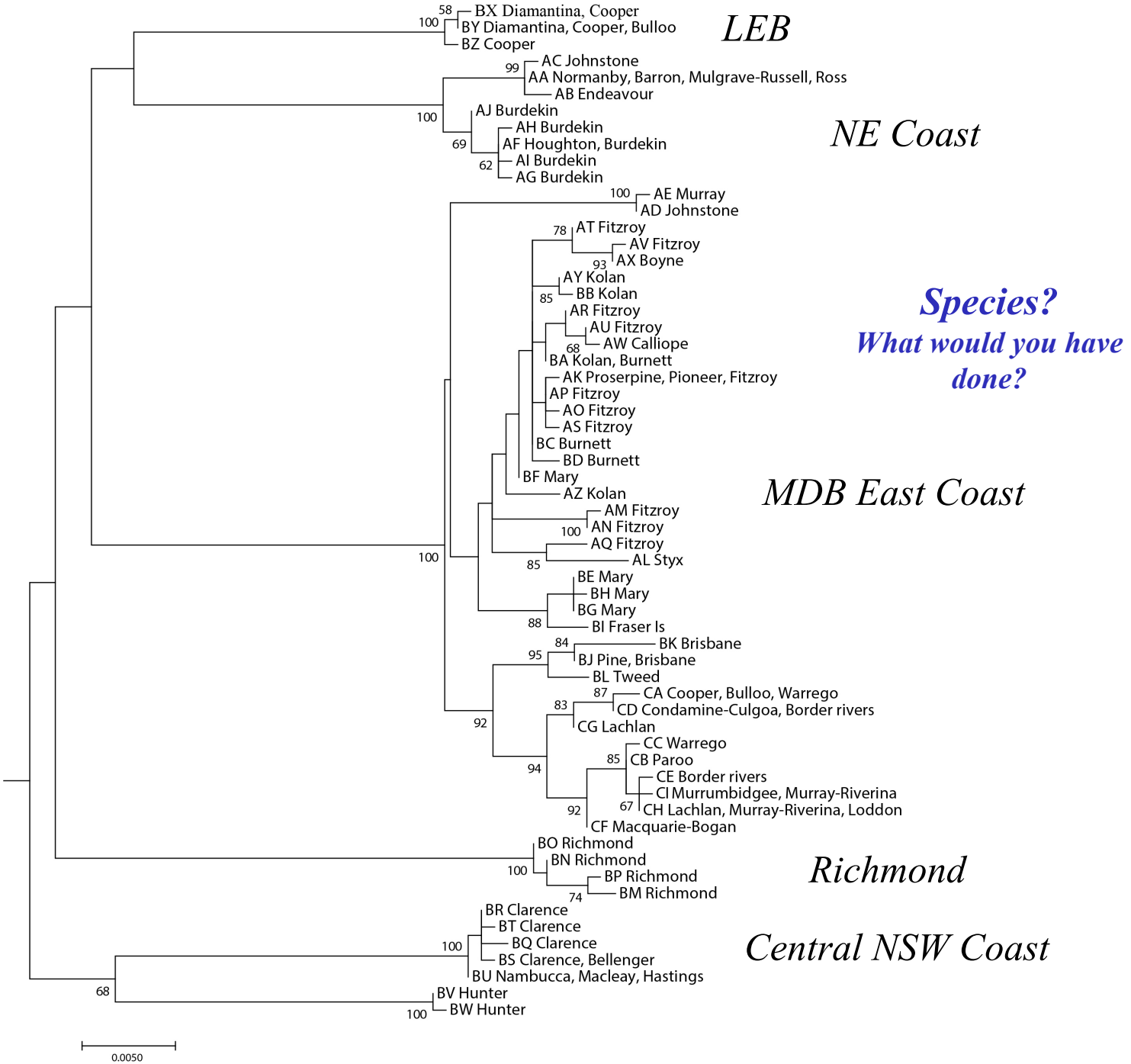
Speciation in action

Southern *Emydura* – a dynamic system of incipient species progressing on a trajectory toward species but held back by low level and episodic exchange of alleles across drainage divides on various timescales.



mtDNA

Cytb
Ctl Region



LEB

NE Coast

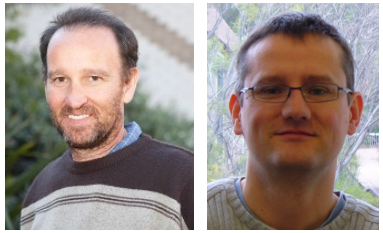
Species?

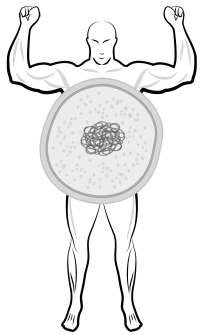
What would you have done?

MDB East Coast

Richmond

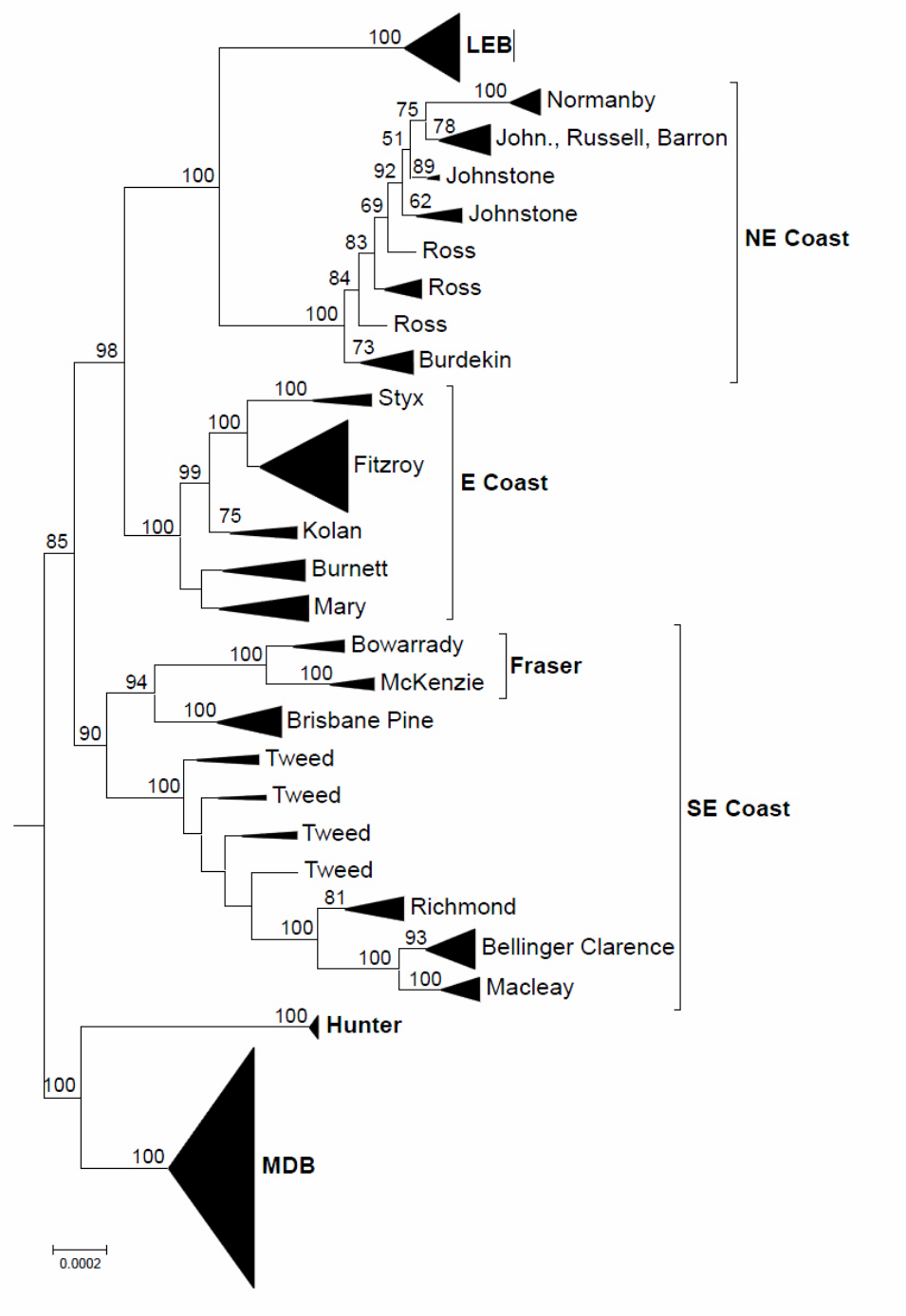
Central NSW Coast





nuDNA

22,000 SNPs



Species?

What would you have done?

Conclusion

A dominant role for population genomics in species delineation may put a break on what many see as unacceptable taxonomic inflation.

This is possible because we can now genotype large numbers of individuals with a dense sampling regime.

Should we think about species delimitation and phylogenetic reconstruction as separate exercises?

"The biodiversity bandwagon: the splitters have it"

Let's make taxonomy great again.


Thank you