

A new dinosaur supertree and the utility of large trees in macroevolution



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NUI MAYNOOTH
Oileáil na hÉireann Mhá Nuad



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“The affinities of all the beings of the same class have sometimes been represented by a great tree...”

Charles Darwin, 1859

“All the events of biological evolution are played out somewhere along the branches of phylogenetic trees”

Mark Pagel, 1999

Why bigger is better

- Increased taxon sampling can aid phylogenetic accuracy (e.g. Hedkote *et al.* 2006)
- Phylogenetic signal may still reside in poorly known taxa (Wilkinson and Benton 1995)
- Computationally feasible (e.g. Frost *et al.* 2006: 532 OTUs)
- Taxonomic gaps inhibit phylogenetic interpretation (e.g. Lieberman 2000)

But...

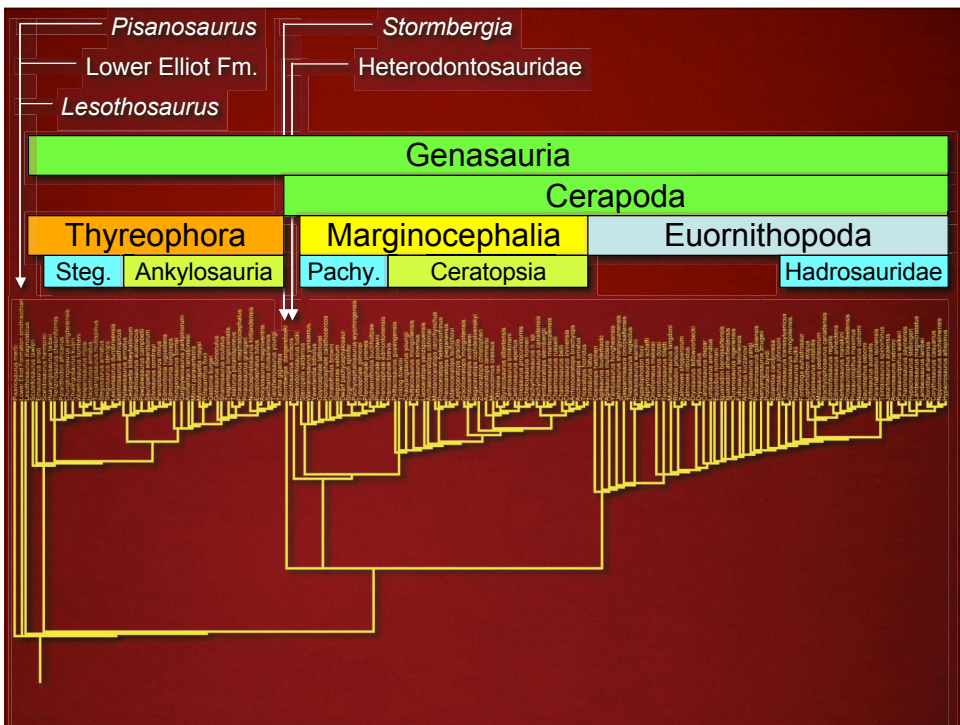
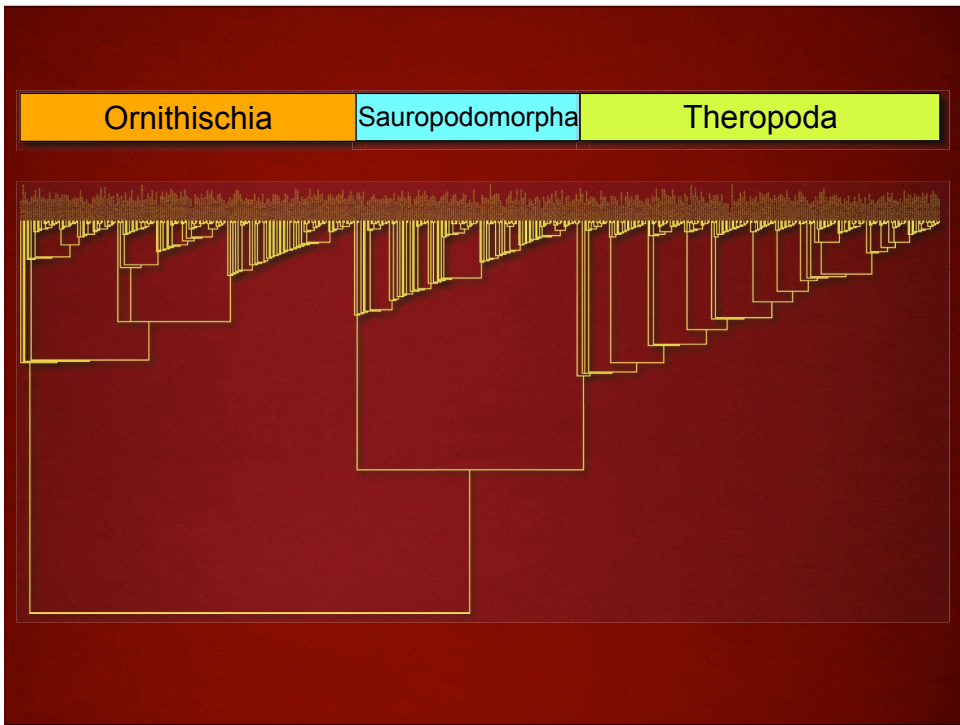
- Morphological datasets still lag behind
- Holtz *et al.* 2004 (76 taxa, 638 characters)
- Alternative is a supertree approach
- Much maligned for a variety of reasons, but methodology is improving!

Methodological improvements

- Data quality
 - Matrix and character list
 - Independent analyses only (redundancy)
- Taxa
 - Species (Weishampel *et al.* 2004)
 - Higher taxon substitution (Page 2004)
- Standardised input
 - Strict consensus trees
- Differential weighting

Results

- Total of 139 publications and 152 source trees
- Initial MRP matrix of 449 species and 2139 'characters'
- Parsimony ratchet (Nixon 1999)
- Ran for one week and recovered...
- ...1 MPT!



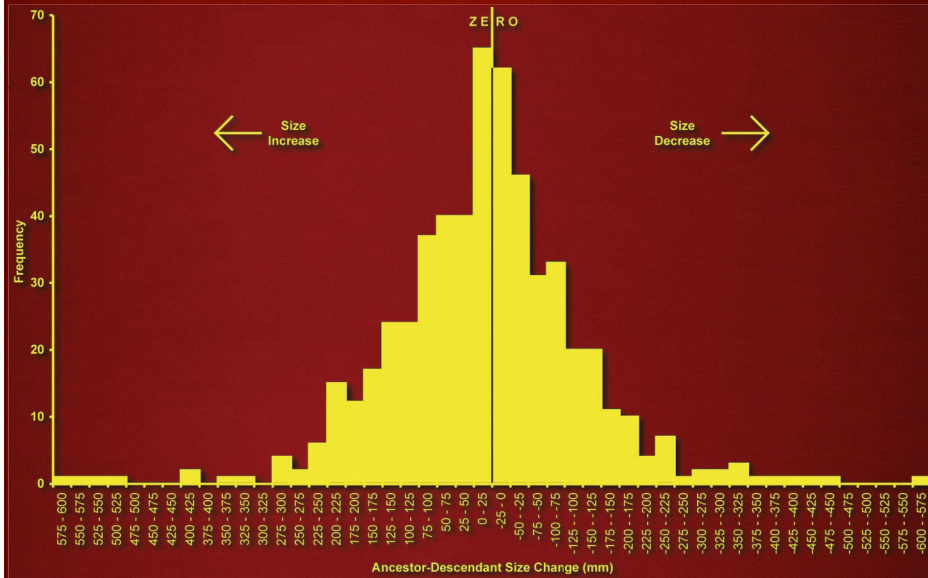
What use are big trees?

- Size change
- Ghost ranges
- Palaeobiogeography

Size Change in Dinosauria

- Used femur length data of Carrano (2006)
- Ancestral sizes reconstructed using minimum sum of squared change
- Recorded change along each branch (ancestor-descendant pair)

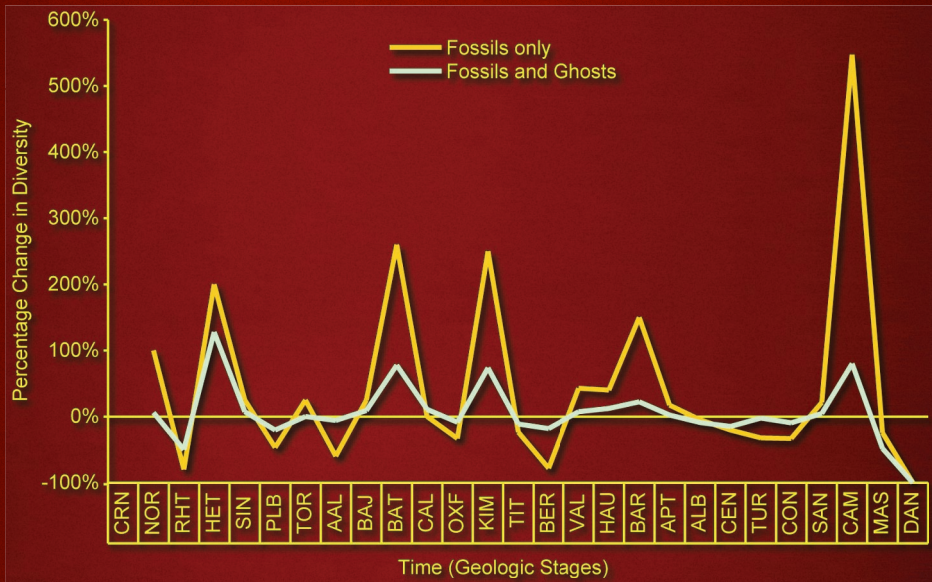
Size Change in Dinosauria



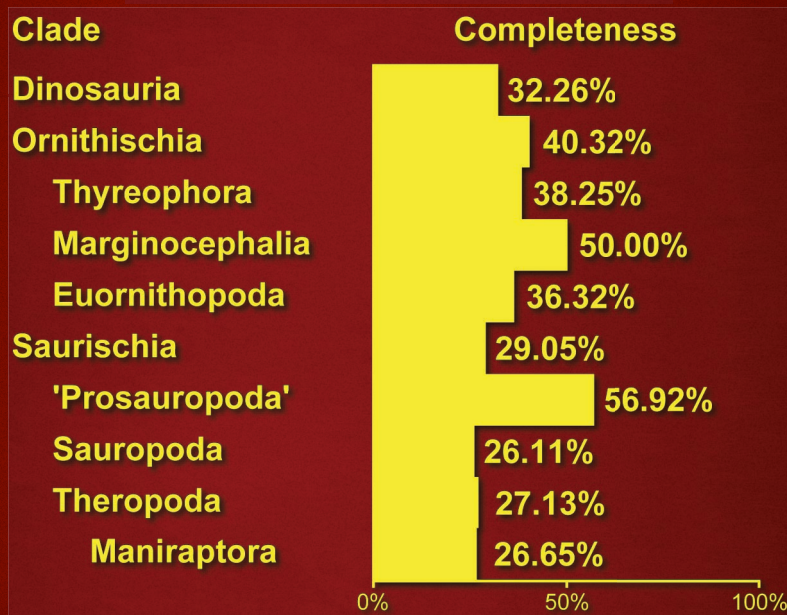
Size Change in Dinosauria

Clade	Mean	Reject H_0 ?
Dinosauria	+ve	Yes
Ornithischia	+ve	Yes
Thyreophora	+ve	Yes
Marginocephalia	+ve	Yes
Euornithopoda	+ve	No
Saurischia	+ve	No
'Prosauropoda'	+ve	No
Sauropoda	+ve	No
Theropoda	+ve	No
Maniraptora	+ve	No

Ghost Ranges in Dinosauria



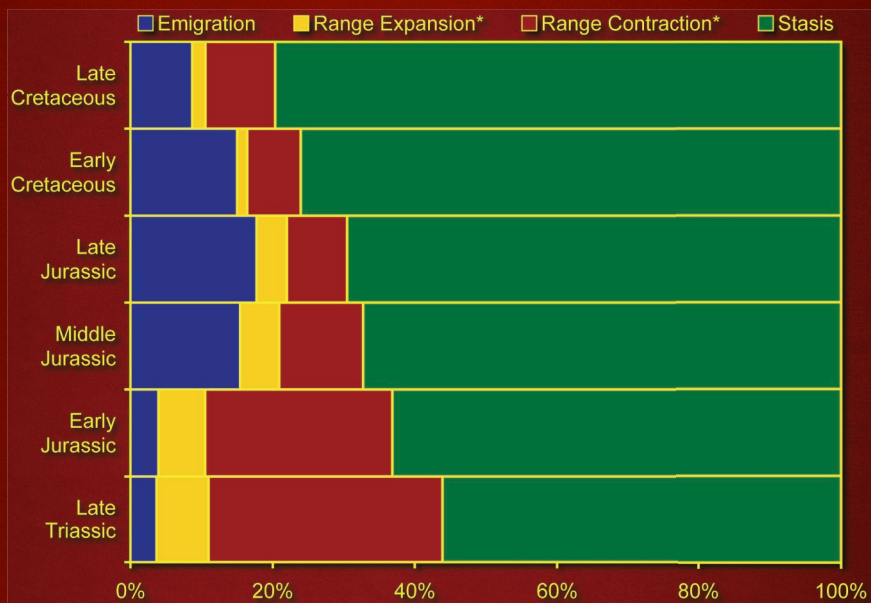
Ghost Ranges in Dinosauria



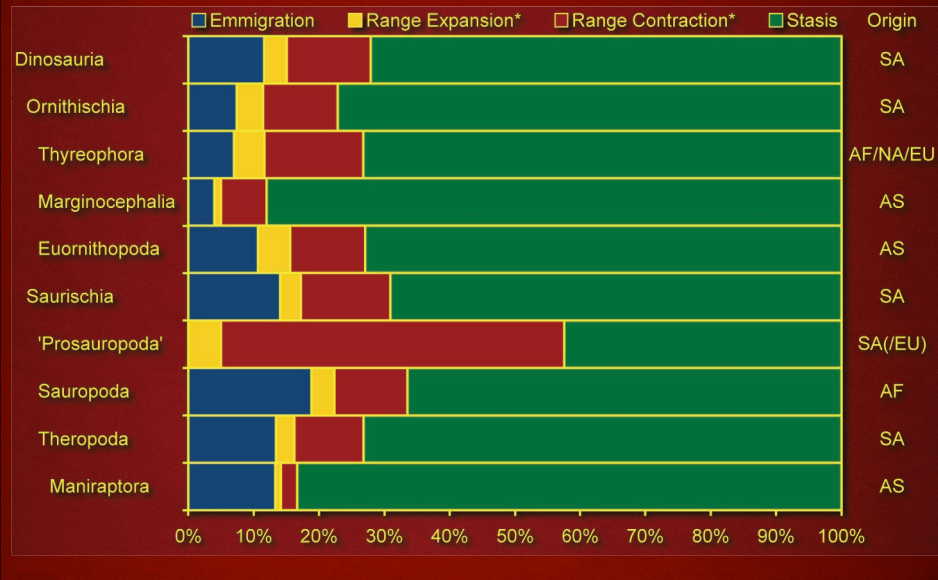
Palaeobiogeography of Dinosauria

- Replaced each taxon with area
- Modern day continents used (except India)
- Fitch (1972) parsimony used to estimate ancestral area distributions (Lieberman 2000)
- Four types of branch:
 - Emigration (e.g. NA -> SA)
 - Range Expansion (e.g. NA -> NA+SA)
 - Range Contraction (e.g. NA+SA -> SA)
 - Stasis (e.g. SA -> SA)

Palaeobiogeography of Dinosauria



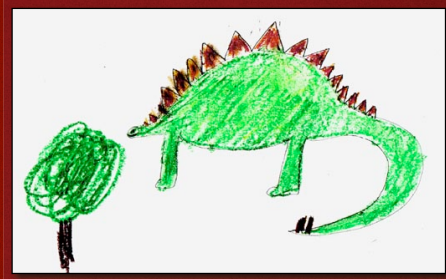
Palaeobiogeography of Dinosauria



Summary

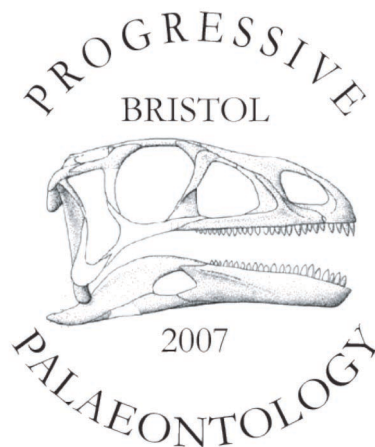
- We can (and should) attempt ever larger trees
- Large phylogenies provide a framework for quantitatively testing (macro)evolutionary hypotheses
- Dinosaurs:
 - generally got bigger
 - have an incomplete fossil record
 - didn't get out much

Acknowledgements



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