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Predicting vegetation diversity & structure from ecological and evolutionary first principles

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Walking through any forest, one is struck by the variety of plant forms coexisting. To explain vegetation structure and diversity, models must allow for multiple species to coexist, and ultimately, predict the outcome of community assembly in different environments. In this talk, I describe how adaptive dynamics theory provides a new framework for predicting the mixtures of species traits that are favoured in vegetation. Predictions are generated by embedding trait-based coexistence and selection into models of forest dynamics, mapping from physiological trade-offs in plant function to individual-level outcomes such as growth rates, and ultimately population-level demographics, and fitness. Results thus far show how i) how key trait-based trade-offs enable different strategies to coexist via successional niche differentiation; ii) how joint consideration of multiple traits can produce forests of higher diversity than was previously thought possible, and iii) how trait mixtures respond to environmental conditions. To conclude, I consider some major challenges in applying this approach to making large-scale predictions of forest structure.

Primary author: Dr FALSTER, Daniel (University of New South Wales)

Presenter: Dr FALSTER, Daniel (University of New South Wales)

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