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Ecological community modelling: climate-informed adaptation strategies for southeastern Australia's biodiversity

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Abstract: Climate change is significantly impacting biodiversity, as evidenced by numerous studies documenting shifts in species distributions and varying effects on diversity based on location, species tolerance, and adaptability. These impacts are likely to intensify as climate change progresses, with future outcomes remaining uncertain due to unpredictable global emission trends.

Our research aims to provide spatially explicit data detailing projected changes to biodiversity in southeastern Australia. These data are used to assess the risk, exposure and vulnerability of biodiversity, and derive layers of conservation and restoration benefits. Adaptation scenarios and strategies are developed and tested to offer land management and policy options that enhance the outcomes for nature in southeastern Australia.

Building upon our work developing the Biodiversity Impact and Adaptation Framework (Drielsma et al. 2017), this research integrates several new spatial datasets from multiple disciplines into ecological models. These include NARCliM 2.0 future climate scenarios, inundation, soil and erosion projections, which provide added accuracy and depth to ecological projections of the impact of climate change on biodiversity in NSW. This research utilises an updated species database combining full-floristic survey data from NSW DCCEEW Bionet database and ACT Government, Office of Nature Conservation. Attributes include incidence records (presence-absence) and %foliage cover as a measure of species abundance, both crucial for describing the diversity of an area. Additional species attributes include status (native and introduced) and growth form (tree, shrub, grass & grass-like, forb, fern and other).

The framework employs several modelling techniques, however here, we focus on one technique, generalised dissimilarity modelling (GDM). GDM, is an effective method for characterising and predicting beta diversity by analysing pairwise distances between species recorded in survey plots. We model the change in plant community composition across space and time implementing a dissimilarity metric specifically designed for abundance data and compare the results to models derived from incidence data. Models are developed for all native and all introduced vascular species, and for each growth form, excluding 'other' which unlike the other forms, contains a wide variety of different expressions of both form and function. Projected changes in growth form abundance and distribution are analysed to infer how vegetation structure and plant species richness may change over time, affecting species habitats, ecosystems and ecosystem services.

Furthermore, supervised classification of the abundance-derived continuous dissimilarity layers for historical and NARCliM 2.0 future scenarios allows for detailed analysis, including uncertainty, of how communities - such as those of the NSW vegetation classification system - may be affected in terms of risk, exposure and vulnerability. Climate-informed adaptation scenarios and strategies test options for conservation, restoration and invasive species management.

REFERENCES

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