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An evaluation of coastal dune forest restoration in northern KwaZulu-Natal, South Africa

by

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An evaluation of coastal dune forest restoration in northern KwaZulu-Natal, South Africa

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"One should always have a definite objective… it is so much more satisfying to reach a target by personal effort than to wander aimlessly. An objective is an ambition, and life without ambition is…well, aimless wandering." A.W. Wainwright 1973

Abstract

Ecological restoration has the potential to stem the tide of habitat loss, fragmentation and transformation that are the main threats to global biological diversity and ecosystem services. Through this thesis, I aimed to evaluate the ecological consequences of a 33 year old rehabilitation programme for coastal dune forest conservation. The mining company Richards Bay Minerals (RBM) initiated what is now the longest running rehabilitation programme in South Africa in 1977. Management of the rehabilitation process is founded upon the principles of ecological succession after ameliorating the mine tailings to accelerate initial colonisation.

Many factors may detract from the predictability of the ecological succession. For example, if historical contingency is a reality, then the goal of restoring a particular habitat to its former state may be unattainable as a number of alternative stable states can result from the order by which species establish. Succession appears to be a suitable conceptual basis (at this stage in regeneration at least) for the restoration of coastal dune forest. Patterns of community characteristics observed in rehabilitating coastal dune forest sites were similar to those predicted by ecological succession, with few exceptions.

Changes in the species pool such as the establishment of strong dominants may lead to divergence of regenerating trajectories away from the desired endpoints. The species composition of herbaceous plants in regenerating coastal dune forest sites became increasingly uniform as the time since disturbance increased. Despite initially becoming more similar they

deviated away from an undisturbed reference site. Contrary to our expectations, non-native species did not contribute the most to dissimilarity. The deviation from the reference forest is attributable to the higher abundance of a native forest specialist in the reference site and the higher abundances of native woodland adapted species in the rehabilitating sites.

Changes in the disturbance regime under which species have evolved may lead to arrested succession. The rehabilitation of coastal dune forest relies on the *Acacia karroo* successional pathway which, has been criticised because *Acacia* dominated woodlands may stagnate succession. The patterns of species composition within regenerating coastal dune forest are a response to the canopy characteristics and represent an early stage in forest succession. Succession did not appear to be stagnant.

Ecological succession does not pay much heed to the role that the surrounding landscape composition can play in the assembly of communities. The theory of Island biogeography provides predictions about how landscape composition influences community assembly. Landscape spatial parameters, measuring edge, isolation, and area explained the patch occupancy of the several bird and tree species, however, responses to patch characteristics were varied and idiosyncratic. For restoration to succeed, managers need to consider the spatial configuration of the landscape to facilitate colonization of rehabilitating patches.

From this thesis and previous work, it appears that processes are in place that will lead to the reassembly of dune forest communities. As the rehabilitating sites are at an early stage of regeneration this may take some time to give rise to these coastal dune forest communities, and the management of rehabilitating coastal dune forest must allow for this. In addition, it is

important to remember that time may be interacting with the landscapes spatial attributes, which may limit the presence of certain species.

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Disclaimer

The present dissertation includes four paper manuscripts, prepared for submission to different scientific peer-reviewed journals. Styles and formatting of these chapters follow the respective journal requirements. This results in some duplication in the study site description and methods between chapters. Chapters 3, 4, and 6 follow the format requirements for the journal *Restoration Ecology*, whereby Chapter 5 follows the requirements for the *Journal of Vegetation Science*. Chapter 6 has already been published in Restoration Ecology as "Grainger, M.J., R.J. van Aarde and T.D. Wassenaar (2011). Landscape Composition Influences the Restoration of Subtropical Coastal Dune Forest. Restoration Ecology **19**: 111 – 120 (DOI: 10.1111/j.1526-100X.2009.00630.x)". I hereby declare all the work to be my own and that I have acknowledged all those that helped me and contributed to producing this dissertation.

Matthew James Grainger

27th October 2011

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