A whole-island estimate of energy flow and nutrient cycling for Marion Island: Pie-in-the-sky or realizable?

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One of the earliest objectives of the biological research program on Marion Island was project "to obtain a better insight into the interesting food cycles of the ecosystem of the oceanic island Marion"[1], and the specific aims were to quantify the flow of energy (primary and secondary production, decomposition) and cycling of nutrients (ocean-island interactions and nutrient cycling in the vegetation and soils). Research toward this objective has included synecological studies of the standing crop[2], primary production[3], nutrient uptake[4] and soil respiration[5] of selected lowland plant communities, a quantification of the transfer of nutrients and energy from the ocean to the island via precipitation[6] and manuring by seabirds and seals[7], and also some autecological studies of primary production and mineral nutrition of selected plant species[8]. The primary production and nutrient cycling studies involved an onerous program of collecting, sorting and chemically analysing several thousand plant and soil samples over several years, and resulted in information for only eight of the island's 42 plant communities[3,9]. The original aspiration of a whole island energy and nutrient flow model seemed unattainable. However, ordinations of soil chemistry, soil physical and botanical information showed that the island's vascular and cryptogamic plant species occur as a set of groups in the ordination spaces. The groupings, with considerations of the species growth form and taxonomic characteristics, enable a suite of plant guilds to be recognised in the island's flora. These guilds proved cardinal in classifying the island's terrestrial habitats[10] along gradients of the main forcing variables that determine ecological succession on the island (moisture, exposure, parent soil material, salt-spray and manuring and trampling by seals and seabirds). The forcing variables determine structure (habitat type) through their influence on function (primary production, decomposition, nutrient pool sizes and transformations). Hence the plant-guild approach has potential for a model to estimate standing crop, primary production, energy capture and patterns of uptake, retranslocation /litter loss of nutrients for habitats or plant communities for which we have no, or only incomplete, data. This talk explores that potential and points out what information is needed to complete, parameterize and verify the model.

References

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