# THE DESIGN OF A RISK ASSESSMENT MODEL TO DETERMINE THE IMPACT OF THE HERBAL MEDICINE TRADE ON THE WITWATERSRAND ON RESOURCES OF INDIGENOUS PLANT SPECIES

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# ABSTRACT

Exploitation of botanical resources has resulted in significant decreases in the sizes of some plant populations, especially for species that have a high commercial value and are important to the lives and livelihoods of rural communities. Medicinal plant resources are used and traded commercially in both rural areas and urban centres, and over-exploitation has become a deterministic factor in the extinction risks to certain species. The main aim of the study was to design a risk assessment model to determine the impact of the medicinal plant trade on the Witwatersrand (centred around Johannesburg) on indigenous plant resources. The goal was to incorporate trade variables correlated with harvesting risks together with biological characteristics of the harvested species to predict which species are most threatened by the trade and are thus high on the list for conservation priority.

The study required semi-quantitative surveys of the medicinal plants sold by traders in the Witwatersrand to be conducted. In 1994 and 2001, the plants sold in 50 *muti* shops and by 100 vendors in the Faraday Street market respectively were inventoried. Quantitative trade data were also captured, including volume, pricing structures and plant size (e.g. bark thickness and bulb diameter). A scientific sampling strategy was adhered to throughout the study to add statistical validity to the results. In a novel approach to analysing ethnobotanical data, the frequency of plant occurrences in the markets was analysed using measures (analysed by EstimateS) of species diversity traditionally used in ecology. The measures allowed for sampling strategies and sizes to be compared between data sets and for the number of species likely to be sold in the region to be estimated. Furthermore, data sets could be compared in terms of species richness, diversity, evenness and complimentarity.

Another novel approach taken in the thesis was to estimate the number of individual plants harvested annually by gatherers, specifically the number of trees that are debarked and the number of whole bulbs that are removed. In order to estimate the number of trees debarked, a study was conducted to determine the relationship between bark thickness and stem diameter for six species. The results made it possible to estimate the condition of the resource in the wild from market records (i.e. bark thicknesses) and to see how the availability of larger trees has declined for species such as *Warburgia salutaris* between 1994 and 2001. Results for bulbs showed that there has been a significant decrease in the diameter of *Eucomis autumnalis* bulbs present in the markets in the same period, suggesting significant levels of resource depletion.

The thesis explored the use of a multivariate methodology for assessing the extinction risks of species and assigning species harvested for the medicinal plant trade to various hierarchies of risk and conservation priority. Hierarchical and non-hierarchical cluster analysis (Ward's and K-means respectively) methods were found to be effective in assigning species to clusters of similar risk and conservation priority. From a combined list of 392 ethnospecies recorded in the *muti* shops and Faraday market, a short-list of 119 higher risk species was identified using four to five trade variables. This list was further reduced to 87 species to ascertain conservation priorities based on the additional inclusion of seven biological variables in the assessment. From this list, approximately 31 species were identified as having higher conservation priority and would be candidates for further research, management and protection within the ambit of conservation and sustainable utilisation programmes. These species would further benefit from Orange Listing or having their IUCN Red List status re-evaluated.

The methods developed in this study are recommended for other ethnobotanical studies. Furthermore, the risk assessment method could be applied to the assessment of species similarly traded in other medicinal plant markets or applied to the assessment of species under threat from other stressors at a regional, provincial and/or national level using the appropriate variables.

**DECLARATION**

I declare that this thesis is my own, unaided work. It is being submitted for the Degree of Doctor of Philosophy in the University of the Witwatersrand. It has not been submitted for any degree or examination to any other university

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Date: 9 March 2007

# ACKNOWLEDGEMENTS

When I joined the Botany Department after doing Honours in Geography at Wits and Botany 1 at UNISA, I was the department's very first ethnobotany student. More excellent students have since followed *and* graduated before me. At my very first meeting with the people on my research committee to present my MSc proposal in 1994, I will never forget Prof Richard Pienaar (HOD at the time) asking me "So, how is this science?" It was a challenge I rose to, and to some extent it fuelled my desire to reverse the prevalent opinion at the time that ethnobotany was a 'soft science' with very little in the way of quantitative analysis. It was a subconscious goal that was fed by my fascination with my subject matter as well as the aspiration to not be uninformed. To some extent, I'm like my late father on this. Dad disliked not knowing things that he felt he should know. I know he gently pushed me most of my life to always look deeper than surface and to question and explore. I wasn't just to look for the faeries in the forest if he asked, but the *green* ones. His tactics were supported by my mother, who believes I can do anything I put my mind to and encourages me to do what makes me happy. One of her philosophies is that it isn't always satisfying working for "the highest bidder". I'm glad my parents knew me well enough to encourage my potential. I thank them both so very much for their love and caring, as well as their emotional and financial support. I hope I was worth every penny.

By the time I graduate it will more than two years since my father passed away. I'm sad he wasn't able to physically see the day when it came – especially since he spent a few years before he died wondering and worrying about whether or not I'd ever finish. I know he wasn't the only one who worried about that, and at times even I felt that the mountain was too steep to climb. However, it is now done. And, the 24 year old girl who started this journey in 1994 is now 37 in 2006 and a universe away from the person she was at the start. My love and thanks goes out to all those who have been part of my journey and my learning.

Of course, after 12 years, many people come in and out of your life and so there are many to thank. Besides my late father, there are 2 other people who have since passed on that deserve a mention. Firstly, my Rastafarian friend Fanny Makgaba who assisted me for several years with the *muti* shop surveys and the early surveys of the Faraday market. He unfortunately passed away on the 3rd April 2003 before I really had a chance to repay in kind his help and his friendship. Second, is Musa Maswangangi who passed in September 2002 of non-Hodgkin's lymphoma. Musa was one of the students who assisted with the Faraday survey. Their sudden and unexpected crossings are a loss not only to me, but to a society they had a potential role in adding value to (and had added value to in many ways). Fanny's passing was especially personal for me because he made a significant contribution to my work.

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And finally:

> *"A PhD is a stepping stone into a research career. All you need to do is demonstrate your capacity for independent, critical thinking. That's all you need to do. A PhD is three years of solid work, not a Nobel Prize"* (Mullins and Kiley 2002)[1].

I know some heads are nodding after reading this, and I would reluctantly admit to having made career out of a PhD until I came to my senses. After this book is closed, I look forward to the next chapter…..

[1] Mullins, G. and Kiley, M. (2002) 'It's a PhD not a Nobel Prize': how experienced examiners assess research theses. *Studies in Higher Education* 27(4): 368-386

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