The relative performance of surrogate measures for viable populations

by

Mariaan Solomon

Submitted in partial fulfilment of the
Requirements for the degree of
Magister Scientiae
(Zoology)

Faculty of Biological and Agricultural Sciences
University of Pretoria
Pretoria

2000

The relative performance of surrogate measures for viable populations

by

Mariaan Solomon

Supervisor: Professor A. S. van Jaarsveld
Department of Zoology and Entomology
University of Pretoria
Pretoria
Republic of South Africa

ABSTRACT

Preservation of the total variety of the earth's biomes is necessary for the preservation of all extant species. Without sufficient quantities of their natural habitats, species will become extinct in the wild. Conservation area assessment techniques have concentrated on reserve placement, with less attention being afforded to reserve design principles such as population viability. The incorporation of viable populations of all species into conservation areas, to secure their long-term persistence, has not been explicitly accomplished to date. This study aims to explore the basis for including population viability into conservation area selection procedures. Due to the lack of spatially explicit abundance data for most species, reserve planning concentrates on representing all species in a given region a specified number of times, the current debate being about how best to achieve this goal and not about the inclusion of viable populations. The Kruger National Park annual herbivore census represents a spatially explicit data set that can be used to establish the spatial consequences of jointly incorporating viable populations of 12 large herbivore species (acting as umbrella species) into conservation area selection procedures. This was achieved by selecting for viable populations and quantifying the land surface area in which they occur, and which is subsequently needed to sustain these populations, ranging in size from 50 - 10 000 individuals per species. The outcome was that nearly 50% of each land classification unit in a region is needed to represent these individuals - irrespective of the size of the "viable

population" specified. Furthermore, it was established that selecting a fixed percentage of each classification unit is not cost-effective in terms of land-use, and that this approach should be replaced with a system differentially concentrating on areas with higher conservation potential (e.g. source areas). Since conservation actions are only as good as the quality of the data on which they are based, it is imperative that biodiversity surveys be invested in.

Similarly, when selecting for increasing percentages of all the units within a land classification system, the number of individuals fortuitously included through this selection process was quantified. Also, the number of species for which viable populations was selected was deduced, for viable populations comprising either 100 or 500 individuals. Only at a 40% surrogate selection level were viable populations of all species included. Collectively, these results suggest that the most cost-effective MVP's can only be selected once the abundance-related stratification of species across a landscape is known, or if the location of source populations can be established.

In 1992 a recommendation by the IUCN that each country should strive to protect 10% of each of its biomes was made. It was implied that this target would be sufficient to conserve biodiversity world-wide. In the present study we propose that this figure is far from adequate in offering long-term protection and ensuring the survival of constituent species. These results accentuate the need for the concept of population viability to be included into conservation area selection procedures, where species representation seems to be the primary conservation goal, and long-term survival of species is not afforded adequate consideration.

ACKNOWLEDGEMENTS

I would like to thank my supervisor, Prof. Albert van Jaarsveld for all his invaluable advice, input and ideas during the preparation of this dissertation, giving me the opportunity to learn a number of new computer packages, gain experience in the field of conservation biology, and financially helping to support my attendance at the Mammal Ecology conference in Nelson, BC.

My sincerest thanks go to Harry Biggs, for encouragement, motivation and advice. But most of all, thank you for always believing in me, making time for me amidst your extremely busy schedule and listening to my ideas and views and giving valuable discussion and constructive criticism.

Funding for the study was provided by the National Research Foundation and the University of Pretoria, and is gratefully acknowledged.

I am grateful to South African National Parks for allowing me access to their Ecological Arial Survey data, and for providing accommodation whilst in Skukuza.

Sincere thanks to Harry Biggs, Nick Zambatis and Naledi Maré for all the time spent discussing and preparing the Land classification paper, as well as for their inputs in creating the respective tables and figures in the manuscript.

My appreciation goes to Stefanie Freitag for introducing me to Dbxl, providing guidance with regards to database management and teaching me basic computer programming skills. I am most grateful for the use of the algorithms she coded. Dean Fairbanks is thanked for sharing his knowledge of Geographic Information Systems (GIS), specifically with regards to ARCVIEW® and ARC/INFO® GIS.

Heath Hull and Gründlingh Enslin are acknowledged for their invaluable assistance in programming algorithms used in this study. Heath and Stephanie Koch are thanked for helping me with ReGIS and Dbxl - thank you guys!

I thank my family and friends, who have played a major role in the completion of this dissertation, from the bottom of my heart:

To my friends and fellow students: Stephanie Koch, Belinda Reyers, Heath Hull, Marilyn Lever, Barend Erasmus, Berndt Janse van Rensburg and Caron Foord - thank you for your friendship, stimulating discussions and encouragement in the lab throughout the study.

Esmé Louw, Jacolette Adam en Anina Koekemoer for their interest and support throughout.

Thomas Booysen, for everything. Friendship, motivation, encouragement, understanding and for believing in me.

My parents, Ben and Annette and my brothers, Hendri and Ben. Thank you for you continual love, support and patience through all the years! Without you none of this would have been possible.

DISCALIMER

This M.Sc. dissertation consists of chapters and appendices that have been prepared for submission to, or publication in, a range of scientific journals. As a result, the chapter and appendix formats may contain some inconsistencies and overlap may occur to secure publishable entities.

TABLE OF CONTENTS

Page