NICHE PARTITIONING AMONG FUR SEALS

Submitted by

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STATEMENT OF AUTHORSHIP

Except where reference is made in the text of the thesis, this thesis contains no material published elsewhere or extracted in whole or in part from a thesis submitted for the award of any other degree or diploma.

No other person's work has been used without due acknowledgement in the main text of the thesis.

The thesis has not been submitted for the award of any degree or diploma in any other tertiary institution.

This thesis is presented as a series of published and soon to be published papers. Although I did the significant aspects of analysis and interpretation of the results, the following people are co-authors of some of these papers because they assisted in the pursuit of the research or preparation of the thesis as summarised below:

J McKenzie, A Morrissey, R McIntosh, SD Goldsworthy, A Baylis, N Calvert, M Berris, D Dowie, PD Shaughnessy, A Welling, M Chambellant, T Dorr, R van Veen and many others assisted with fieldwork. MA Hindell, MD Sumner and M Coyne gave advice of the analysis of dive data, satellite tracking data and oceanography data, respectively. SD Goldsworthy and MA Hindell supervised this project and received grants that funded part of this research. I offered co-authorship on papers to the people who helped considerably on this project.

All research procedures reported in the thesis were approved by the La Trobe University Animal Ethics Committee and the South Australian Department for Environment and Heritage Animal Ethics Committee.

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PUBLICATIONS

The following peer-reviewed papers resulted from work completed during candidature

Page B, Welling A, Chambellant M, Goldsworthy SD, Dorr T, van Veen R. 2003. Population status and breeding season chronology of Heard Island fur seals. Polar Biology. 26: 219-224.

Page B, McKenzie J, McIntosh R, Baylis AMM, Morrissey A, Calvert N, Haase T, Berris M, Dowie D, Shaughnessy PD, Goldsworthy SD. 2004. Entanglement of Australian sea lions and New Zealand fur seals in lost fishing gear and other marine debris before and after Government and industry attempts to reduce the problem. Marine Pollution Bulletin 49: 33-42

Page B, McKenzie J, and Goldsworthy SD. 2005. Dietary resource partitioning among sympatric New Zealand and Australian fur seals. Marine Ecology Progress Series 293: 283-302

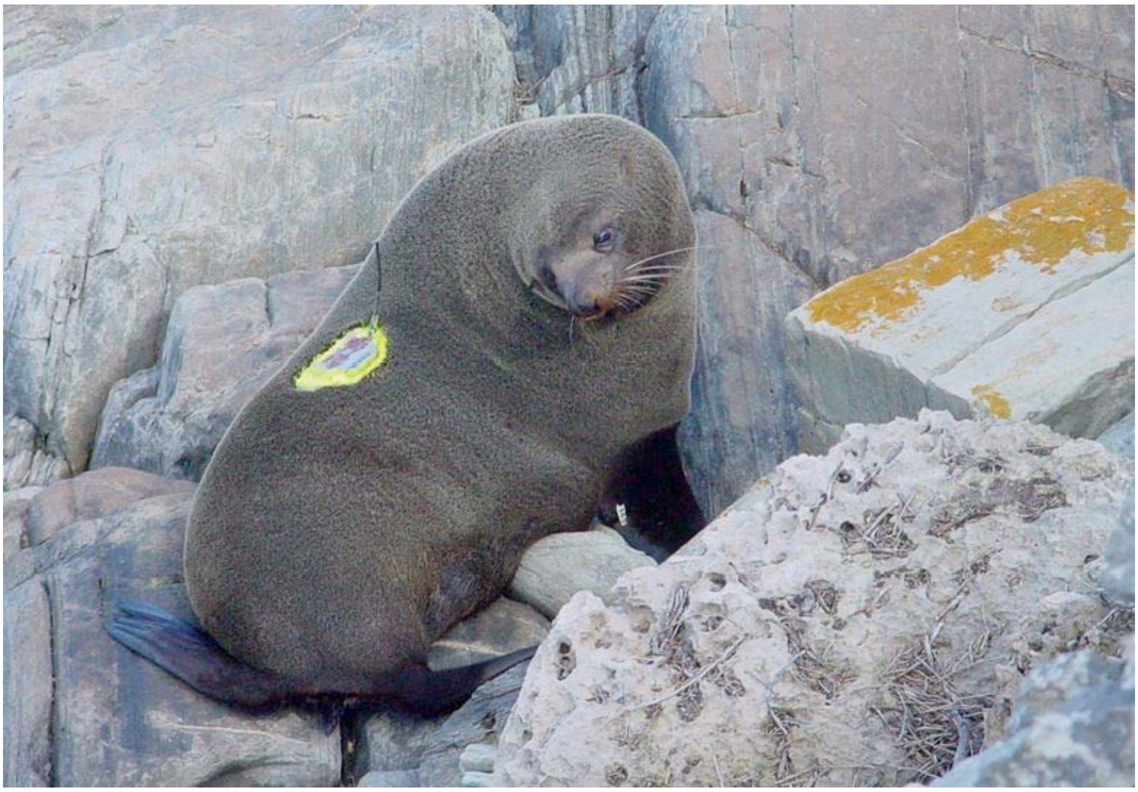
Page B, McKenzie J, Hindell MA and Goldsworthy SD. 2005. Drift dives by male New Zealand fur seals (*Arctocephalus forsteri*). Canadian Journal of Zoology 83: 293-300

Page B, McKenzie J and Goldsworthy SD. 2005. Inter-sexual differences in New Zealand fur seal diving behaviour. Marine Ecology Progress Series 304: 249-264

Page B, McKenzie J, Sumner MD, Coyne M and Goldsworthy SD. *in press*. Spatial separation of foraging habitats among New Zealand fur seals. Marine Ecology Progress Series

McKenzie J, Parry LJ, Page B and Goldsworthy SD. 2005. Estimation of pregnancy rates and reproductive failure in New Zealand fur seals (*Arctocephalus forsteri*) using serum progesterone concentrations and observation of live births. Journal of Mammalogy 86: 1237-1246

Baylis AMM, Page B, Peters K, McIntosh R, McKenzie J and Goldsworthy SD. 2005. The ontogeny of dive behaviour in New Zealand fur seal pups (*Arctocephalus forsteri*). Canadian Journal of Zoology 83: 1149-1161



ABSTRACT

At Cape Gantheaume, Kangaroo Island (South Australia), adult male, lactating female and juvenile New Zealand (NZ) and Australian fur seals regularly return to the same colony, creating the potential for intra- and inter-specific foraging competition in nearby waters. I hypothesised that these demographic groups would exhibit distinct foraging strategies, which reduce competition and facilitate their coexistence. I analysed the diet of adult male, adult female and juvenile NZ fur seals and adult male Australian fur seals and studied the diving behaviour of adult male and lactating female NZ fur seals and the at-sea movements of juvenile, adult male and lactating female NZ fur seals. Female diet reflected that of a generalist predator, influenced by prey availability and their dependant pups' fasting abilities. In contrast, adult male NZ and Australian fur seals used larger and more energy-rich prey, most likely because they could more efficiently access and handle such prey. Juvenile fur seals primarily utilised small lantern fish, which occur south of the shelf break, in pelagic waters. Juveniles undertook the longest foraging trips and adult males conducted more lengthy trips than lactating females, which perform relatively brief trips in order to regularly nurse their pups. Unlike lactating females, some adult males appeared to rest underwater by performing dives that were characterised by a period of passive drifting through the water column. The large body sizes of adult males and lactating females facilitated the use of both benthic and pelagic habitats, but adult males dived deeper and for longer than lactating females, facilitating vertical separation of their foraging habitats. Spatial overlap in foraging habitats among the age/sex groups was minimal, because lactating females typically utilised continental shelf waters and males used deeper water over the shelf break, beyond female foraging grounds. Furthermore, juveniles used pelagic waters, up to 1000 km south of the regions used by lactating females and adult males. The age and sex groups in this study employed dramatically different strategies to maximise their survival and reproductive success. Their prey and foraging habitats are likely to be shaped by body size differences, which determine their different physiological constraints and metabolic requirements. I suggest that these physiological constraints and the lactation constraints on females are the primary factors that reduce competition, thereby facilitating niche partitioning.

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TABLE OF CONTENTS

LIST OF FIGURES

CHAPTER 2. DIETARY RESOURCE PARTITIONING AMONG SYMPATRIC NEW ZEALAND AND AUSTRALIAN FUR SEALS

CHAPTER 3. INTER-SEXUAL DIFFERENCES IN NEW ZEALAND FUR SEAL DIVING BEHAVIOUR

CHAPTER 5. SEPARATION OF FORAGING HABITATS AMONG NEW ZEALAND FUR SEALS

APPENDIX 1. ENTANGLEMENT OF AUSTRALIAN SEA LIONS AND NEW ZEALAND FUR SEALS IN LOST FISHING GEAR AND OTHER MARINE DEBRIS BEFORE AND AFTER GOVERNMENT AND INDUSTRY ATTEMPTS TO REDUCE THE PROBLEM

APPENDIX 2. POPULATION STATUS AND BREEDING SEASON CHRONOLOGY OF THE FUR SEALS AT HEARD ISLAND

LIST OF TABLES

CHAPTER 1. GENERAL INTRODUCTION

CHAPTER 2. DIETARY RESOURCE PARTITIONING AMONG SYMPATRIC NEW ZEALAND AND AUSTRALIAN FUR SEALS

APPENDIX 1. ENTANGLEMENT OF AUSTRALIAN SEA LIONS AND NEW ZEALAND FUR SEALS IN LOST FISHING GEAR AND OTHER MARINE DEBRIS BEFORE AND AFTER GOVERNMENT AND INDUSTRY ATTEMPTS TO REDUCE THE PROBLEM

APPENDIX 2. POPULATION STATUS AND BREEDING SEASON CHRONOLOGY OF THE FUR SEALS AT HEARD ISLAND