

The role of juvenile foraging ecology and growth in  
the evolution of life history strategies for southern  
elephant seals

By

Iain Craig Field

BSc (Hons) School of Oceanography, Southampton University

Grad Dip (Hons) IASOS, University of Tasmania

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### Statement Of Originality

This thesis contains no material which has been accepted for a degree or diploma by the University or any other institution. To the best of my knowledge and belief, this thesis contains no material previously published or written by another person except where due acknowledgement is made in the text.

Iain Field

Date

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## Dedication

To my parents, John and Agnes, for their everlasting and enduring support and encouragement.

# Abstract

In highly dynamic and unpredictable environments such as the Southern Ocean, species that have evolved behaviours that reduce the effects of intra-specific competition may have a selective advantage. This is particularly true when juveniles face disadvantages when foraging due to morphological or physiological limitation, such as in the case of many marine mammals.

Southern elephant seals (*Mirounga leonina*) are a major consumer of biomass in the Southern Ocean with a global distribution. Recent modelling of the Macquarie Island population concluded that juvenile survival is a key parameter in influencing the rates of population change and as an important demographic component of the population. Resource limitation has been suggested as the primary reason for the change in numbers of these populations and this coupled with the importance of juvenile rates of survival influencing population change may provide some insight into explaining any reduction in juvenile survival. Until now, little has been known about these juveniles, ontogenetic and intra-specific differences in life history and foraging ecology have been suggested but not investigated. During this juvenile stage individuals undergo many morphometric and physiological changes as they develop toward maturity. Therefore, it would seem likely that studying the foraging ecology and growth and development patterns of this demographic group may show the proximate processes in affecting population dynamics. This study has followed juvenile seals as they grow and develop rapidly toward adulthood observing changes in foraging areas or strategies and associated changes in prey availability, differences in the seasonal availability of prey, changes in morphology and physiology for growth, maintenance or provisioning toward adulthood. In this thesis I present data for:

1) *Anaesthesia for safe handling* - I assessed the effects of variation in body condition and age at on the characteristics of anaesthesia, including induction time and dose-specific recovery rate which has increased the control over immobilisation level and duration, and reduces handling times for wild pinnipeds.

2) *Foraging range* and 3) *Habitat use of the Southern Ocean* - I tracked the at-sea movements of juvenile southern elephant seals using locations derived from recorded light levels.

4) *Diet* – I describe intra-specific dietary differences in prey composition and size.

5) *Metabolic estimates and energy use* and 6) *Growth and body condition changes* - I examined changes in mass and body composition of juvenile southern elephant seals during and between their annual moult and mid-year haul-outs.

*General discussion* - These key ecological areas of an important predator has increased our understanding of the evolutionary and ecological interactions that influence the population dynamics of southern elephant seals at Macquarie Island and the structure of the Southern Ocean ecosystem.

## Statement of publication and co-authorship

Publications produced as part of this thesis:

Field IC, Bradshaw CJA, McMahon CR, Harrington J, Burton HR (2002) Effects of age, size and condition of elephant seals (*Mirounga leonina*) on their intravenous anaesthesia with tiletamine and zolazepam. *Veterinary Record* 151 (8): 235-240

Field IC, Bradshaw CJA, Burton HR, Hindell MA (2004) Seasonal use of oceanographic and fisheries management zones by juvenile southern elephant seals (*Mirounga leonina*) from Macquarie Island. *Polar Biology* 27:432-440

Field IC, Bradshaw CJA, Burton HR, Sumner MD, Hindell MA (2005) Resource partitioning through oceanic segregation of foraging juvenile southern elephant seals. *Oecologia* 142:127-135

Field IC, Bradshaw CJA, Burton HR, Hindell MA (2005) Patterns of onshore mass change and metabolism in juvenile southern elephant seals. *Physiological and Biochemical Zoology* 78(4):491-504

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We the undersigned agree with the above stated “proportion of work undertaken” for each of the above published (or submitted) peer-reviewed manuscripts contributing to this thesis:

Mark Hindell  
(Candidate’s Supervisor)

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(Head Of School)

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