

Copyright is owned by the Author of the thesis. Permission is given for a copy to be downloaded by an individual for the purpose of research and private study only. The thesis may not be reproduced elsewhere without the permission of the Author.

**AN INVESTIGATION OF FACTORS INFLUENCING THE GRAZING OF
RAGWORT (*Senecio jacobaea* L.) BY SHEEP (*Ovis aries* L.) ON A HILL
COUNTRY FARM**

**A thesis presented in partial fulfilment
of the requirements for the degree of
Master of Science in Ecology
at Massey University.**

ROBERT DEAN SUTHERLAND

1997

Abstract

Grazing by sheep (*Ovis aries*) can control ragwort (*Senecio jacobaea*), but some flock members seldom eat it. For mature ewes, 11% appeared to avoid eating ragwort, compared with 16% of hoggets and 25% of lambs. Reluctant and avid ragwort feeders from each age group were fed ragwort indoors. During 5-min feeding sessions on three consecutive days, sheep classed as ragwort-averse, regardless of age, consumed less ragwort than avid ragwort eaters. Half of the ragwort-averse and avid ragwort eaters were confined on ragwort containing pasture for 10 days. Avid eaters consumed 45% of the volume of tagged ragwort plants within two days compared with no ragwort grazing by averse sheep. After 10 days, the ragwort-averse sheep consumed a similar rosette volume as the avid eaters, but lower volumes of elongated plants. Scan-sampling before and after confinement detected no change in the ragwort grazing of avid and averse sheep. Two further days of indoor ragwort grazing detected no differences in the behaviour of sheep that experienced restricted grazing compared with those that did not. The ragwort grazing of ragwort-averse and avid ragwort eaters may not be modified easily. The effects of pre-weaning ragwort exposure and post-weaning grazing with ewes on ragwort grazing by lambs were studied. Sampling periods were Weeks 1, 3, and 12 following weaning. Grazing behaviour was observed for 1-hour daily and the 24-hour reduction in ragwort volume measured on each of 4 or 5 consecutive days. Lambs exposed to ragwort before weaning consumed more ragwort than non-exposed lambs during the first two sampling periods. Lambs from ragwort-free pasture that grazed with ewes spent more time grazing ragwort than lambs grazing alone from the same background during Weeks 1 and 3. These effects did not persist into the 12th week following weaning. Lambs in all groups increased their ragwort eating markedly between Weeks 3 and 12. This may indicate an increased ability of lambs to consume ragwort with increasing age or an acclimation period in which all lambs come to accept ragwort. Grazing management techniques employed before, and immediately after weaning, appear not to effect the long-term ragwort eating of lambs.

Acknowledgments

I would like to thank Sustainability Division, AgResearch for initiating this study and for providing the facilities and expertise that made it possible.

To Dr Robin Fordham, supervisor extraordinaire, thank you! Especially for telling me what I needed to hear at times when I really needed to hear it. I owe you a great debt.

I am also indebted to Dr Kevin Stafford (Massey University) and Keith Betteridge (AgResearch), the two remaining thirds of the best team of supervisors ever assembled! Thank you!

To Fiona Prince. My lifeline. Thank you for keeping me sane and for being an inspiration. I couldn't have done this without you.

To the C. Alma Baker Trust, thank you for funding my research efforts. This work was also funded by the Postgraduate Research Fund and a grant from the Ecology Department Development Fund.

A special award to Matt Dyke, for unparalleled sheep-watching enthusiasm. Volunteers are hard to come by, especially good ones like you!

To Des Costall of AgResearch. It was a pleasure working with you. Thanks especially for the crash-course in sheep husbandry!

Thanks to staff, technicians, and fellow students in the Ecology Department, Massey University.

Thanks to John Napier and the other farm staff at Ballantrae for keeping tabs on the sheep!

Michael Ralphs and an anonymous reviewer from the Journal of Range Management provided helpful comments, as did Lindsay Matthews of AgResearch Ruakura.

A special thank you for Richie. Your understanding and empathy is a credit to you.

To Noel, Chris, Adrian, Christina, Paul, Barry and Patricia. Many thanks for your input and support for this project.

To the flatties at number 24. Thank you for letting me keep ragwort in the freezer! You're the best!

Lastly, a special thank you to the Sutherland Family: Angela, Bob, Jenney, Joanna, and Colin. Thank you for always being there.

Contents

ABSTRACT	
ACKNOWLEDGMENTS	
CONTENTS	
LIST OF TABLES	
LIST OF FIGURES	
LIST OF PLATES	
CHAPTER ONE: INTRODUCTION AND LITERATURE REVIEW	1
1.1. RAGWORT BIOLOGY	2
1.1.1. HISTORY AND DISTRIBUTION	2
1.1.2. DESCRIPTION	2
1.1.3. PROPAGATION	3
1.1.4. HABITAT AND DISPERSAL	6
1.2. RAGWORT AS A WEED	8
1.2.1. TOXICITY	8
1.2.2. RELATIVE FORAGE REDUCTION	12
1.3. RAGWORT CONTROL	13
1.3.1. LIFE-CYCLE COMPLETION	14
1.3.2. HAND-PULLING AND GRUBBING	14
1.3.3. FLAME-THROWERS	14
1.3.4. MOWING	15
1.3.5. PASTURE RENOVATION	15
1.3.6. CHEMICAL HERBICIDES	15
1.3.7. BIOLOGICAL CONTROL	17
1.3.8. GRAZING CONTROL	18
1.4. USING SHEEP TO CONTROL RAGWORT	19
1.4.1. HISTORY AND PRACTICES	19
1.4.2. RAGWORT CONTROL WITH SHEEP ON CATTLE FARMS	20
1.4.3. WHEN ATTEMPTS AT SHEEP CONTROL FAIL	22
1.5. AIMS	23

CHAPTER TWO: THE INCIDENCE OF SHEEP THAT RARELY EAT RAGWORT WITHIN ROMNEY FLOCKS OF DIFFERING AGE, AND THE SUSCEPTIBILITY OF RAGWORT AVERSIONS TO BEHAVIOUR MODIFICATION.	24
2.1. INTRODUCTION	24
2.2. OBJECTIVES	25
2.3. METHODS AND MATERIALS	25
2.3.1. STUDY AREA	25
2.3.2. IDENTIFYING RAGWORT-AVERSE SHEEP	26
2.3.3. INDOOR PRESENTATION OF RAGWORT TO SHEEP	26
2.3.4. CONFINING SHEEP ON RAGWORT INFESTED PASTURE	29
2.3.5. SUBSEQUENT SCAN-SAMPLING OF LAMBS	30
2.4. RESULTS	30
2.4.1. PROPORTIONS OF RAGWORT-AVERSE SHEEP	30
2.4.2. INDOOR RAGWORT GRAZING	31
2.4.3. OUTDOOR CONFINEMENT COMPARISON	32
2.4.4. BEHAVIOUR OF LAMBS AFTER ONE YEAR	36
2.5. DISCUSSION	36
2.5.1. EVIDENCE FOR RAGWORT AVERSIONS	36
2.5.2. RAGWORT FEEDING BEHAVIOUR	37
2.5.3. ROBUSTNESS OF RAGWORT FEEDING BEHAVIOUR	39
CHAPTER THREE: CAN THE REARING CONDITIONS FOR LAMBS INCREASE RAGWORT GRAZING?	41
3.1. INTRODUCTION	41
3.2. OBJECTIVES	42
3.3. METHODS AND MATERIALS	42
3.3.1. STUDY AREA	42
3.3.2. FORMATION OF TREATMENT GROUPS	42
3.3.3. EXPERIMENT DESIGN	44
3.3.4. ANIMAL MEASUREMENTS	44
3.3.5. PLANT MEASUREMENTS	46
3.4. RESULTS	46
3.4.1. PASTURE MEASUREMENTS AND LAMB WEIGHTS	46
3.4.2. SCAN-SAMPLING OF LAMBS	47

3.4.3. FOCAL SAMPLING OF LAMBS	48
3.4.4. PLANT VOLUME REDUCTION	49
3.4.5. EWE BEHAVIOUR	50
3.4.6. RAGWORT GROWTH STAGE PREFERENCES OF LAMBS	51
3.4.7. ACTIVITY BUDGETS	52
3.5. DISCUSSION	53
3.5.1. SAMPLING ISSUES	53
3.5.2. RAGWORT EXPOSURE BEFORE WEANING	55
3.5.3. DIURNAL PREFERENCE PATTERNS	55
3.5.4. SOCIAL FACILITATION BY EWES	56
3.5.5. PERSISTENCE OF EXPOSURE AND EWE EFFECTS	57
3.5.6. RAGWORT FEEDING OF EWES	59
3.5.7. RAGWORT GROWTH STAGE PREFERENCES OF LAMBS	59
3.5.8. ACTIVITY BUDGETS OF EWES AND LAMBS	60
3.5.9. CONCLUSIONS	60
CHAPTER FOUR: GENERAL DISCUSSION	61
4.1. SUMMARY OF MAIN FINDINGS	61
4.2. IMPLICATIONS FOR FARMERS	62
4.2.1. SELECTING THE BEST SHEEP FOR RAGWORT CONTROL	62
4.2.2. RAGWORT-AVERSE SHEEP	62
4.2.3. RAGWORT CONTROL WITH LAMBS	62
4.3. FUTURE WORK	63
4.3.1. REPLICATION	63
4.3.2. DIFFERENCES IN THE CONSUMPTION OF RAGWORT BY SHEEP	63
4.3.3. STOCKING RATES FOR RAGWORT CONTROL WITH SHEEP	65
4.3.4. INTEGRATING SHEEP WITH OTHER WEED CONTROL MEASURES	65
REFERENCES	66
APPENDIX A: PAPER SUBMITTED TO JOURNAL OF RANGE MANAGEMENT	75

List of Tables

Table	Title	Page
1.1	Comparative sensitivity of various animal species to <i>Senecio jacobaea</i> (Cheeke, 1994).	12
2.1.	Percentage of sheep from ewe (n=140) and hogget (n=98) flocks not observed to eat ragwort after the 10 and 30-minute sampling periods at Ballantrae, April 1996.	31
2.2.	Mean (\pm SE) rate (grams/min) of ragwort consumed indoors by ewes, hoggets, and lambs at Ballantrae, April 1996.	32
2.3.	Mean proportion of lambs, hoggets, and ewes in each feeding class observed eating ragwort before and after confinement at Ballantrae, April 1996.	33
2.4.	Mean percentage of grazing observations where ragwort was consumed for averse and avid eaters before and after confinement at Ballantrae, April 1996.	33
2.5.	Mean (\pm SE) percentage of rosettes and elongated plant volumes removed by averse and avid ragwort eaters after 10 days of confinement at Ballantrae, April 1996.	35

List of Tables (continued)

Table	Title	Page
3.1.	Mean percentage (\pm SE) of feeding scans spent eating ragwort by lambs from ragwort-free (naive) or ragwort-present (exposed) pasture, grazing with or without ewes, during Weeks 1, 3 and 12.	47
3.2.	Mean percentage (\pm SE) of feeding time spent eating ragwort by lambs from ragwort-free (naive) or ragwort-present (exposed) pasture, grazing with or without ewes, during Weeks 1, 3 and 12.	48
3.3.	Mean percentage (\pm SE) of ragwort volume reduced after 24-hour grazing periods by lambs from ragwort-free (naive) or ragwort-present (exposed) pasture, grazing with or without ewes, during Weeks 1, 3 and 12.	49
3.4.	Mean percentage of feeding scans spent eating ragwort by ewes that grazed with lambs from ragwort-free or ragwort-present pasture during Weeks 1 and 3 at Ballantrae 1995-96.	50
3.5.	Mean percentage of feeding time spent eating ragwort by ewes that grazed with lambs from ragwort-free or ragwort-present pasture during Weeks 1 and 3 at Ballantrae 1995-96.	51

List of Figures

Figure	Title	Page
2.1.	Mean cumulative volume (%) of elongated ragwort plants removed by avid and averse sheep after one, two and 10 confinement days at Ballantrae, April 1996.	34
2.2.	Mean cumulative volume (%) of rosette ragwort plants removed by avid and averse sheep after one, two and 10 confinement days at Ballantrae, April 1996.	35
3.1.	Mean volumes (%) of rosette and elongated ragwort plants removed during Week 12 by lambs from ragwort-free and ragwort-present pasture backgrounds at Ballantrae 1995-96.	51
3.2.	Relative proportions of grazing on ragwort, grazing on pasture, and activities other than grazing for the combined focal ewe data and the focal lamb data from Week 12 at Ballantrae 1995-96.	52

List of Plates

Plate	Title	Page
1	Large ragwort rosette	4
2	Elongated ragwort plant with large yellow corymbs	5
3	Ewe eating ragwort from a metal tray during a 5-min confinement period indoors.	28
4	Lambs with freshly painted numbers, grazing amongst elongated ragwort plants.	43
5	Focal-sampling of lambs and ewes confined in a daily grazing area.	45