



**The seasonal physiology of *Antechinus stuartii*:
renal and gonadal correlates**

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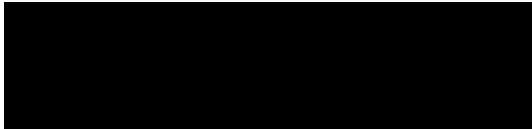
June 1996

A thesis submitted for the degree of Doctor of Philosophy of the
University of New England

Declaration

I certify that this thesis has not already been submitted for any degree and is not currently being submitted for any other degree or qualification.

I certify that any help received in preparing this thesis, and all sources used, have been acknowledged in this thesis.



Bronwyn M. McAllan

Table of Contents

	Page
Summary	i
Acknowledgments	iii
Abbreviations used in the following chapters	v
List of tables	vii
List of figures	ix
Chapter 1	
Introduction	1
1.1	2
1.2	3
1.2.1	3
1.2.2	6
1.2.3	8
1.3	16
1.3.1	16
1.3.2	16
1.3.3	20
1.3.4	21
1.4	21
1.4.1	21
1.4.2	25
1.4.3	26
1.4.4	28
1.5	31
1.5.1	31
1.5.2	35
1.5.3	39
1.5.4	44
1.6	50

Chapter 2	General materials and methods	52
2.1	Introduction	52
2.2	Field work and animals	52
2.3	Animal maintenance in captivity	53
2.4	Renal function determination	54
2.4.1	Measurement of glomerular filtration rate	54
2.4.2	Urine and faecal collections	54
2.4.3	Urine electrolytes	55
2.4.4	Faecal electrolytes	55
2.4.5	Total electrolytes	55
2.5	Tissue and blood collections	56
2.5.1	Animal sacrifice	56
2.5.2	Plasma samples	57
2.5.3	Haematocrit	57
2.5.4	Plasma electrolytes	57
2.5.5	General procedure for tissue collections	57
2.5.6	Histological procedure for light microscopy	58
2.5.7	Histological procedure for electron microscopy	59
2.5.8	Histological procedure for frozen sections	59
2.6	Morphometric analysis	60
2.7	Statistical methods	60
2.7.1	Renal function experiments	60
2.7.2	Morphometric data	61
Chapter 3	Seasonal changes in renal function in <i>Antechinus stuartii</i>	62
3.1	Introduction	62
3.2	Materials and methods	63
3.2.1	Animals	63
3.2.2	Measurement of glomerular filtration rate	63
3.2.3	Haematocrit	64

3.2.4	Plasma samples	64
3.2.5	Urine and faecal collections	64
3.2.6	Urine and plasma electrolytes	64
3.2.7	Faecal electrolytes	64
3.2.8	Statistical methods	64
3.3	Results	65
3.3.1	Body mass	65
3.3.2	Glomerular filtration rate	65
3.3.3	Haematocrit	65
3.3.4	Plasma analysis	65
3.3.5	Urine analysis	73
3.3.6	Faecal analysis	73
3.4	Discussion	78
Chapter 4	Seasonal changes in the renal morphology of <i>Antechinus stuartii</i>	89
4.1	Introduction	89
4.2	Materials and methods	90
4.2.1	Animals	90
4.2.2	Histology	91
4.2.3	Morphometry	91
4.3	Results	97
4.3.1	Gross morphology	97
4.3.2	Light microscopy	99
4.3.3	Morphometry	99
4.4	Discussion	114
4.4.1	General changes in morphology	114
4.4.2	Effect of diet on renal indices	115
4.4.3	Comparative morphology and <i>A. stuartii</i>	130
Chapter 5	Seasonal changes in the reproductive anatomy of male <i>Antechinus stuartii</i>	133
5.1	Introduction	133
5.2	Materials and methods	135
5.2.1	Animals	135
5.2.2	Histology	135
5.2.3	Morphometry	135

5.2.4	Statistical methods	136
5.3	Results	136
5.3.1	Testis	136
5.3.1.1	Scrotal width	136
5.3.1.2	Testicular morphology	136
5.3.1.3	Epididymal morphology	140
5.3.1.4	Epididymal morphometry	140
5.3.2	Accessory reproductive tract	141
5.3.2.1	Prostate	141
5.3.2.2	Cowper's or bulbourethral glands	144
5.4	Discussion	155
Chapter 6	The effects of testosterone and cortisol on renal function in male <i>Antechinus stuartii</i>	165
6.1	Introduction	165
6.2	Materials and methods	167
6.2.1	Animals	167
6.2.2	Body mass	167
6.2.3	Measurement of glomerular filtration rate	167
6.2.4	Haematocrit	167
6.2.5	Plasma samples and electrolytes	168
6.2.6	Urine and Faecal Collections	168
6.2.7	Urine electrolytes	168
6.2.8	Faecal samples	168
6.2.9	Food and water consumption	169
6.2.10	Experimental procedure	169
6.2.11	Statistical methods	170
6.3	Results	170
6.3.1	General description	170
6.3.2	Body mass	171
6.3.3	Glomerular filtration rate	171
6.3.4	Haematocrit	174
6.3.5	Plasma electrolytes	174
6.3.6	Urine and faecal measurements	174

6.3.7	Urine analysis	174
6.3.8	Food and water consumption	180
6.4	Discussion	180
Chapter 7	The effects of testosterone and cortisol on renal morphology of male <i>Antechinus stuartii</i>	194
7.1	Introduction	194
7.2	Materials and methods	195
7.2.1	Animals	195
7.2.2	Histology	196
7.2.3	Morphometry	196
7.2.4	Statistical analysis	196
7.3	Results	197
7.3.1	Gross morphology	197
7.3.2	Light microscopy	197
7.3.3	Morphometry	201
7.4	Discussion	207
Chapter 8	The effects of testosterone and cortisol on the reproductive tract of male <i>Antechinus stuartii</i>	220
8.1	Introduction	220
8.2	Materials and methods	222
8.2.1	Animals	222
8.2.2	Histology	223
8.2.3	Morphometry	223
8.3	Results	223
8.3.1	External morphology	223
8.3.2	Testis	224
8.3.2.1	Testes mass and (scrotal) width	224
8.3.2.2	Testicular morphology	224
8.3.2.3	Epididymal morphology	227
8.3.2.4	Epididymal morphometry	227
8.3.3	Accessory reproductive tract	227
8.3.3.1	Prostate	227

8.3.3.2	Cowper's or bulbourethral glands	230
8.3.4	Adrenal glands	241
8.4	Discussion	241
Chapter 9	General discussion	253
9.1	General discussion	253
9.2	Suggestions for further study	268
References		269
Appendices		
Appendix I	Methods in stereology	i
Appendix II	Field studies	viii
Appendix III	Histological methods	xvi
Appendix IV	<i>In vitro</i> autoradiography	xxix
Appendix V	Carnivore and non-carnivore data used in regression analyses and analyses of variance	xliv
Appendix VI	Publications arising from the thesis	lix
Appendix VII	Single injection method for GFR estimation	lxi

Summary

Antechinus stuartii is a small marsupial that has an unusual life history pattern. It includes a highly synchronised brief mating period occurring at the same time every year within a particular population. Following the mating period all males die from an uncontrolled stress response, which is associated with high plasma concentrations of glucocorticoids and testosterone. Seasonal changes in renal structure and function, and their contributions to male mortality were investigated. Changes in the reproductive tract were also assessed. Following the seasonal study, changes in renal structure and function and reproductive tract were assessed in males given depot injections of either saline, testosterone only, cortisol only or testosterone plus cortisol at doses mimicking those found in the mating period.

Glomerular filtration rate (GFR) changed seasonally, with GFR of males lower in July and August, and that of females lower only in the pre-mating period. Plasma sodium and chloride levels were higher, and potassium levels were lower in July and August in both sexes. GFR decreased following testosterone treatment, independent of cortisol. Urinary electrolytes, osmolality, and urea significantly decreased in all cortisol treated animals. Plasma potassium and chloride were affected by the administration of cortisol.

In the seasonal study, glomerular volumes increased in July and August in males, coinciding with a reduction in glomerular number per mm^2 of cortex. Tubular diameters and cellular volumes increased in males from July and August. In the hormone study, glomerular volumes were increased by the administration of cortisol, with numbers of glomeruli per mm^2 reduced by cortisol or testosterone administration. Testosterone administration increased the diameters of the proximal and distal tubules, and caused cellular hypertrophy. Cortisol administration increased the diameters of the collecting tubules without cellular hypertrophy.

In the seasonal study the reproductive tract was undifferentiated in February and May. Differentiation and hypertrophy of the accessory reproductive tract were observed in July, and continued into August. In the hormone study neither treatment affected spermatogenesis, although testosterone treatment caused hypertrophy of the epididymal cells. The mass, differentiation and secretory activity of the accessory

reproductive tract were increased by testosterone administration. Adding cortisol to the testosterone treatment reduced the mass and secretory activity of the glands which appeared similar to those of males captured in August.

The present study has demonstrated that there are seasonal changes in renal structure and function in male *A. stuartii*, and these changes were mimicked by the administration of testosterone, with less influence from cortisol administration. The accessory reproductive tract was also sensitive to these hormones. This study demonstrates that the synchronous seasonal changes that occur in *A. stuartii* are not confined to the reproductive tract, and the changes are governed less by cortisol, than by the sensitivity of *A. stuartii* males to testosterone.

Acknowledgments

First thanks must go to my supervisors Julie Roberts and Tim O'Shea. They were willing to support my ambitious project, especially when some aspects of the project did not necessarily promise much return. Moreover, they were extremely supportive during the extended suspension and disruption of my candidature due to my serious illness. Their unfailing encouragement during this personally difficult time will always be appreciated.

The field collection of *Antechinus stuartii* was aided by many people, and I thank Michael Clinchy, Fritz Geiser, Tom Geiser, Debbie Haynes and Gerhard Körtner for their help with the trapping. Thanks must also go to all my animal wranglers, who braved being bitten by hissing *A. stuartii* as I bled the animals for the GFR experiments. These include Cindy Blaney, Grahame Chaffey, Debbie Haynes, Craig Lawler, Tim O'Shea and Julie Roberts.

Many people made my time in the Physiology Department a pleasant one, and these include Cindy Blaney, Amy Johnston, Alison Leary, Annette McLeod, and Carol Quilkey. Both Amy Johnston and Alison Leary read parts of my thesis, for which I am grateful. I would like to thank Peter Garlick, Annette McLeod, and Carol Quilkey for the many useful discussions on the vagaries of the histology of renal tissue. Thanks also to Leanne Lisle, from the Department of Agronomy, U.N.E. for teaching me the sealed chamber digestion methods for electrolyte analysis. Special thanks go to Cindy Blaney and Helen Sink, who have always been a constant support over this time.

Dr Paul Whittington from the Department of Zoology, U.N.E., must be thanked for his support in allowing me to use his photomicrograph equipment that enabled me to produce the laser prints of the histological images in the thesis. Both he, Dr David Merritt, and Mr Michael Murray were always helpful and patient when the programmes invariably crashed at my sensitive touch.

Dr Lee Astheimer kindly allowed me to come down and use her facilities at the University of Wollongong. Her patience and endurance in teaching me how to run hormone assays on small volumes of plasma is gratefully acknowledged. I would also like to thank Lee

Astheimer and Bill and Marina Buttemer for their hospitality over that time.

Thanks also to Associate Professor Jean Joss from Macquarie University, who had many useful hints for me when I was attempting *in vitro* autoradiography. I'm only sorry that in the end this section of my thesis was relegated to an appendix.

Finally, I wish to thank my spouse, Fritz Geiser, who has endured endless monologues on renal structure and function in *A. stuartii*; and also my son Tom Geiser, who has sacrificed part of his childhood to 'that Ph.D'.

Abbreviations

ACTH	Adrenocorticotrophic hormone
ADH	Antidiuretic hormone
CBG	Corticosteroid binding globulin
CCD	cortical collecting duct
CD	collecting duct
Cl⁻	chloride ions
CNT	connecting tubule
CRF or CRH	Corticotropin releasing hormone
⁵¹Cr-EDTA	⁵¹ Chromium-Ethylene diamine tetra acetic acid
DHEA	dəhydroepiandrosterone
DHT	d hydrotestosterone
DCT	d stal convoluted tubule
DST	d stal straight tubule
FSH	Follicle stimulating hormone
g	grams
GFR	Glomerular filtration rate
hCG	human chorionic gonadotrophin
11β-OHSD	11β - hydroxysteroid dehydrogenase
IMCD	inner medullary collecting duct
IU	International Units
JGA	juxtaglomerular apparatus
kg	kilogram
L	Litre
LH	Luteinising hormone
LVP	lysine vasopressin
mL	millilitre
mol	moles
MT	Medullary thickness
OMCD	outer medullary collecting duct
osm	osmolal
PCT	proximal convoluted tubule
PLSD	protected least significant difference
PST	proximal straight tubule
PMS	Pregnant mares serum

PMT	Percentage medullary thickness
POMC	Proopiomelanocortin
RIA	Radioimmunoassay
RMT	Relative medullary thickness
TAL	thick ascending limb of the loop of Henle
TALH	thin ascending limb of the loop of Henle
TDLH	thin descending limb of the loop of Henle

List of tables	Page
Table 1.1 Plasma testosterone concentrations in <i>A. stuartii</i> and some other mammals.	10
Table 1.2 Numbers of bulbourethral glands in some marsupials.	13
Table 1.3 Plasma glucocorticoid concentrations in some marsupials and placentals.	29
Table 3.1 Body weight (g), Glomerular filtration rate ($\text{mL}\cdot\text{min}^{-1}\cdot\text{kg}^{-1}$) and Haematocrit (%)	66
Table 3.2 Plasma Electrolytes ($\text{mmol}\cdot\text{L}^{-1}$) and Osmolality ($\text{mosmol}\cdot\text{kg}^{-1}$)	70
Table 3.3 Urine Electrolytes ($\text{mmol}\cdot\text{L}^{-1}$) and Osmolality ($\text{mosmol}\cdot\text{kg}^{-1}$)	74
Table 3.4 Total excreted urinary electrolytes (nmol)	75
Table 3.5 Faecal Electrolytes ($\text{mmol}\cdot\text{kg}^{-1}$)	76
Table 3.6 Faecal Electrolytes- Total excreted (nmol)	77
Table 3.7 Plasma sodium and potassium values ($\text{mmol}\cdot\text{L}^{-1}$) for some mammals.	83
Table 4.1 Body mass (kg), kidney mass (g), kidney size (mm) and source of data for the allometric equations for marsupials.	93
Table 4.2 Gross renal morphology of <i>Antechinus stuartii</i> .	98
Table 4.3 Glomerular measurements.	105
Table 4.4 Mean tubular diameters (μm) of different sections of the nephron.	107
Table 4.5 Epithelial cell volumes (μm^3) of different sections of the nephron.	109
Table 5.1 Morphometric analyses of testicular structures.	137

Table 6.1 Body mass (g) and haematocrit (%) in <i>A. stuartii</i> before and 25-30 days after hormone or saline injection. Plasma electrolytes ($\text{mmol}\cdot\text{L}^{-1}$) and osmolality ($\text{mosm}\cdot\text{kg}^{-1}$) are from animals at the end of the experiment.	172
Table 6.2. GFR ($\text{mL}\cdot\text{min}^{-1}\cdot\text{kg}^{-1}$), urine volumes (mL), and faecal water content (%) in <i>A. stuartii</i> before and 25-30 days after hormone or saline injection.	178
Table 6.3 Urine electrolytes ($\text{mmol}\cdot\text{L}^{-1}$), osmolality ($\text{mosm}\cdot\text{kg}^{-1}$), and urea ($\text{mmol}\cdot\text{L}^{-1}$) in <i>A. stuartii</i> before and 25-30 days after hormone or saline injection.	181
Table 6.4 Total electrolytes and urea excreted (μmol) overnight in <i>A. stuartii</i> .	184
Table 7.1 Gross renal morphology of <i>Antechinus stuartii</i> from testosterone and cortisol experiments.	198
Table 7.2 Glomerular numbers per mm^2 and glomerular volumes of <i>A. stuartii</i> from testosterone and cortisol experiments.	202
Table 7.3 Tubular diameters of renal components in <i>Antechinus stuartii</i> from testosterone and cortisol experiments.	206
Table 7.4 Cellular volumes (μm^3) of renal components in <i>Antechinus stuartii</i> from testosterone and cortisol experiments.	208
Table 8.1 Measurements of the reproductive tracts and adrenal glands of male <i>A. stuartii</i> from testosterone and cortisol experiments.	225

List of figures

Figure 3.1 Seasonal changes in the glomerular filtration rate ($\text{mL}\cdot\text{min}^{-1}\cdot\text{kg}^{-1}$) in <i>A. stuartii</i> and <i>M. musculus</i> .	67
Figure 3.2 Seasonal changes in the haematocrit (%) in <i>A. stuartii</i> and <i>M. musculus</i> .	68
Figure 3.3 Plasma concentrations in $\text{mmol}\cdot\text{L}^{-1}$ of a) potassium and b) sodium.	71
Figure 3.4 Plasma concentrations of a) chloride ($\text{mmol}\cdot\text{L}^{-1}$) and b) plasma osmolality ($\text{mosmol}\cdot\text{kg}^{-1}$).	72
Figure 4.1 Regression equations for a) kidney mass (g) versus body mass (kg) and b) kidney size (mm) versus body mass (kg).	95
Figure 4.2 Views of the cortex of the kidneys of males from a) February, b) May, c) July and d) August.	101
Figure 4.3 Views of the juxtamedullary glomeruli of the kidneys of two males from August.	103
Figure 4.4 Seasonal changes in the mean glomerular volumes (μm^3) of <i>A. stuartii</i> , a) cortical glomerular volumes, b) juxtamedullary glomerular volumes.	106
Figure 4.5 Seasonal changes in the means of proximal tubule cell volumes (μm^3) of <i>A. stuartii</i> .	110
Figure 4.6 Seasonal changes in the means of distal straight tubule cell volumes (μm^3) of <i>A. stuartii</i> .	111
Figure 4.7 Seasonal changes in the means of cortical collecting duct cell volumes (μm^3) of <i>A. stuartii</i> .	112
Figure 4.8 Seasonal changes in the means of collecting duct of the outer medulla cell volumes (μm^3) of <i>A. stuartii</i> .	113
Figure 4.9 Regression equations for carnivorous and non-carnivorous mammals for a) kidney mass (g)	119

versus body mass (kg) in mesic environments and b) kidney mass (g) versus body mass (kg) in xeric environments.	
Figure 4.10 Regression equations for carnivorous and non-carnivorous mammals for a) kidney size (mm) versus body mass (kg) in mesic environments and b) kidney size (mm) versus body mass (kg) in xeric environments.	121
Figure 4.11 Regression equations for carnivorous and non-carnivorous mammals for a) RMT versus body mass (kg) in mesic environments and b) RMT versus body mass (kg) in xeric environments.	124
Figure 4.12 Regression equations for carnivorous and non-carnivorous mammals for a) PMT versus body mass (kg) in mesic environments and b) PMT versus body mass (kg) in xeric environments.	126
Figure 4.13 a) Kidney mass as a percentage of body mass and b) Kidney size as a percentage of body mass (arcsin transformed), for carnivorous and non-carnivorous mammals from mesic and xeric environments.	128
Figure 4.14 a) RMT and b) PMT, for carnivorous and non-carnivorous mammals from mesic and xeric environments.	129
Figure 5.1 The seasonal changes in the scrotal width of <i>A. stuartii</i> .	138
Figure 5.2 The seasonal changes in the epithelium of the caput section of the epididymis, a) epithelial cell height (μm) and b) epithelial cell volume (μm^3).	142
Figure 5.3 The seasonal changes in the epithelium of the caudal section of the epididymis, a) epithelial cell height (μm) and b) epithelial cell volume (μm^3).	143
Figure 5.4 The seasonal changes in the cytology of the prostate of <i>A. stuartii</i> . a) The anterior to medial section of the prostate of a male from February. b) The anterior end of the prostate of a male from May.	145

Figure 5.5 Prostate glands of males from a) July and b) and c) August.	147
Figure 5.6 Dissection of an August male <i>A. stuartii</i> .	150
Figure 5.7 Cross-section of the male reproductive tract of <i>A. stuartii</i> .	151
Figure 5.8 The bulbourethral glands of males from a) and b) February, and c) May.	153
Figure 5.9 a) Urethral bulb of a male from July, and b) gland IV of a male from August.	154
Figure 5.10 The bulbourethral glands in males from July, a) gland I, b) gland II, c) gland III.	157
Figure 5.11 The bulbourethral glands in males from August, a) gland I, b) gland II, c) gland III.	159
Figure 6.1 a) Differences in body mass (g) between pre-injection and post-injection times in males from testosterone and cortisol experiments. b) Differences in haematocrit (%) between pre-injection and post-injection times in males from testosterone and cortisol experiments.	173
Figure 6.2 Differences in GFR ($\text{mL}\cdot\text{min}^{-1}\cdot\text{kg}^{-1}$) between pre-injection and post-injection times in males from testosterone and cortisol experiments.	175
Figure 6.3 Plasma concentrations ($\text{mmol}\cdot\text{L}^{-1}$) of a) sodium and b) potassium in males from testosterone and cortisol experiments.	176
Figure 6.4 a) Plasma chloride concentrations ($\text{mmol}\cdot\text{L}^{-1}$) and b) plasma osmolality ($\text{mosm}\cdot\text{kg}^{-1}$) in males from testosterone and cortisol experiments.	177
Figure 6.5 a) Differences in urine volume (mL) between pre-injection and post-injection times in males from testosterone and cortisol experiments. b) Differences in faecal water (%) between pre-injection and post-injection times in males from testosterone and cortisol experiments.	179

Figure 6.6 Differences in a) urinary sodium concentrations ($\text{mmol}\cdot\text{L}^{-1}$), b) potassium concentrations ($\text{mmol}\cdot\text{L}^{-1}$) and c) b) chloride concentrations ($\text{mmol}\cdot\text{L}^{-1}$) between pre-injection and post-injection times in males from testosterone and cortisol experiments.	182
Figure 6.7 a) Differences in urine osmolality ($\text{mosm}\cdot\text{kg}^{-1}$) between pre-injection and post-injection times in males from testosterone and cortisol experiments. b) Differences in urinary urea concentrations ($\text{mmol}\cdot\text{L}^{-1}$) between pre-injection and post-injection times in males from testosterone and cortisol experiments.	183
Figure 6.8 Water consumption (mL drunk per day) throughout the testosterone and cortisol experiment.	185
Figure 6.9 Food consumption (g eaten per day) throughout the testosterone and cortisol experiment.	186
Figure 7.1 Cortex of the kidney of males treated with a) saline, b) testosterone only, c) cortisol only, and d) testosterone plus cortisol.	200
Figure 7.2 The number of glomeruli per mm^2 of renal cortex in males from the testosterone and cortisol experiment.	203
Figure 7.3 The mean glomerular volumes (μm^3) of <i>A. stuartii</i> from the testosterone and cortisol experiment a) cortical glomerular volumes, b) juxtamedullary glomerular volumes.	204
Figure 7.4 Changes in the means of proximal tubule cell volumes (μm^3) of <i>A. stuartii</i> from the testosterone and cortisol experiment.	209
Figure 7.5 Changes in the means of distal straight tubule cell volumes (μm^3) of <i>A. stuartii</i> from the testosterone and cortisol experiment.	210
Figure 7.6 Changes in the means of cortical collecting duct cell volumes (μm^3) of <i>A. stuartii</i> from the testosterone and cortisol experiment.	211
Figure 7.7 Changes in the means of collecting duct	212

of the outer medulla cell volumes (μm^3) of *A. stuartii* from the testosterone and cortisol experiment.

Figure 8.1 The changes in the scrotal width of <i>A. stuartii</i> treated with saline, testosterone only, cortisol only or testosterone plus cortisol.	226
Figure 8.2 The changes in the epithelium of the caput section of the epididymis, a) epithelial cell height (μm) and b) epithelial cell volume (μm^3).	228
Figure 8.3 The changes in the epithelium of the caudal section of the epididymis, a) epithelial cell height (μm) and b) epithelial cell volume (μm^3).	229
Figure 8.4 The prostate of a) a saline treated male and b) a cortisol only treated male.	231
Figure 8.5 Prostate of a testosterone only treated male.	233
Figure 8.6 Prostate of a testosterone plus cortisol treated male.	235
Figure 8.7 The bulbourethral glands of a saline treated male.	238
Figure 8.8 The bulbourethral glands of a cortisol only treated male.	240
Figure 8.9 The bulbourethral glands of a testosterone only treated male.	243
Figure 8.10 The bulbourethral glands of a testosterone plus cortisol treated male.	245
Figure 8.11 a) The urethral bulb of a testosterone only treated male. b) Gland IV of a testosterone plus cortisol treated male.	246
Figure 9.1 The effects of testosterone and cortisol on mammalian renal structure.	259
Figure 9.2 The effects of testosterone and cortisol on the renal structure of <i>A. stuartii</i> .	261