

Physiological monitoring of welfare for conservation of
Arabian oryx, *Oryx leucoryx*

Submitted by

Mansoor Hamed AlJahdhami

to the University of Exeter as a thesis for the degree of Doctor of
Philosophy in Biological Sciences by Research.

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Mansoor H. AlJahdhami



Feeding of a captive herd of Arabian oryx at Jaaluni enclosure, the field center of the Arabian Oryx Sanctuary, Sultanate of Oman. (Photo: Mansoor AlJahdhami)

Abstract

The endangered Arabian oryx, *Oryx leucoryx* faces a wide range of issues that potentially have adverse effects on their welfare while they are free-ranging in their natural habitat, housed in captivity for conservation breeding or when they are translocated from the wild to captivity or vice versa. Furthermore, the global increase in the number of captive Arabian oryx (currently more than 95 % of the world population of about 8000 individuals), gives rise to particular concern for their welfare and health within captive conditions.

Thorough assessment of the welfare of animals involves physiological and behavioural measures. Methods for assessment of welfare in Arabian oryx have not been established and the present studies aim at establishing physiological tools for assessment of welfare. Therefore, the present studies developed and applied new methods for non-invasive assessment of welfare in the Arabian oryx (using faecal samples), and established reference values for a range of haematological, biochemical and clinical parameters. The potential disturbances in these parameters were investigated after immobilisation and tranquillisation and post- transportation.

Two enzyme immuno-assays (EIA I and II) for faecal glucocorticoid metabolites (FGM) were validated by stimulation and suppression of the hypothalamic-pituitary-adrenal axis through injection of synthetic adrenocorticotrophic hormone (ACTH) and dexamethasone, respectively. These studies established a lag-time of 14 ± 1 h between secretion of glucocorticoids into the blood stream and excretion of the measured FGM. Faecal incubation at 30°C for 3 days showed that EIA I measured more stable faecal glucocorticoid metabolites than EIA II, and has greater potential for application in field conditions. This method was found to be invaluable for measuring stress and hence assessment of welfare status, and its use is recommended in planning welfare improvements. Measurement of FGM successfully detected the stress of road transportation (630 km for 8-10 h), showing an increase 2 days after transport, followed by recovery to basal FGM levels after re-housing for up to 11 days. Releasing oryx to the wild, in Oman, and tracking for 11 days, after transportation 50-70 km from the captive site (Arabian Oryx

Sanctuary, Jaaluni), caused an increase in FGM to the highest levels seen in these studies, and suggests a high level of stress was experienced after release of oryx.

Published reference values for haematological, biochemical, hormonal and clinical parameters for Arabian oryx are limited, with little information for non-immobilised and non-tranquillised oryx or consideration of possible age and sex differences. Therefore, reference values and inter-percentile ranges (2.5 and 97.5 percentiles) were established for 32 parameters, in separate groups of male and female adult oryx, without using immobilising or tranquillising chemicals during capture. The haematological parameters investigated were white blood cell count and differentiation (%) of cell types (neutrophils, lymphocytes, monocytes, eosinophils, basophils), number of platelets, red blood cell count, haemoglobin concentration and haematocrit, erythrocyte cell volume, erythrocyte haemoglobin content and concentration, serum osmolality and ions (sodium, potassium, chloride, calcium, magnesium and phosphorus). Biochemical parameters investigated were serum urea, glucose, total protein, albumin and plasma lactate concentrations. Clinical parameters investigated were body temperature, heart and respiratory rates. Hormonal parameters measured were cortisol, free-thyroxine, free-triiodothyronine and insulin concentrations. Near basal values for serum cortisol were measured in Arabian oryx sampled within 2 min, while values were significantly higher in oryx sampled within 5-10 min. The reference values established in these studies are considered valuable tools for diagnosis of disease and physiological alterations in male and female Arabian oryx.

To investigate the possible effects of the common practice of immobilisation and tranquillisation on physiological and biochemical status, two restraint chemicals (xylazine and perphenazine enanthate) were evaluated. Xylazine (an immobilising agent) caused changes in many clinical, hormonal, haematological and biochemical parameters; respiratory rate decreased by 74 %, heart rate decreased by 58 %, causing a decrease in red blood cell count, haemoglobin concentration and haematocrit, serum albumin and total protein concentration. Xylazine also induced a decrease in serum insulin, which probably caused the observed increase in serum glucose.

Perphenazine enanthate (a long-acting tranquilliser) was found to have no adverse effects on most parameters, which generally remained in the reference ranges. However, a

reduction in blood haematocrit and related parameters (red blood cell count and plasma haemoglobin concentration) occurred, 1-3 days after injection. The tranquilliser also plays a role in reducing stress and significantly reduced serum cortisol 2-3 days after injection in oryx held in captivity compared to oryx that received a saline (control) injection. FGM increased significantly one day after injection of perphenazine enanthate and saline, suggesting the animals were initially stressed by the handling and venipuncture, taking into consideration the lag-time from cortisol secretion to appearance of FGM.

The baseline concentration of serum cortisol was used in assessing the stress caused by handling before and after transporting Arabian oryx for 630 km (8-10 h) and the acute effects of handling and injections. Increased serum cortisol was always associated with leukocytosis, neutrophilia and lymphopenia. Serum cortisol of non-transported oryx was reduced by the tranquilliser perphenazine enanthate, but transportation of tranquillised Arabian oryx during hot ambient temperature (maximum 42 °C) resulted in fatigue and prevented reaching a clear conclusion of the role of the tranquilliser in reducing transport stress. Non-tranquillised oryx transported at a maximum of 26-30 °C showed a similar level of stress as implied by the level of faecal glucocorticoid metabolites, but without fatigue. However, the tranquilliser induced calmness in Arabian oryx for up to 7 days, which facilitated capture and handling. Therefore, perphenazine enanthate has a potential to be used in the management practices, such as movement and transport of Arabian oryx.

This thesis discusses the current and future welfare issues that face Arabian oryx in captivity, upon release and in the wild. Additional methods are proposed for thorough assessment and improvement of welfare to complement the methods established by the present studies.

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Table of Contents

Abstract	4
Special Thanks	7
Acknowledgments	8
Table of Contents.....	12
List of Tables	17
List of Figures	23
List of Abbreviations	31
1. Chapter 1 General introduction.....	33
1.1 Arabian oryx	33
1.1.1 Re-introductions and the current status.....	33
1.1.2 Climate.....	40
1.1.3 Reproduction.....	46
1.1.4 Health and welfare of Arabian oryx.....	46
1.1.5 Physiological adaptations of Arabian oryx.....	53
1.1.5.1 Water economy and heterothermy	53
1.1.5.2 Nutrition and diet	55
1.2 Stress and welfare	56
1.2.1 Assessment of health, stress and welfare.....	58
1.2.2 Improvement of welfare.....	59
1.2.3 Catecholamines.....	60
1.2.4 Glucocorticoids.....	60
1.2.4.1 Synthesis, circulation and metabolism of glucocorticoids	61
1.2.4.2 Route of excretion of glucocorticoid metabolites	62
1.2.4.3 Circadian and seasonal pattern of secretion of glucocorticoids	64
1.2.4.4 The gender differences in glucocorticoid secretion	65
1.2.4.5 Lag-time of faecal production	66
1.3 Measurement of glucocorticoids.....	66
1.3.1 Selection of assays for faecal glucocorticoids metabolites.....	70
1.3.2 Analytical validation	73
1.3.3 Biological and physiological validation.....	73
1.4 Aims of the study.....	73
2. Chapter 2 Measuring faecal glucocorticoid metabolites as a non-invasive method for assessment of welfare in Arabian oryx	75
2.1 Introduction	75
2.2 Materials and methods.....	79
2.2.1 ACTH challenge test.....	79
2.2.2 Dexamethasone suppression test	80
2.2.3 Stability of faecal glucocorticoid metabolites	80
2.2.4 Collection of faecal samples.....	81
2.2.5 Extraction of faecal glucocorticoid metabolites	81
2.2.6 Buffers and solutions for enzyme immuno-assay	82
2.2.6.1 Assay buffer.....	82
2.2.6.2 First coating buffer	82

2.2.6.3	Second coating buffer	82
2.2.6.4	Washing solution.....	82
2.2.6.5	Substrate buffer for peroxidase	83
2.2.6.6	Enzyme solution for streptavidin-reaction.....	83
2.2.6.7	Substrate solution for peroxidase	83
2.2.7	Enzyme immuno-assays reagents.....	83
2.2.7.1	Preparation of samples.....	83
2.2.7.2	Preparation of the standard.....	83
2.2.7.3	Coating antibody	84
2.2.7.4	Specific steroid antibodies	84
2.2.7.5	Biotin-labelled steroids	84
2.2.8	Protocol of enzyme immuno-assay	84
2.2.9	Procedural validations.....	85
2.2.9.1	Blanks	85
2.2.9.2	Standard curves	85
2.2.10	Statistical analysis	87
2.3	Results	88
2.3.1	ACTH challenge test.....	88
2.3.1.1	EIA I.....	88
2.3.1.2	EIA II	88
2.3.2	Dexamethasone suppression test.....	93
2.3.3	Stability of faecal glucocorticoid metabolites	95
2.4	Discussion	97
2.5	Summary and conclusions.....	100
3.	Chapter 3 Reference values for haematological, biochemical and physiological parameters in Arabian oryx.....	101
3.1	Introduction	101
3.2	Materials and methods.....	105
3.2.1	Capture and confinement	105
3.2.2	Capture for collection of blood samples	106
3.2.3	Measurement of heart rate, respiratory rate and body temperature.....	106
3.2.4	Collection of blood samples	108
3.2.5	Haematology.....	108
3.2.6	Processing of blood samples.....	109
3.2.7	Analysis of ions, hormones and biochemical parameters.....	109
3.2.8	Osmolality.....	110
3.2.9	Statistics	111
3.3	Results	113
3.3.1	Haematology.....	113
3.3.2	Biochemistry, ions, osmolality, hormones and clinical parameters.....	117
3.4	Discussion	124
3.4.1	Haematology.....	126
3.4.2	Biochemistry, ions, osmolality, hormones and clinical parameters.....	133
3.5	Summary and conclusions.....	137
4.	Chapter 4 Investigations of the effects of the tranquilliser, perphenazine enanthate on Arabian oryx	139
4.1	Introduction	139
4.2	Materials and methods.....	141

4.2.1	Injection of perphenazine enanthate.....	141
4.2.2	Injection of saline	143
4.2.3	Analysis of blood samples	144
4.2.4	Analysis of faecal samples.....	144
4.2.5	Statistics	144
4.3	Results	146
4.3.1	Behavioural observations.....	149
4.3.2	Body temperature, heart and respiratory rates.....	150
4.3.3	Hormones.....	152
4.3.4	Haematology.....	152
4.3.5	Biochemistry and ions.....	154
4.4	Discussion	162
4.4.1	Behavioural observations.....	162
4.4.2	Body temperature, heart and respiratory rates.....	163
4.4.3	Hormones.....	164
4.4.4	Haematology.....	167
4.4.5	Biochemistry and ions.....	168
4.4.6	Study design, conclusions and future studies	168
5.	Chapter 5 Investigations of the effects of the immobilisation with xylazine on Arabian oryx 171	
5.1	Introduction	171
5.2	Materials and methods.....	174
5.2.1	Immobilisation with xylazine	174
5.2.2	Analysis of blood samples	174
5.2.3	Statistical analysis	174
5.3	Results	175
5.3.1	General observations.....	175
5.3.2	Body temperature, heart and respiratory rates.....	175
5.3.3	Hormones.....	176
5.3.4	Haematology.....	177
5.3.5	Biochemistry and ions.....	177
5.4	Discussion	180
5.4.1	Effectiveness of xylazine and reversal in Arabian oryx	180
5.4.2	Body temperature, heart and respiratory rates.....	181
5.4.3	Hormones.....	183
5.4.4	Haematology.....	184
5.4.5	Biochemistry and ions.....	185
5.4.6	Study design, conclusions and future studies	186
6.	Chapter 6 Monitoring the well-being of Arabian oryx during translocation and after release to the wild.....	189
6.1	Introduction.....	189
6.2	Materials and methods.....	192
6.2.1	Arabian oryx	192
6.2.2	Logistics and organisation of transport.....	194
6.2.3	Collection of blood and faecal samples	194
6.2.4	Transport.....	194
6.2.5	Post-translocation monitoring.....	197
6.2.6	Release of oryx to the wild	198

6.2.7	Analysis of faecal samples.....	200
6.2.8	Analysis of blood samples	200
6.2.9	Statistics	201
6.3	Results	203
6.3.1	Transport.....	203
6.3.1.1	General behavioural observations during transport	203
6.3.1.2	Haematology.....	204
6.3.1.3	Serum biochemistry and ions	205
6.3.1.4	Serum cortisol.....	213
6.3.1.5	Faecal glucocorticoid metabolites.....	213
6.3.2	Release of oryx to the wild	215
6.4	Discussion	223
6.4.1	Transport.....	223
6.4.2	Release to the wild	231
6.5	Summary and conclusions.....	233
7.	Chapter 7 General discussion.....	235
7.1	Overview	235
7.2	Captive breeding.....	236
7.2.1	Current welfare of captive Arabian oryx	237
7.2.2	Welfare assessment in captivity	240
7.2.2.1	Faecal glucocorticoid metabolites.....	240
7.2.2.2	Reference values	242
7.2.2.3	Other measures of welfare	243
7.2.3	Future welfare of captive Arabian oryx	244
7.2.3.1	Genetic management.....	244
7.2.3.2	Control of overcrowding.....	244
7.2.3.3	Health screening and control of diseases in captivity.....	245
7.2.3.4	Management of stress levels.....	246
7.2.3.5	Assessment of behaviour	246
7.2.3.6	Welfare standards.....	246
7.2.4	Improvement of welfare in captivity	247
7.3	Welfare of animals during release to the wild	248
7.3.1	Preparation for release.....	248
7.3.1.1	Welfare.....	248
7.3.1.2	Conservation.....	249
7.3.2	The process of releasing animals to the wild.....	251
7.3.2.1	Capture	251
7.3.2.2	Temporary confinement.....	252
7.3.2.3	Transport.....	253
7.3.2.4	Translocating animals to the wild	254
7.4	Welfare of translocated animals in the wild.....	255
7.4.1	Welfare issues in the wild.....	256
7.4.1.1	Poaching.....	257
7.4.1.2	Drought.....	258
7.4.2	Monitoring the welfare of reintroduced animals	260
7.4.2.1	Intervention.....	263
7.4.3	Assessment of reintroduction success.....	264
7.5	Future directions for conservation of Arabian oryx and their welfare	265

7.5.1 Captive oryx.....265

7.5.2 Translocation of Arabian oryx.....267

7.5.3 Free-ranging oryx in the wild268

8. Appendices269

 Appendix I.....269

 Appendix II271

 References283

List of Tables

Table 1.1 The countries where Arabian oryx have been re-introduced or there is a captive-breeding programme (Shobrak, 2007; Soorae, 2008).....	37
Table 3.1 List of individual Arabian oryx from which the reference values were obtained. The list is ordered by the date of blood sampling.....	107
Table 3.2 Inter- and intra-variations (%) of haematological parameters calculated for 8 male Arabian oryx after measurement by Cell-Dyn 4000.....	109
Table 3.3 Dilutions of a sample with normal saline (NaCl) and the resultant correspondent decrease in the concentration of some blood ions, biochemical and hormonal parameters. All parameters declined as a response to the dilution.	112
Table 3.4 Inter- and intra-variations (%) of serum ions, biochemistry and hormones calculated from 4 duplicated samples.....	112
Table 3.5 Reference values of haematological parameters for male and female oryx. n, number of animals; SD, standard deviation of mean; SEM, standard error of mean; 2.5 and 97.5 percentiles; WBC, white blood cells (leukocytes); RBC, red blood cells (erythrocytes) MCV, mean corpuscular volume; MCH, mean corpuscular haemoglobin; and MCHC, mean corpuscular haemoglobin concentration.	114
Table 3.6 Statistical comparison for differences between sexes and the speed of capture on haematological parameters using two way ANOVA. Differences are considered significant when $P < 0.05$. NS, non-significant; WBC, white blood cells (leukocytes); RBC, red blood cells (erythrocytes) MCV, mean corpuscular volume; MCH, mean corpuscular haemoglobin; and MCHC, mean corpuscular haemoglobin concentration. When data were not normally distributed, they were transformed using the given type of transformation to achieve normality.....	115
Table 3.7 Reference values for haematological data of 24 male and 12 female Arabian oryx. The parameters that differ significantly between males and females are shown in bold . n, number of animals ; SD, standard deviation of mean; SEM, standard error of mean; 2.5 and 97.5 percentiles; WBC, white blood cells; RBC, red blood cells (erythrocytes)	

MCV, mean corpuscular volume; MCH, mean corpuscular haemoglobin; and MCHC, mean corpuscular haemoglobin concentration.....	116
Table 3.8 Blood ions, osmolality, biochemistry, hormonal and clinical parameters for male and female Arabian oryx. n, number of animals ; SD, standard deviation of mean; SEM, standard error of mean; 2.5 and 97.5 percentiles; T ₃ , triiodothyronine, T ₄ , thyroxine; bpm, breaths per min (for respiratory rate) or beats per min (for heart rate).	119
Table 3.9 Statistical comparison for differences between sexes and the speed of capture on ions, osmolality, biochemistry, hormones and clinical parameters using two way ANOVA. The parameters in bold font were not tested because they were either not normally distributed or they have missing values. Therefore, they were tested with t-test or Mann-Whitney U test (Table 3.10). Differences were considered significant when P < 0.05., NS, non-significant, NP, non-parametric; T ₃ , triiodothyronine and T ₄ , thyroxine.....	120
Table 3.10 Statistical analysis using t-test or Mann Whitney test, for differences between sex and speed of capture, on the parameters that could not be tested by two way ANOVA. NS, non-significant and T ₄ , thyroxine.....	121
Table 3.11 Combined data of male and female oryx for ions, osmolality, biochemistry, hormones and clinical parameters. Note: the parameters in bold and italics font differed significantly within sexes (^y), or in relation to speed of capture (^z) or within both categories (^x). Data missing for oryx ^a (21-36), ^b (1-20), ^c (10,12,15), ^d (7,10, 12, 14, 15, 17 and 19), ^e (7,10, 12, 14, 15, 17, 18 and 19) as numbered in Table 3.1. n, number of animals; SD, standard deviation of mean; SEM, standard error of mean; 2.5 and 97.5 percentiles; T ₃ , triiodothyronine, T ₄ , thyroxine; bpm, breaths per min (for respiratory rate) or beats per min (for heart rate).....	122
Table 3.12 The parameters that significantly differed in relation to speed of capture (A), sexes (B) or both categories (C). Data are presented as mean ± standard error of mean. n, number of animals, T ₄ , thyroxine and T ₃ , triiodothyronine.....	123
Table 3.13 Comparison of haematological values for neonates as reported by Bounous-Dalton and Hood (1980) and for adults as reported in the present study. n, number of	

animals; SD, standard deviation of mean; SEM, standard error of mean; WBC, white blood cells; RBC, red blood cells (erythrocytes) MCV, mean corpuscular volume; MCH, mean corpuscular haemoglobin; and MCHC, mean corpuscular haemoglobin concentration.	130
Table 3.14 Comparison of haematological values for neonates as reported by Ferrell et al. (2001) and for adults as reported in the present study. WBC, white blood cells; min, minimum; max, maximum and n, number of animals.....	130
Table 3.15 Comparison between some haematological parameters reported by Kilgallon et al., (2008) and the present study. SD, standard deviation of mean, SEM, standard error of mean, n, number of animals and WBC, white blood cells.....	132
Table 3.16 Comparison between some haematological parameters reported by the database of ISIS (2002) and the present study. SEM, standard error of mean, n, number of animals, WBC, white blood cells; RBC, red blood cells (erythrocytes) MCV, mean corpuscular volume; MCH, mean corpuscular haemoglobin; and MCHC, mean corpuscular haemoglobin concentration.....	132
Table 3.17 Comparison between the concentration of chloride, magnesium and body temperature reported by ISIS, 2002 data base and the present study.	134
Table 3.18 Dates of repeated sampling from 8 male and 8 female Arabian oryx.....	136
Table 4.1 List of the 16 Arabian oryx used for perphenazine enanthate experiment with body weight (kg) and dose (mg/kg), calculated retrospectively. The animals were weighed after the experiment due to unavailability of facilities during the experiment.	142
Table 4.2 Mean ambient temperatures (°C) during the treatment of Arabian oryx with the tranquilliser, perphenazine enanthate or saline. The dates of these treatments are also shown.....	143
Table 4.3 The correlation between the dose of the tranquilliser perphenazine enanthate and the data for haematological, biochemical, hormonal and clinical parameters. All statistical analyses are shown as the correlation coefficient (Pearson's r, unless designated by ^a where Spearman's ρ). Each cell shows, from top to bottom, (correlation coefficient, P value and n = number of samples). * Asterisks indicate	

statistically significant correlations. Not that the number of samples, n, is sometimes less than 16 when samples could not be obtained from all animals. WBC, white blood cells; RBC, red blood cells; MCV, mean corpuscular volume; MCH, mean corpuscular haemoglobin; MCHC, mean corpuscular haemoglobin concentration, T₄, thyroxine and T₃, triiodothyronine.....149

Table 4.4 Clinical parameters of 16 Arabian oryx that were injected with saline and perphenazine enanthate at time point 0 h. SEM, standard error of mean. Asterisks and **bold font** indicate statistically significant different from time point 0 h, * P < 0.05, Friedman repeated measures ANOVA, Tukey’s test. ** P < 0.05, one way repeated measured ANOVA followed by Holm-Sidak multiple comparisons.151

Table 4.5 Hormonal parameters of 16 Arabian oryx that were injected with saline and perphenazine enanthate at time point 0 h. SEM, standard error of mean, T₄, thyroxine and T₃, triiodothyronine. Asterisks and bold font indicate statistically significant different from time point 0 h, * P < 0.05, Friedman repeated measures ANOVA, Tukey’s test, ** P < 0.05, One way repeated measures ANOVA followed by Holm-Sidak multiple comparisons.151

Table 4.6 Haematological parameters of 16 Arabian oryx injected with saline and perphenazine enanthate at time point 0 h. SEM, standard error of mean; WBC, white blood cells; RBC, red blood cells; MCV, mean corpuscular volume; MCH, mean corpuscular haemoglobin; and MCHC, mean corpuscular haemoglobin concentration. Asterisks and **bold font** style indicate significantly different than the time point 0 h, *P < 0.05, Friedman repeated measures ANOVA, followed by Tukey’s test. ** P < 0.05, one way repeated measured ANOVA followed by Holm-Sidak multiple comparisons.157

Table 4.7 Ions and biochemical parameters of 16 Arabian oryx that were injected with saline and perphenazine enanthate at time point 0 h. SEM, standard error of mean. Asterisks and **bold font** style indicate significantly different than the time point 0 h, * P < 0.05, One way repeated measured ANOVA followed by Holm-Sidak multiple comparisons.....161

Table 5.1 Haematological parameters in 16 Arabian oryx before and after injection of xylazine. SEM, standard error of mean; C.I. confidence interval, WBC, white blood cells; RBC, red blood cells (erythrocytes); MCV, mean corpuscular volume; MCH, mean corpuscular haemoglobin; and MCHC, mean corpuscular haemoglobin concentration. Asterisks (*) and bold font indicate significant difference.....	178
Table 5.2 Ions and biochemical parameters in 16 Arabian oryx before and after administration of xylazine. SEM, standard error of mean. Asterisks (*) and bold font indicate significant difference. NA, not available because the data were rank transformed for statistical analysis.....	179
Table 6.1 The Arabian oryx transported from the Omani Mammals Breeding Center to the Arabian Oryx Sanctuary.....	193
Table 6.2 Haematological parameters of seven male Arabian oryx (from batches A and B) measured immediately before transport and within 1-2 h after transport. Data are shown as mean \pm standard error of mean. RBC, red blood cells (erythrocytes); MCV, mean corpuscular volume; MCH, mean corpuscular haemoglobin; and MCHC, mean corpuscular haemoglobin concentration.....	207
Table 6.3 Haematological parameters in one female (997) from batch A transported without tranquillisation. WBC, white blood cells (leukocytes); RBC, red blood cells (erythrocytes); MCV, mean corpuscular volume; MCH, mean corpuscular haemoglobin; and MCHC, mean corpuscular haemoglobin concentration.	208
Table 6.4 Haematological parameters of six male Arabian oryx (batch C) measured immediately before injection of tranquilliser perphenazine enanthate (two days before transport), immediately before transport and within 1h of translocation. Data are shown as mean (standard error). Data with different letters are significantly different from each other (One way repeated measures ANOVA and post hoc multiple comparisons by Holm-Sidak method. RBC, red blood cells (erythrocytes); MCV, mean corpuscular volume; MCH, mean corpuscular haemoglobin; and MCHC, mean corpuscular haemoglobin concentration.....	210

Table 6.5 Serum ions and osmolality measured in nine male Arabian oryx (batches A and B) measured immediately before transport and within 1-2 h after transport (paired t-test). Data are shown as mean \pm standard error.	211
Table 6.6 Serum ions and osmolality of six male Arabian oryx measured immediately before injection of perphenazine enanthate (2 days before transport), immediately before transport and within 1 h after transport. Data are shown as mean \pm standard error. Data with different letters are significantly different from each other (one way repeated measures ANOVA).....	211
Table 6.7 Biochemical parameters of nine male Arabian oryx measured just before transport and shortly after transport (paired t-test). Data are shown as mean \pm standard error.....	212
Table 6.8 Biochemical parameters of six male Arabian oryx measured at injection of tranquilliser (2 days before transport), just before transport and shortly after transport. Data are shown as mean \pm standard error. Data with different letters are significantly different from each other (one way repeated measures ANOVA).....	212
Table 6.9 The concentration of serum cortisol (nmol/l) in individual non-tranquillised (A) and tranquillised Arabian oryx (B). NA, not available.....	214
Table 6.10 The mean immuno-reactive faecal glucocorticoid metabolites (ng/g faeces) for the three transported batches at one day before transport, immediately before transport and 2 days after transport to Jaaluni. Number of samples given in brackets. NA, not available.....	214
Table 8.1 Comparison between the size and the nuclear features of blood cell types of Arabian oryx and humans. Information about the size and the features of nucleus for humans were obtained from Junquera and Carnerio (2005).	282

List of Figures

- Figure 1.1 Map to show locations of captive Arabian oryx in Oman. The Omani Mammals Breeding Centre is located in Seeb within the Capital, Muscat. Jaaluni is located in the central region of Oman within the Arabian Oryx Sanctuary in Jiddat Al Harasis area.38
- Figure 1.2 The number of Arabian oryx at the Arabian oryx sanctuary in Oman, in the wild (estimated by sight mark re-sight method, Arabian oryx project, unpublished data) and in captivity (counted) between 1982 and 2009.39
- Figure 1.3 The means, minima and maxima of monthly temperatures at Jaaluni from 1980 - 2001. Data are shown as mean \pm standard error of mean. The data were obtained from Meteorological Department, Directorate General of Civil Aviation and Meteorology, Ministry of Transport and Communications, Oman.41
- Figure 1.4 The means, minima and maxima of monthly temperatures at Seeb station in Muscat between 1974 and 2003. Data are shown as mean \pm standard error of mean. The data were obtained from Meteorological Department, Directorate General of Civil Aviation and Meteorology, Ministry of Transport and Communications, Oman.....42
- Figure 1.5 The means, minima and maxima of monthly relative humidity at Seeb station in Muscat between 1983 and 2003. Data are shown as mean \pm standard error of mean. The data were obtained from Meteorological Department, Directorate General of Civil Aviation and Meteorology, Ministry of Transport and Communications, Oman.....43
- Figure 1.6 The minima and maxima of monthly relative humidity at Jaaluni between 1980 and 2003. Data are shown as mean \pm standard error of mean. The data were obtained from Meteorological Department, Directorate General of Civil Aviation and Meteorology, Ministry of Transport and Communications, Oman.44
- Figure 1.7 Rainfall at Jaaluni between 1990 and 2008, (Al-Kharousi (2003) and AOP, unpublished data).45
- Figure 1.8 Scheme of the secretion, metabolism and excretion of glucocorticoids. Adapted from Möstl and Palme, 2002.63

Figure 1.9 Labelling of a steroid rings and numbering of carbon atoms.....	63
Figure 2.1 The standard (5 β -Androstane-3 α -ol-11,17-dione) used for raising antibodies in both EIA I and EIA II.	77
Figure 2.2 The antigen injected into rabbits for raising the antibodies used in EIA I. 5 β -Androstane-11,17-dione-3-hemisuccinate (HS): bovine serum albumin (BSA).	77
Figure 2.3 The antigen injected into rabbits for raising the antibodies used in EIA II. 5 β -Androstane-3 α -ol-11-one-17-carboxymethyloxime (CMO): bovine serum albumin (BSA).	77
Figure 2.4 3D-Illustration of the 20 holding pens at the Omani Mammals Breeding Centre, Seeb, Oman.	80
Figure 2.5 Standard curve of EIA I.	86
Figure 2.6 Standard curve of EIA II.	86
Figure 2.7 Immuno-reactive faecal glucocorticoid metabolites measured by EIA I in 8 Arabian oryx (4 females and 4 males) after injection with ACTH at 0 h. Data are shown as mean \pm standard error. Asterisks (*) show time points where immuno-reactive faecal glucocorticoid metabolites were significantly different from basal (0-2 h) values. Data were analysed by a one way repeated measures ANOVA, $P < 0.001$. ..	89
Figure 2.8 Immuno-reactive faecal glucocorticoid metabolites measured by EIA I in 4 male Arabian oryx after injection with ACTH at 0 h.	90
Figure 2.9 Immuno-reactive faecal glucocorticoid metabolites measured by EIA I in 4 female Arabian oryx after injection with ACTH at 0 h.	90
Figure 2.10 Immuno-reactive faecal glucocorticoid metabolites of 8 Arabian oryx (4 males and 4 females) after injection of ACTH (arrow), measured by EIA II. Data are shown as mean \pm standard error. Asterisk (*) shows significantly different from basal values (0-2 h), Two way repeated measures ANOVA, followed by multiple comparisons versus control using Holm-Sidak method, * $P < 0.001$	91
Figure 2.11 Immuno-reactive faecal glucocorticoid metabolites measured by EIA II in 4 male Arabian oryx after injection with ACTH at 0 h.	92

-
- Figure 2.12 Immuno-reactive faecal glucocorticoid metabolites measured by EIA II in 4 female Arabian oryx after injection with ACTH at 0 h.92
- Figure 2.13 Immuno-reactive faecal glucocorticoid metabolites measured by EIA I in 8 female and 8 male Arabian oryx after injection with dexamethasone at 0 h. Data are shown as mean \pm standard error. Asterisk shows significant decrease compared to the data at 0 h, two way repeated measures ANOVA, followed by multiple comparisons versus control using Holm-Sidak method, * $P < 0.001$93
- Figure 2.14 Immuno-reactive faecal glucocorticoid metabolites measured by EIA II in 8 female and 8 male Arabian oryx after dexamethasone injection at 0 h. Data are shown as mean \pm standard error. Asterisk shows significant decrease compared to the value at injection 0 h, two way repeated measures ANOVA, followed by multiple comparisons versus control using Holm-Sidak method, * $P = 0.006$94
- Figure 2.15 Immuno-reactive faecal glucocorticoid metabolites measured by EIA I in 4 male and 4 females Arabian oryx. Eight faecal samples were divided into 5 sub-samples incubated at 30 °C for 4, 12, 24 h and 3 days. Data are shown as mean \pm standard error. Data points with different letter above error bars are significantly different from each other, two way repeated measures ANOVA, followed by multiple comparisons using Holm-Sidak method, $P < 0.001$95
- Figure 2.16 Immuno-reactive faecal glucocorticoid metabolites measured by EIA II in 4 male and 4 females Arabian oryx. Eight faecal samples were divided into 5 sub-samples incubated at 30 °C for 4, 12, 24 h and 3 days. Data are shown as mean \pm standard error. Data points with different letter above error bars are significantly different from each other, two way repeated measures ANOVA, followed by multiple comparisons using Holm-Sidak method, $P < 0.001$, except for 12 h versus 24 h and 4 h versus 12 h, $P < 0.01$96
- Figure 3.1 The serum cortisol concentration in repeated samplings from 16 Arabian oryx (8 males and 8 females) sampled as shown in Table 3.18. The cortisol values in different sampling occasions with similar small case letters are not significantly different from each other. $P < 0.001$ except for occasion D versus E, $P < 0.01$, Two way repeated

measured ANOVA, followed by Holm-Sidak multiple comparisons. Data are shown as mean \pm Standard error.136

Figure 4.1 Serum cortisol measured in 16 Arabian oryx injected with the tranquilliser, perphenazine enanthate and saline. Data are presented as mean \pm standard errors. The time points that have similar small case letters are not significantly different from each other. Two separate (one way repeated measures ANOVA) tests were used for saline and perphenazine enanthate injections and each treatment has its own small case letters.....155

Figure 4.2 Faecal glucocorticoid metabolites in 16 Arabian oryx that were injected with the tranquilliser perphenazine enanthate or saline. Data are presented as mean \pm standard errors. The time points that have similar small case letters are not significantly different from each other. Two separate (one way repeated measures ANOVA) tests were used for saline and perphenazine enanthate injections and each treatment has its own small case letters. The blue line represents the baseline of faecal glucocorticoid metabolites (273 ng/g faeces), that was obtained from the ACTH experiment described in chapter 2 (section 2.3.1.1).156

Figure 4.3 The red blood cell count in 16 Arabian oryx measured after injection of the tranquilliser, perphenazine enanthate and saline at time point 0 h. Data are presented as mean and standard errors. The time points that have similar small case letters are not significantly different from each other. Significant difference, $P < 0.05$, Friedman repeated measures ANOVA, Tukey's test.....158

Figure 4.4 The concentration of haemoglobin in 16 Arabian oryx measured after injection of the tranquilliser, perphenazine enanthate and saline at time point 0 h. Data are presented as mean and standard errors. The time points that have similar small case letters are not significantly different from each other. Significant difference, $P < 0.05$, Friedman repeated measures ANOVA, Tukey's test.....159

Figure 4.5 The haematocrit in 16 Arabian oryx measured after injection of the tranquilliser, perphenazine enanthate and saline at time point 0 h. Data are presented as mean and standard errors. The time points that have similar small case letters are not

- significantly different from each other. Significant difference, $P < 0.05$, Friedman repeated measures ANOVA, Tukey's test.....160
- Figure 5.1 The effects of xylazine on heart rate, respiratory rate and body temperature. * $P < 0.001$, paired t-test.176
- Figure 6.1 The Arabian oryx enclosure at Jaaluni with total area of 1.898 km^2 . The areas of the sub-enclosures are 0.734 km^2 (top right), 0.383 km^2 (top left) and 0.756 km^2 (the south enclosure). Holding pens are at the top left corner.195
- Figure 6.2 A satellite image (A) and a diagram (B) of the holding pens (A, B, C and D) in Jaaluni at the corner of the main oryx enclosure. Note the artificial shade within the holding pens in the satellite image.....196
- Figure 6.3 Arabian oryx were released from Jaaluni ($19^\circ 56' 45.7'' \text{ N}$, $57^\circ 06' 11.8'' \text{ E}$) to the wild at the sites ($19^\circ 29' 48.8'' \text{ N}$, $56^\circ 59' 38.4'' \text{ E}$) for group B and ($19^\circ 17' 21.0'' \text{ N}$, $57^\circ 01' 32.4'' \text{ E}$) for group C. The map was produced using (MapSource, Garmin).200
- Figure 6.4 White blood cell count (WBC, $\times 10^9/\text{L}$) and the percentages of differentials of seven male Arabian oryx (from batches A and B) measured immediately before transport and within 1-2 h after transport. * $P < 0.05$, paired t-test.....207
- Figure 6.5 White blood cell (WBC, $\times 10^9/\text{L}$) count and differentials of six male Arabian oryx (batch C) measured immediately before injection of tranquilliser perphenazine enanthate (two days before transport), immediately before transport and within 1h of translocation. Data with different letters are significantly different from each other (One way repeated measures ANOVA and post hoc multiple comparisons by Holm-Sidak method).209
- Figure 6.6 A scatter plot of immuno-reactive faecal glucocorticoid metabolites one day before and up to 11 days after transport of 17 oryx, measured by EIA I (see Chapter 2, section 2.2.7.4). The blue line represents the baseline value (273 ng/g faeces) obtained in Chapter 2, (see section 2.3.1.1). The shapes represent sexes and the batch as follows, triangle (females of batch A), diamond (males of batch A), square (batch B all males) and circle (batch C all males).....216

Figure 6.7 Median of faecal glucocorticoid metabolites one day before and 11 days after transport from Muscat to Jaaluni holding pens. The blue horizontal line represents the baseline value (273 ng/g faeces) obtained in Chapter 2, (see section 2.3.1.1).....217

Figure 6.8 Release of batch B on 19 April 2007 was at site 1. The male oryx, 1B was found at site 2, one day after release at 3 pm (temperature 45 °C). The male oryx, 10B returned to Jaaluni (50 km away from site 1, within two days from release and was housed in Jaaluni holding pens with oryx of batch C and faecal samples were collected for up to seven days. On day 3 after release, three oryx (16B, 17B and 19B) were found at site 3, walking towards Jaaluni, at 6 pm (37 °C) but they were herded back to the south away from Jaaluni. They were observed foraging for food while walking at that day and water was offered to these three oryx but they refused to drink, suggesting a lack of thirst. On day 4 after release, a male oryx, 20B was found close to the tarmac road at site 4, at 9 am (35 °C). On day 5, the three male oryx (16B, 17B and 19B), were found again together at site 5 at 6 pm (34 °C), which was also close to the road. On day 6, oryx 20B was seen at site 6, at 10 am (37 °C), which is about 9 km away from where the oryx was last seen at site 4. At site 7, oryx 19B was found alone on day 11, indicating that it had separated from 16B and 17B.218

Figure 6.9 The release of oryx in batch C on 16 May 2007 at site 1. The inset map shows Jaaluni and the tarmac road from Hayma to Duqm. The oryx were released at site 1 which is 73 km from Jaaluni. One day later, 10C and 16C were seen foraging in a very good vegetated area at site 2 at 4 pm (39 °C). The male 16 C had an abscess on the skin below the lower jaw. On day 2 after release, 17C and 20C were found first at site 3 at 7 am (27 °C) and 10C and 16C were seen later at site 4 at 8 am (27 °C). On the fourth day, 17C and 20C were found together lying down under an *Acacia sp.* tree at site 5 at 4 pm (38 °C). The search for released oryx continued for about 10 days after release, but none of the released oryx were seen after the fourth day.219

Figure 6.10 A scatter plot of the faecal content of immuno-reactive glucocorticoid metabolites at and after hard release of 13 male Arabian oryx from the holding pens in Jaaluni to the wild. The blue horizontal line at value 273 ng/g faeces represents the baseline value obtained in Chapter 2, (section 2.3.1.1). The shapes represent batches as follows, diamond (batch A), square (batch B) and circle (batch C).220

Figure 6.11 Median of faecal glucocorticoid metabolites after hard release of Arabian oryx from the holding pens of Jaaluni to the wild. The blue horizontal line represents the baseline value (273 ng/g faeces) obtained in chapter 2: see (section 2.3.1.1).	221
Figure 6.12 Immuno-reactive faecal glucocorticoid metabolites measured by EIA I and EIA II (as described in chapter 2) in the male oryx, 10B. This male returned to Jaaluni after two days from hard release crossing more than 50 km and faecal samples were collected just before herding in the holding pen (day 1) and for six days later. The dashed line represents baseline value obtained in Chapter 2, section 2.3.1.1	222
Figure 8.1 Typical illustration of morphology of white blood cell types (Junquera and Carnerio, 2005).	273
Figure 8.2 An electron micrograph of Arabian oryx neutrophil (x20000). N, nucleus and G, granules.....	274
Figure 8.3 A Micrograph of Arabian Oryx neutrophil. Light microscope, high magnification, Wright-Giemsa stain, (x2000).....	274
Figure 8.4 An electron micrograph of an Arabian oryx basophil (x20000). N, nucleus and B, basophilic granules.....	275
Figure 8.5 A micrograph of Arabian oryx basophil. Light microscope, high magnification, Wright-Giemsa stain, (x2000).....	275
Figure 8.6 An electron micrograph of an Arabian oryx eosinophil (X20000). N, nucleus and G, granules with disk-like electron dense crystalline core.....	276
Figure 8.7 A micrograph of Arabian oryx eosinophil. Light microscope, high magnification, Wright-Giemsa stain, (x2000).....	276
Figure 8.8 An electron micrograph of an Arabian oryx monocyte (x25,000). N, nucleus.	277
Figure 8.9 A micrograph of Arabian oryx monocyte. Note the horse-shoe like nucleus. Light microscope, high magnification, Wright-Giemsa stain, (x2000).....	277
Figure 8.10 An electron micrograph of an Arabian oryx lymphocyte (x30,000). N, nucleus.	278

Figure 8.11 A micrograph of Arabian oryx lymphocyte. Light microscope, high magnification, Wright-Giemsa stain, (x2000).....	278
Figure 8.12 An electron micrograph of Arabian oryx erythrocytes (x25,000).....	279
Figure 8.13 An electron micrograph of an Arabian oryx platelet (x30,000). OCS, open canalicular system and G, granules.....	280
Figure 8.14 A group of platelets from Arabian oryx with red blood cells. Light microscope, high magnification, Wright-Giemsa stain, (x2000).	280

List of Abbreviations

°C	Degrees Celsius
ACTH	Adrenocorticotrophic Hormone
ALT	Alanine Aminotransferase
ANOVA	Analysis of Variance
AOP	Arabian Oryx Project
AOS	Arabian Oryx Sanctuary
AST	Aspartate Aminotransferase
BAV-3	Bovine Adenovirus 3
bpm	Breaths per minute (pulmonary ventilation) or beats per minute (heart rate)
BRSV	Bovine Respiratory Syncytial Virus
BSA	Bovine Serum Albumen
CCCAO	The Coordination Committee for the Conservation of Arabian Oryx
CL	Caseous Lymphadenitis
CMO	Carboxymethyloximes
CRH	Corticotropic Releasing Hormone
DADDOO	1,8-Diamino-3,6-dioxaoctane
DDW	Double Distilled Water
df	Degrees of Freedom
dL	decilitre
DOA	11,17-Dioxoandrostananes
DRC	Diwan of Royal Court
EIA	Enzyme-Immuno-assay
FAWC	Farm Animal Welfare Council
FGM	Faecal Glucocorticoid Metabolites
fL	femto-litre
FMD	Foot And Mouth Disease
FSH	Follicle-Stimulating Hormone
GLM	General Linear Models
h	Hour
HCL	Hydrochloric Acid
HPA	Hypothalamic-Pituitary- Adrenal Axis
HPLC	High Performance Liquid Chromatography
HS	Hemisuccinate,
IFCC	The International Federation of Clinical Chemistry
IUCN	The International Union For Conservation of Nature
LCMS	Liquid Chromatography and Mass Spectrometry
LH	Luteinizing Hormone
M	Molar
MCH	Mean Corpuscular Haemoglobin
MCHC	Mean Corpuscular Haemoglobin Concentration
MCV	Mean Corpuscular Volume
min	Minute
OIE	The World Organisation of Animal Health
OMBC	The Omani Mammals Breeding Center

pg	picogram
POD	Peroxidase
PPR	Peste Des Petits Ruminants
RBC	Red blood cells
RIA	Radioimmuno-assay
SD	Standard Deviation
SEM	Standard Error of the Mean
T ₃	Triiodothyronine
T ₄	Thyroxine
UAE	United Arab Emirates
WBC	White Blood Cells