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Phenotypic flexibility in the basal metabolic rate of Laughing Doves (Streptopelia Senegalensis) in response to short-term thermal acclimation

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Phenotypic flexibility in the basal metabolic rate of Laughing Doves (*Streptopelia senegalensis*) in response to short-term thermal acclimation

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A dissertation submitted to the Faculty of Science, University of the Witwatersrand, in fulfillment of the requirements for the degree of Master of Science.

Johannesburg, 2006

DECLARATION

I declare that this dissertation is my own unaided work. It is being submitted for the Degree of Master of Science in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in any other University.

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Kinesh Chetty

13 April 2006

ABSTRACT

Phenotypic flexibility in basal metabolic rate (BMR) in response to short-term thermal acclimation was assessed in the Laughing Dove (*Streptopelia senegalensis*), a common resident bird species distributed throughout most of southern Africa. I hypothesised that *S. senegalensis* would display flexibility in BMR over short time scales and that this flexibility would be reversible. Additionally, I hypothesised BMR to be repeatable, and that changes in BMR would be correlated with changes in organ mass. I tested these hypotheses by measuring BMR in three groups of 10 birds before and after a short-term (21 day) thermal acclimation period to one of three air temperatures (10^{o}, 22^{o} & 35^{o}C). After acclimation the three temperature groups were randomly divided and reverse-acclimated for another 21 days to one of the two thermal environments not yet experienced. After this reverse-acclimation period BMR was measured again. The dry masses of the stomach, kidney, heart, intestines, liver and pectoral muscles of acclimated birds were used to determine possible mechanistic correlates of BMR adjustments. Additionally, by monitoring BMR every 4-6 days during cold (10^{o}C) and heat (35^{o}C) acclimation I was able to assess the temporal dynamics of adjustments in BMR in response to short-term thermal acclimation.

BMR was both flexible and reversible in *S. senegalensis* as a consistent relationship between BMR and acclimation air temperature was observed after acclimation and reverse-acclimation. BMR increased with decreasing acclimation temperature. Furthermore, a significant proportion (25%) of the observed variation in BMR was repeatable in the 22^{o}C group in spite of the change in BMR induced by thermal acclimation. The mechanistic correlate of BMR adjustment in *S. senegalensis* appears to

be metabolic intensity and not organ size, as the only organ to show a significant increase in size was the intestine of the acclimated 10°C group, which was significantly heavier than the intestine of the 22°C group. BMR also decreases in response to the reduction of flight and/or exercise. Since this reduction was not accompanied by a correlated change in organ mass or body mass, the reduction in BMR as a response to captivity appears to be linked to metabolic intensity of the organs and skeletal muscles.

In *S. senegalensis* adjustments in BMR occur during the first 30 days of captivity and thermal acclimation. The response in BMR to acclimation temperature is clearly evident as BMR of the heat-acclimated group was significantly lower than the cold-acclimated group after 21 days. During the response period, which lasts approximately 30 days, BMR adjusts as a mechanism to offset the costs of thermoregulation and habituation to captivity while other metabolic parameters such as body mass, body temperature, and minimum wet thermal conductance adjust to captivity and the thermal environment. After 30 days BMR of the cold and heat-acclimated groups converge on 0.68W, indicating that once the associated metabolic parameters adjust and stabilize in response to the thermal environment, BMR continues to adjust to captivity.

Acknowledgments

I would like express my deepest gratitude to my supervisor, Dr. Andrew McKechnie, his patience, time, effort and willingness to help me compile this dissertation is something I will never forget and forever appreciate. Andrew, I am truly grateful for the opportunity, thank you.

I would also like to thank the staff at the University of Kwa-Zulu Natal in Pietermaritzburg, especially Prof. Barry Lovegrove who allowed me to use his laboratory for my data acquisition and also provided invaluable help during the initial component of this study.

Most importantly, I would like to thank my family, throughout my University career they have supported me in every possible facet of my studies. This project would not have been possible without their support and encouragement, for this and everything else I will always be grateful.

Finally to my fiancé Heike, you were with me always…thank you sweetheart.

List of Abbreviations:

BMR: Basal metabolic rate

CE: Constant environment

C_{wet}: Minimum wet thermal conductance

M_b: Body mass

MR: Metabolic rate

T_a: Ambient air temperature

T_{acc}: Acclimation air temperature

T_b: Body temperature

T_{lc}: Lower critical limit of thermoneutrality

TNZ: Thermoneutral zone

VO_2: Oxygen consumption

TABLE OF CONTENTS

Declaration……ii
Abstract……iii
Acknowledgements……...v
List of Abbreviations……vi
List of Figures……...ix
List of Tables……x

Chapter 1: General Introduction……...…1
1.2. Research Objectives……..4
1.3. The Study Animal…….5

Chapter 2: Basal metabolic rate adjustments in response to short-term thermal acclimation: magnitude, reversibility, repeatability and correlation with body composition……..7
2.1. Abstract……7
2.2. Introduction……..8
2.3. Materials and Methods……...12
2.3.1 Capture and housing……...…..…..……..……12
2.3.2. Oxygen consumption and body temperature……..13
2.3.3. Experimental protocol…...…….……15
2.3.3.1. Determination of the thermoneutral zone (TNZ)……...……15
2.3.3.2. Experiment 1- BMR responses to Acclimation and reverse-acclimation……....16
2.3.4. Minimum wet thermal conductance (C_{wet})…… 18
2.3.5. Repeatability of basal metabolic rate……..18
2.3.6. Experiment 2 – Body composition and organ masses....19
2.3.7. Data analysis……...20
2.4. Results……...……..20
2.4.1. Body mass……...20
2.4.2. Body Temperature……..….21
2.4.3. Minimum wet thermal conductance……..…..23
2.4.4. Basal metabolic rate……24
2.4.5. Experiment 2 - Body composition and organ masses….30
2.5. Discussion……...33
2.5.1. Basal metabolic rate……33
2.5.2. Body temperature……37
2.5.3. Conductance……38
2.5.4. Experiment 2 - Body composition and organ mass…….41
2.5.5. General……42

Chapter 3: Temporal dynamics of basal metabolic rate adjustments to short-term thermal acclimation……..44
3.1. Abstract……...44
3.2. Introduction…….45
3.3. Materials and methods……....46
3.3.1. Experimental protocol…….46
3.3.2. Data analysis……...47
3.4. Results…….....48
3.4.1. Body mass……...48
3.4.2. Body temperature……48
3.4.3. Minimum wet thermal conductance……48
3.4.4. Temporal dynamics of basal metabolic rate……50
3.5. Discussion……..56

Chapter 4: Concluding discussion……..59

Literature Cited……61

List of Figures

Chapter 2

Figure 1. Flow diagram of Experiment 1 – Responses in basal metabolic rate to acclimation and reverse-acclimation in Laughing Doves…….….17
Figure 2. The relationship between body temperature, experimental group and acclimation temperature in Laughing Doves……...……..22
Figure 3. The relationship between minimum wet thermal conductance, experimental group and acclimation temperature in Laughing Doves……...…….24
Figure 4. The relationship between basal metabolic rate and body mass in Laughing Doves…….26
Figure 5. The relationship between basal metabolic rate, experimental group and acclimation temperature in Laughing Doves…….27
Figure 6. The relationship between basal metabolic rate and acclimation temperature after acclimation and reverse-acclimation in Laughing Doves……..28
Figure 7. Ranking and repeatability in basal metabolic rate after acclimation to three ambient temperatures in Laughing Doves…….29
Figure 8. The relationship between BMR in an initial group and three acclimated temperature groups of Laughing Doves…….31
Figure 9. Percentage changes in dry organ masses of Laughing Doves....……...32
Figure 10. The relationship between predicted and observed values of basal metabolic rate in Laughing Doves……..36

Chapter 3

Figure 1. The temporal dynamics of minimum wet thermal conductance in response to short-term thermal acclimation in Laughing Doves….…….49
Figure 2. The relationship between basal metabolic rate and body mass in Laughing Doves ……...…….52
Figure 3. The temporal dynamics of basal metabolic rate in response to short-term thermal acclimation in Laughing Doves……...…….....53
Figure 4. Percentage changes relative to initial basal metabolic rate in Laughing Doves…….54
Figure 5. The response period of adjustments in basal metabolic rate in Laughing Doves.……...…….55

List of Tables

Chapter 2

Table 1. Mean ± SE body mass of Laughing Doves after initial, acclimated and reverse-acclimated time intervals……...21
Table 2. Mean ± SE body temperature of Laughing Doves after initial, acclimated and reverse-acclimated time intervals……..……...22
Table 3. Mean ± SE minimum wet thermal conductance of Laughing Doves after initial, acclimated and reverse-acclimated time intervals……..……...23
Table 4. Mean ± SE basal metabolic rate of Laughing Doves after initial, acclimated and reverse-acclimated time intervals……...……...27
Table 5. Percentage reductions in BMR per degree Celsius in birds after acclimation to different air temperatures……...40