

# **Maternal Effects in the Green Turtle**

## ***(Chelonia mydas)***

SUBMITTED BY SAM B. WEBER TO THE UNIVERSITY OF EXETER  
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**Green turtle covering a clutch of eggs on Long Beach, Ascension Island, UK.**

## Abstract

In oviparous animals, maternal traits such as the investment of resources in eggs and oviposition site selection are often important determinants of offspring phenotypic quality, and may have an adaptive role in tailoring offspring phenotypes to local environmental conditions. This thesis examines the adaptive significance of two specific maternal traits in the green turtle (*Chelonia mydas*); namely the deposition of fat-soluble antioxidants in egg yolk, and the selection of nest sites via natal homing. Diet-derived, fat soluble antioxidants, such as vitamin E and carotenoids, are ubiquitous components in the eggs of oviparous vertebrates, and are thought to have an adaptive role in buffering embryos and neonates against free-radical induced oxidative stress. However, evidence for such a function in wild populations is lacking. This thesis investigates the proximate sources of variation in yolk antioxidant concentrations in the green turtle, particularly in relation to maternal diet, plasma concentrations and laying sequence, and assesses the functional consequences of such variation for offspring phenotypes. Overall, the results presented suggest that maternal access to dietary antioxidants may be a relatively minor source of variation in egg concentrations in wild populations, and that independent physiological mechanisms may instead regulate the deposition of vitamin E and carotenoids in eggs. However, yolk concentrations of vitamin E and carotenoids did not influence offspring resistance to oxidative stress, and were not tailored to the offspring developmental environment. This was despite evidence that the maternally-provided nest environment strongly influenced offspring exposure to oxidative stress. Taken together, these results question the view that maternal deposition of fat-soluble antioxidants in eggs is an adaptive maternal effect to compensate for the risk of oxidative stress in offspring. Secondly, I investigated the adaptive significance of reproductive homing behaviour in green turtles. Female sea turtles generally return to nest at the particular site where they themselves were born ('natal homing'), meaning that the offspring developmental environment may closely resemble that experienced by the mother. I therefore tested the hypothesis that natal homing facilitates the adaptation of developmental tolerances to specific environmental regimes. Using a common-garden rearing experiment I show that the offspring of females nesting on a naturally hot beach have markedly improved viability and growth at high incubation temperatures compared to the offspring of females from a nearby cooler beach. This disparity was not related to maternal provisioning of antioxidants or other key resources in eggs. These results suggest that natal homing may significantly increase maternal and offspring fitness by maintaining a stable selective environment across generations for the evolution of key fitness traits.

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# Table of Contents

<b>Abstract.</b>	<b>iii</b>
Acknowledgements.....	iv
Table of contents.....	v
List of tables.....	vii
List of figures.....	viii
<b>Chapter 1. General introduction</b>	
1.1. Adaptive maternal effects in oviparous animals: an overview.....	1
1.2. Egg yolk antioxidants as adaptive maternal effects.....	1
1.3. Nest site choice and natal homing as adaptive maternal effects.....	6
1.4. Maternal effects in the green turtle.....	7
1.5. Aims and structure of the thesis.....	9
<b>Chapter 2. A novel method for the extraction of carotenoids from egg yolk</b>	
2.1. Abstract.....	11
2.2. Introduction.....	12
2.3. Materials & Methods.....	13
2.4. Results & Discussion.....	16
<b>Chapter 3. Proximate sources of variation in the antioxidant content of green turtle eggs: effects of maternal diet and laying order</b>	
3.1. Abstract.....	21
3.2. Introduction.....	22
3.3. Materials & Methods.....	24
3.4. Results .....	28
3.5. Discussion.....	31
<b>Chapter 4. Relationships between maternal plasma antioxidants and concentrations in the eggs and hatchlings of wild green turtles.</b>	
4.1. Abstract.....	38
4.2. Introduction.....	39
4.3. Materials & Methods.....	41
4.4. Results.....	43
4.5. Discussion.....	47
4.6. Appendix: Supplementary Methods.....	51

<b>Chapter 5. Environmentally induced oxidative stress is not compensated by maternal antioxidant provisioning in the green turtle</b>	
5.1. Abstract.....	52
5.2. Introduction.....	53
5.3. Materials & Methods.....	56
5.4. Results.....	60
5.5. Discussion.....	65
5.6. Appendices: Supplementary Methods & Results.....	70
<b>Chapter 6. Natal homing and adaptation to thermal regimes in the green turtle</b>	
6.1. Abstract.....	73
6.2. Introduction.....	74
6.3. Results.....	76
6.4. Discussion.....	79
6.5. Materials & Methods.....	82
6.6. Appendix: Supplementary Results.....	86
<i>Submitted to Proceedings of the National Academy of Sciences</i>	
<b>Chapter 7. Metabolic effects on eggs production in the green turtle: implications for maternal behaviour</b>	
7.1. Abstract.....	87
7.2. Introduction .....	88
7.3. Materials & Methods.....	90
7.4. Results .....	92
7.5. Discussion.....	97
<b>Chapter 8. General Discussion</b>	
8.1. Antioxidant provisioning in eggs: adaptive maternal..... effect or physiological inevitability?	103
8.2. Natal homing is an adaptive maternal effect driving..... evolutionary change.	109
<b>References.....</b>	<b>115</b>

## List of Tables

<b>Table 1.1.</b>	A summary of maternal effects mediated by carotenoid provisioning in eggs reported for oviparous animals.	4
<b>Table 2.1.</b>	Percentage recoveries for external standards of several common yolk carotenoids following either liquid-liquid extraction (LLE) or solid phase extraction (SPE).	18
<b>Table 2.2.</b>	Carotenoid concentrations in the egg yolk of several species of birds and reptiles extracted by SPE.	18
<b>Table 3.1.</b>	Concentrations of vitamin E and carotenoids in eggs from first laid clutches of wild and captive green turtles	28
<b>Table 3.2.</b>	A comparison of the relative variation in vitamin E and carotenoid concentrations in eggs from the first-laid clutches of wild and captive green turtles.	29
<b>Table 3.3.</b>	Sources of variation in vitamin E and carotenoid concentrations within and among successive clutches of individual green turtles from a hierarchical GLMM.	29
<b>Table 4.1.</b>	Concentrations of vitamin E and carotenoids in the blood plasma of nesting green turtles and newly emerged hatchlings.	43
<b>Table 4.2.</b>	Relative levels of different tocopherols and carotenoids in the blood plasma of nesting green turtles and newly emerged hatchlings.	45
<b>Table 5.1.</b>	Variation in the development times of green turtle clutches in relation to nest environment parameters	60
<b>Table 5.2.</b>	Variation in hatchling plasma malondialdehyde concentrations, body size and hatching success in wild green turtle clutches in relation to the nest environment and egg antioxidant levels.	61

<b>Table 5.3.</b>	Variation in maternal antioxidant provisioning in eggs in relation to clutch size and environmental characteristics of the nest site.	63
<b>Table A6.1.</b>	Composition of green turtle eggs from Long Beach and North East Bay clutches used in the common-garden experiment.	86

## List of Figures

<b>Figure 1.1.</b>	Location of Ascension Island and approximate migration route of green turtles.	9
<b>Figure 2.1.</b>	Outline of solid phase extraction procedure for isolating carotenoids from yolk lipids.	15
<b>Figure 2.2.</b>	HPLC chromatograms of egg yolk carotenoids from various species extracted using LLE or SPE.	17
<b>Figure 2.3.</b>	HPLC chromatograms of egg yolk carotenoids from various species obtained following LLE using a low injection volume.	19
<b>Figure 2.4.</b>	Inter-specific variation in the carotenoid concentrations of avian and reptilian eggs.	20
<b>Figure 3.1.</b>	Variation in yolk antioxidant concentrations within and among successive clutches of individual wild and captive green turtles.	30
<b>Figure 3.2.</b>	Variation in clutch size across successive clutches of individual wild and captive green turtles.	31
<b>Figure A3.3.</b>	Photograph illustrating the rearing conditions and feeding protocol of captive green turtles at Boatswain Bay, Cayman Islands.	37
<b>Figure 4.1.</b>	Relationships between concentrations of carotenoids and vitamin E in maternal blood plasma and egg yolk; and between concentrations of carotenoids and vitamin E in egg yolk and hatchling blood plasma	44

<b>Figure 4.2.</b>	Relationships between relative levels of lutein and $\alpha$ -tocopherol in maternal plasma and egg yolk; and between relative levels of lutein and $\alpha$ -tocopherol in egg yolks and hatchling plasma.	46
<b>Figure A4.3.</b>	The interdigitary vessel blood sampling protocol of Wallace and George as adapted for green turtles.	51
<b>Figure 5.1.</b>	Outline of hypotheses.	55
<b>Figure 5.2.</b>	Interactive effect of nest depth and sand volumetric water content on plasma malondialdehyde concentrations in hatchling green turtles.	62
<b>Figure 5.3.</b>	Relationships between concentrations of vitamin E and carotenoids in green turtle eggs, and residual hatchling plasma malondialdehyde levels.	63
<b>Figure 5.4.</b>	Relationship between carotenoid concentrations in eggs and residual hatchling carapace length after controlling for plasma levels of oxidative damage.	64
<b>Figure A5.5.</b>	Representative profile showing the change in nest temperature across the incubation period in green turtle nests.	70
<b>Figure A5.6.</b>	Relationship between mean nest temperature and incubation time of green turtle clutches.	72
<b>Figure 6.1.</b>	Overview of study sites.	75
<b>Figure 6.2.</b>	Effects of incubation temperature on hatching success and hatchling morphology for clutches laid at Long Beach and North East Bay.	77
<b>Figure 6.3.</b>	Stages of embryonic mortality for unhatched eggs from Long Beach and North East Bay in the hot incubation treatment.	78
<b>Figure 7.1.</b>	Sea surface temperature at Ascension Island during the 2007 turtle nesting season.	91

<b>Figure 7.2.</b>	Effects of temperature and maternal phenotype on nesting interval length for green turtles nesting at Ascension Island.	93
<b>Figure 7.3.</b>	Effect of maternal reproductive investment on nesting interval length for green turtles at Ascension Island.	94
<b>Figure 7.4.</b>	The relationship between ambient water temperature and the rate of egg production for green turtles and loggerhead turtles nesting in Cyprus, Ascension Island and Japan.	96
<b>Figure 8.1.</b>	Conceptual diagrams illustrating the coevolution of maternal oviposition preferences and offspring adaptations via alternative mechanisms.	110
<b>Figure 8.2.</b>	Egg mimicry in cuckoos.	113