

# **FOOD, SEX AND DEATH: COSTS OF REPRODUCTION AND THE MECHANISTIC BASIS OF AGEING.**

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**PHD THESIS**

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## ABSTRACT

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Ageing is the progressive decline in physiological performance with age, which is almost universal amongst multicellular organisms. While understanding ageing is an important aim in biological research, our current understanding of how and why we age is incomplete. In this thesis, I examine how sexual selection affects the evolution and mechanistic basis of ageing. I then explore how diet affects lifespan and reproduction in either sex. Finally, I test the hypotheses that oxidative stress, which occurs when cellular levels of Reactive Oxygen Species exceed circulating antioxidant defences causes ageing (i.e. the free radical theory of ageing) and/or constrains life-history strategies.

To ask these questions, I employ quantitative genetics in decorated crickets *Grylloides sigillatus* to examine the genetic co(variance) of ageing, lifespan, reproductive effort, oxidative damage and antioxidant protection. In the Australian field cricket, *Teleogryllus commodus*, I apply the geometric framework of nutrition to examine how lifespan, reproductive effort, oxidative damage and antioxidant capacity respond to dietary manipulation.

In *G. sigillatus*, I found that sexual selection caused divergent strategies of age-dependent reproductive effort across the sexes and that this, in turn, promoted different rates of ageing in males and females. I found a trade-off between early reproductive effort and ageing rate in both sexes, although this trade-off was more pronounced in females (Chapter 3). I then explored the mechanistic basis of these sex-specific life-history strategies and, in support of the free radical theory of ageing, I found that oxidative damage was greatest in the shortest lived sex (females) and was negatively genetically correlated with lifespan. Additionally, oxidative damage was a cost of female reproductive effort that accelerated ageing, showing that oxidative stress may mediate sex-specific life-history strategies in decorated crickets (Chapter 4).

If sexual selection affects reproduction and lifespan it should promote sex-specific life-history responses to dietary manipulation. In Australian black field crickets *Teleogryllus commodus*, I found that males and females have distinct dietary optima for lifespan and reproductive effort and that diet mediated a trade-off between these

traits. I found that mating affected responses to dietary manipulation and caused sexual dimorphism in dietary intake under choice (Chapter 5). However, oxidative stress did not explain these life-history responses to dietary manipulation across the sexes (Chapter 6): although oxidative damage was greatest in the shortest lived sex (i.e. females), diets that extended lifespan did not reduce oxidative damage.

My thesis illustrates the importance of considering sexual selection when considering the evolution and mechanistic basis of ageing. It offers equivocal support for the free radical theory of ageing but shows that oxidative stress may help underpin sex-specific life-history strategies. However, my results highlight that unravelling the relationship between oxidative stress and life-history strategies across the sexes will be a very difficult task.

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