Mechanisms of Life History Evolution

The Genetics and Physiology of Life History Traits and Trade-Offs

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"…integrating an understanding of mechanisms into life history theory will be one of the most exciting tasks facing evolutionary biologists in the 21st century."

Barnes & Partridge (2003)

Foreword: Harvey's legacy

Graham Bell

"Ex ovo omnia" wrote Harvey (1651), and more than three centuries later his dictum still stands. Many examples of vegetative reproduction in animals have been described since Trembley (1744) astonished the world by describing the asexual budding of *Hydra*, but all lineages, so far as we know, pass through a single-cell stage sooner or later. The only more certain observation is that the individual that develops from the egg will eventually senesce and die. The journey between the two fixed points of egg and corpse has no prescribed route, however, and biologists have struggled to discover and interpret the lives of animals, plants, fungi, and seaweeds since the beginning of scientific biology in Harvey's time.

In very broad terms, two main approaches have been followed. The first is concerned largely with juvenile forms, and specifically with discrete developmental stages such as larvae. This is the older school, and its subject is usually called "life cycles." The second is concerned largely with adults, and specifically with the quantitative schedule of reproduction. This has developed over the last 50 years, and its subject is usually called "life histories." The two have been developed to a large extent independently of one another, and the linkages between them remain few and weak.

The study of life cycles is the older tradition, and dates back to the time when it was first demonstrated by Steenstrup (1845) that very dissimilar individuals could be produced, one from another, as a succession of forms belonging to the same lineage. The only example that is familiar to everyone (now that classical zoology has withered from the curriculum) is the succession of polyp and medusa in some cnidarians, but much more complex life cycles have evolved in groups such as digenean trematodes. It is often difficult to work out how and when one stage gives rise to another, especially when this involves reproduction by eggs. In other cases, however, the developmental sequence is clear even though it passes through larval stages that are very different from the adult, by virtue of the physical continuity of macroscopic individuals. There is no profound difference between the two, however. The juvenile starfish, for example, develops as a miniature version of the adult from a small patch of tissue within the body of a small ciliated-band animal living in the plankton. As the starfish animal enlarges, the ciliated-band animal shrinks, and its remnants are eventually discarded. This process is called "development" because the physical continuity of larva and adult is clear, but it is manifestly the same kind of process as the transition between polyp and medusa, a succession of morphologically distinct phases within a single lineage.

The study of life cycles has been predominantly descriptive, a tradition that has continued, in the form of discovering the regulatory genes responsible for the evolution of body plans, down to the present day. The possibility of a theoretical account of the life cycle was raised by Garstang (1928) nearly a century ago: given that an animal developing from an egg must grow steadily larger, it must be functional first as a small individual and subsequently as a large individual. A ciliary-band animal living at low Reynold's number in the plankton is one possible route to a large hydraulically powered animal living on the sea floor, whereas the reverse route is impracticable. Nevertheless, a systematic theoretical framework capable of interpreting the succession of phases in development has yet to be constructed.

The parallel effort to understand the sexual phases of life cycles is a similar but more complicated story, largely because of the great difficulty of establishing the site and timing of the crucial events of fusion and reduction, even after the advances of microscope design in the later nineteenth century. It was not until the closing decades of the century that the essential distinction between spore and gamete was unequivocally established, and by the end of the first decade of the twentieth century a correct account of the alternation of generations in the life cycle of seaweeds and land plants had been successfully accomplished (see the review by Farley 1982). A theoretical basis for understanding the alternation of generations in terms of the fundamentally different requirements of spores and gametes, and thus the different structure and behavior of spore-producing and gamete-producing individuals, was provided at the same time (Bower 1908). Before it could be extensively developed, however, the field was largely abandoned, swept away by the flood of research into transmission genetics, which had just been provided with the firm theoretical framework of Mendelism. The endlessly varied sexual cycles of eukaryotes have continued to provide rich material for extending our knowledge of natural history, but we cannot yet interpret them within a consistent theoretical framework. In recent years there has been a modest revival of interest in the theory of phenomena such as gamete dimorphism, but this has not yet become firmly coupled to field studies and experimentation.

The field of life histories has developed more recently and in a very different fashion, being highly theoretical from the outset. Simplifying history (as one must in a foreword) it was galvanized by Cole's paradox: a lineage in which females live forever and produce an infinite number of litters of whatever size has the same rate of increase as one in which all females die immediately after producing their first litter, but produce one more offspring (Cole 1954).

Working out the reasons for this counter-intuitive result led to a general interpretation of suicidal versus repeated reproduction that was subsequently elaborated into an account of the schedule of reproduction over the whole of the adult stage. Juvenile stages such as larvae are ignored; alternative adult stages such as sporophytes and gametophytes are not distinguished. Freed from zoology, botany, and genetics a highly abstract and general theory of the life history could be developed.

Much of this theory was based on a principle of optimality: quantities such as the rate of reproduction and the probability of survival are negatively correlated, such that intermediate values of both maximize the overall rate of increase of a lineage. This enabled the schedule of reproduction to be predicted from the costs of reproduction, in terms of reduced growth or survival. This approach has had some brilliant successes, beginning with David Lack's classical interpretation of clutch size in birds (see Lack 1966). It could also be extended to the puzzling phenomenon of senescence, which could now be interpreted as a non-adaptive side effect of selection for early reproductive maturity (Williams 1966a). Moreover, the generality of the predictive framework made it possible to contrive experimental tests in laboratory model systems, which had never been possible for life cycles.

The very generality that gave the theory such power was also a source of weakness, insofar as the sources of the costs of reproduction on which the theory was based did not need to be specified and therefore could not be investigated within the confines of the theory itself. For this reason, attention began to shift towards the nature of the costs themselves. This is not as straightforward as it might appear. It seems obvious that producing larger offspring will mean producing fewer, and almost equally obvious that allocating a greater share of resources to reproduction must deplete the stock available to support maintenance and defense. One function necessarily interferes with the other. It was soon found, however, that in practice the correlations between fitness components are usually positive rather than negative. This was quickly attributed to environmental variance of productivity among sites when comparisons are made in the field, or to genetic variance of overall fitness among strains when comparisons are made in the laboratory. The expected costs are then expressed only at evolutionary equilibrium, when genetic variance for overall fitness has been reduced to a low level by selection. This evolutionary argument, however, implies that costs of reproduction measured as negative genetic correlations need not have any mechanistic basis in terms of functional interference. A simple illustration of this conclusion is to generate n random numbers and label them x_1, x_2 etc; then repeat the process to obtain a second set labeled y_1, y_2 etc. Plotting y_i on x_i produces a cloud of points with zero correlation. Now choose the small percentage of pairs with the highest values of $(x_i + y_i)$; plotting y_i on x_i now produces a graph with a slope of –1 (if the x_i and y_i have equal variance) and $r^2 \approx 0.5$. This striking pattern has been carved out of the original unstructured data by the act of choosing an unrepresentative set of cases, and natural selection will likewise generate negative genetic correlation among components of fitness from random life histories through the propagation of an unrepresentative set of genotypes. No causal connection between the components, for example through pleiotropic gene expression, is necessary for such correlations to arise.

Understanding the mechanistic basis for costs of reproduction is thus an important aspect of understanding life histories as a whole. Moreover, it may contribute directly to human well-being. The evolutionary reasons for senescence can be framed in terms of pleiotropy or delayed gene expression for example, whereas the physiological reasons must be framed in terms of factors such as the irreversible damage caused by reactive oxygen species, the accumulation of somatic mutations, the intrinsically limited metabolic capacity of tissues, and so forth. Much of the recent research into senescence in the *Drosophila* and *Caenorhabditis* model systems has been driven by the physiological agenda, in part because of its potential for identifying palliative therapies. The value of this research is indisputable. It would be a pity, however, if the evolutionary agenda were to be obscured or lost as a result. Part of the *raison d'être* of this volume is to emphasize that it is important to understand the physiological basis of the costs of reproduction in order to understand how life histories evolve—but conversely that it is equally important to understand how life histories evolve in order to predict how physiological processes are likely to operate. The *clk* genes of *Caenorhabditis*, which slow down vital processes and extend lifespan, are an excellent example of recent research in molecular developmental genetics at the interface between evolution and physiology (Hekimi *et al.* 2001).

A more fundamental task for the future is to build a synthetic evolutionary theory of development that would bring together all the phenomena of life cycles within the same framework. It is not even clear whether this is possible. The classical theory of life histories invokes natural selection, leading to optimal phenotypes. The most successful theories of certain aspects of the life cycle, such as gamete dimorphism and the sex ratio, invoke sexual selection, leading to evolutionary stable states. For some phenomena, such as the alternation of generations, both approaches have been tried without any decisive outcome so far; for others, such as the succession of phases, hardly any formal theory has yet been developed. But the possibility is worth contemplating, and if this volume is not the last word on the subject, it will at any rate be the next word.

Graham Bell
McGill University
23 May 2010

Preface

The major features of a life cycle are shaped by demographic traits—size at birth, growth rate, age and size at maturity, age-specific reproductive investment, number and size of offspring, age-specific survival, and lifespan—connected by constraining trade-offs. Together, these life history traits determine Darwinian fitness by affecting the two most important fitness traits, survival and reproduction. Life history theory seeks to understand the causes and consequences of genetic and environmental variation in life history traits, both within and among species. By combining quantitative genetics, artificial selection, demography, phenotypic manipulations, and optimality modeling, life history theory has had major success in explaining the diversity of life history strategies, as reviewed in three excellent books by Stephen C. Stearns and Derek A. Roff (Stearns 1992, Roff 1992, 2002).

The present book, in contrast to most previous work on life history evolution, emphasizes the mechanistic description, the "molecular natural history," of life history traits and their evolution. Traditionally, life history theory is silent on proximate mechanisms, yet recent advances in mechanistic biology have taught us a great deal about how genetics, development, and physiology affect life history. Although much of this information comes from research outside the realm of evolutionary biology, for example from fields such as the genetics of growth control or the molecular biology of aging, it is often directly relevant for our understanding of the evolution of life histories. To date, however, this mechanistic knowledge has not been adequately integrated into the life history framework. To forge such an integration, and to foster an exchange between scientists who work on organismal versus mechanistic aspects of life histories, this multi-author book brings together leading researchers who share the conviction that many fundamental problems in life history evolution can only be completely understood if we begin to incorporate information on developmental, physiological, and genetic mechanisms into the study of life histories (e.g., Barnes and Partridge 2003, Flatt *et al.* 2005, Heyland *et al.* 2005).

Given the major predictive and explanatory success traditional life history theory has had, why is it important to fill the "black box" of life history evolution with mechanism? A good example is the problem of life history trade-offs. Trade-offs, for example between survival and reproduction, are typically thought to be caused by competitive resource allocation (e.g., Stearns 1992), but whether this physiological explanation is correct is usually unknown. Without detailed knowledge of resource levels, patterns of acquisition and allocation, intermediary metabolism, and endocrine regulation we cannot properly test the assumption that trade-offs are resource based (e.g., Harshman and Zera 2007). Thus, while the existence of trade-offs can often be quite readily established, we do not understand their underlying mechanisms, and this limits our understanding of life history evolution (e.g., Stearns 2000). As several chapters in this book illustrate, the classical assumption of trade-offs being resource based might in fact not always hold.

Another example of how information on mechanisms can illuminate and expand life history theory concerns genes with major effects on life history traits and their integration (e.g., Flatt 2004, Schmidt *et al.* 2008, Paaby *et al.* 2010). Identifying the genes that affect or modulate life history traits will ultimately enable us to answer important evolutionary questions such as: Which genes or alleles affecting life history traits are evolutionarily conserved, and which genes or alleles are lineage-specific? What is the relationship between life history variation segregating within natural populations and genetic differences in life histories among species? Is there standing genetic variation for these genes within populations and are they under selection? What are the genes or alleles that make up genetic correlations and trade-offs? Can the genetic mechanisms that cause trade-offs be uncoupled and how? How do genes interact with the environment to determine life history phenotypes? Several authors in this book review impressive progress in evolutionary quantitative and molecular genetics that has lead to the identification of genes and pathways that are likely to be of major importance in life history evolution.

Although the integration of mechanistic studies into life history evolution is still in its infancy, we believe that—similar to the recent advances made by evolutionary developmental biology (evo-devo), which combines studies of evolution, development, and genetics—future work on life histories will benefit significantly from an explicit consideration of proximate mechanisms. Many examples of such an interdisciplinary approach towards understanding life history evolution can be found throughout this book.

We are targeting this book at advanced undergraduates, graduate students, postdocs, and established researchers in evolution, ecology, evo-devo, development, genetics, physiology, and aging who all aim to understand the mechanisms that shape the expression and evolution of traits that affect Darwinian fitness, including growth, development and maturation, reproduction, and lifespan. In particular, we hope that the chapters in this book will stimulate students and researchers with a strong interest both in organismal biology and molecular biology. For background reading on life histories we refer the reader to the books by Stearns (1992) and Roff (1992, 2002) who cover traditional, nonmechanistic aspects of life history evolution.

The chapters in this book have all been written by leading researchers who use studies of proximate mechanisms to solve fundamental problems in life history biology in a variety of organisms. Their chapters not only represent the current state of the art, but also offer fresh perspectives for future research. In designing the book we have attempted to present a balanced selection of authors (ranging from young to well-established), organismal taxa (e.g., algae, higher plants, nematodes, insects, echinoderms, fish, amphibians, reptiles, birds, humans), and biological disciplines and approaches relevant to life history biology (e.g., developmental biology, genetics, evo-devo, anthropology, behavior, reproductive biology, aging, phenotypic plasticity, social evolution, immunology, metabolism, and endocrinology). Although we have aimed to cover a lot of ground in this book, many interesting and important subjects had to be omitted due to space limitations. For example, while several chapters discuss the mechanisms that affect lifespan, we did not include a detailed discussion of the evolutionary biology of aging—this has been reviewed extensively elsewhere, for example by Rose (1991) and Flatt and Schmidt (2009).

Chapter authors were asked to write chapters that are equally accessible to evolutionary and mechanistic biologists, to make clear references to fundamental concepts in life history evolution, and to cross-reference other chapters in this volume. Authors obviously differ in their scientific views, the level of their exposition of material, and their writing styles, and we have therefore attempted to make chapters somewhat uniform, for example through author guidelines, editorial and external peer reviews, and several revisions. Nevertheless, differences among the chapters do remain—in fact, we feel that they are desirable since they make the perspectives offered here both more personal and pluralistic. Together with the wide range of topics, scientific approaches, and organisms covered in this volume we hope that this diversity in perspective will be stimulating for the reader.

Although not being a chapter in its own right, the book starts out with a foreword by Graham Bell, who gives a broad historical summary of research on life histories and who emphasizes the need for integrating mechanistic insights into this research area. This sets the stage for the actual book chapters which are grouped into seven parts. Each part of the book, except for the last, is preceded by a brief introduction written by the editors. Part 1 (Integrating mechanisms into life history evolution) consists of two chapters which introduce some of the basic concepts of life history theory and outline the utility of mechanistic approaches for understanding problems in life history evolution. Parts

2–6 consist of 24 chapters that make up the bulk of the book. Since many of these chapters are highly integrative and cover more than one type of organism, we have attempted to group these chapters into conceptual categories. The chapters in Parts 2–4 all address mechanisms that deal with one of the three major phases of an organisms' life cycle (Part 2: growth, development, and maturation, Part 3: reproduction, and Part 4: aging and somatic maintenance). The chapters in Parts 5–6 deal with two major concepts in life history theory, namely phenotypic plasticity and trade-offs (Part 5 life history plasticity and Part 6 life history integration and trade-offs). Despite this conceptual structure, many chapters could have easily been placed into other parts of the book. Thus, the structure of the book is not rigid, and many chapters in one part of the book directly touch on issues discussed in other parts of the book. In fact, we feel that a certain amount of overlap among book parts and chapters is desirable and helps the integration of the diverse subjects we cover. We have also aimed to achieve further integration throughout the book by writing short introductory sections that precede each book part and by asking authors to frequently cross-reference other chapters. Part 7 concludes the volume: in Chapter 27 Stephen C. Stearns summarizes and critically discusses the contributions in the book by asking whether progress on understanding mechanisms forces life history theory to change. Chapter 28 is a postscript that rounds up the book: it consists of an exchange between Stearns and the editors, discussing what mechanistic insights can or cannot contribute to our understanding of life history evolution.

The idea for this volume was conceived at a symposium on molecular mechanisms of life history evolution sponsored by the Society for the Study of Evolution (SSE), which we organized at the Evolution meetings at the University of Minnesota in Minneapolis in 2008. We are grateful to all the speakers and participants of this symposium for many stimulating discussions that have helped to shape some of the ideas in this book. Their enthusiasm convinced us to approach this book project. In particular, we thank Derek Roff for his advice and encouragement.

Each book chapter was reviewed by both editors and in most cases by two external reviewers or chapter contributors. We are extremely grateful to these experts for their help and time: without exception they have provided very thoughtful, critical, and helpful suggestions for improving the chapters. For their timely chapter reviews we are indebted to Gro Amdam, Richard Bribiescas, Goggy Davidowitz, Greg Davis, Tony De Tomaso, David Denlinger, Robert Denver, Michelle Elekonich, Peter Ellison, Caleb Finch, Klaus Fischer, Gary Freeman, Owen Gilbert, Michael Hadfield, Dan Hahn, Larry Harshman, John Hatle, Jason Hodin, Hillard Kaplan, Tad Kawecki, Ellen Ketterson, Teri Markow, Alistair McGregor, Amy Moran, Coleen Murphy, Courtney Murren, Amy Newman, Dan Noble, Mats Olsson, Bruno Pernet, Scott Pletcher, Kim Rewitz, Jens Rolff, Michael Rose, Olav Rueppell, Gerhard Schlosser, Paul Schmidt, David Schneider, Stanley Shostak, Cristian Solari, Gabriele Sorci, Stacia Sower, Michael Stern, Richard Strathmann, Stuart Wigby, Karen Williams, and John Youson, and two reviewers who wished to remain anonymous.

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CHAPTER 1

Integrating mechanistic and evolutionary analysis of life history variation

Christian Braendle, Andreas Heyland, and Thomas Flatt

1.1 Introduction

Life histories—describing essential patterns of organismal growth, maturation, reproduction, and survival—show tremendous variation across individuals, populations, species, and environments. Understanding this variation is the goal of life history research. The analytical framework of life history theory focuses on the variation and interaction of different key maturational, reproductive, and other demographic traits, given that natural selection acts to maximize fitness of a life history as a whole (Roff 1992, Stearns 1992). Fitness integrates over the entire reproductive performance of the organism, and life history traits are the major fitness components underlying this integration. However, the investment into alternative life history traits, and thus the possible set of trait combinations, is restricted by genetic, developmental, physiological, and phylogenetic limits. Apart from explaining variation in life history strategies as a result of natural selection, identifying how such trade-offs and constraints shape life histories is the central aim of life history research.

In this chapter we introduce the basic concepts and definitions of life history theory and argue for the importance of integrating a mechanistic perspective into research on life histories. While most traditional life history research is based on mathematical, statistical, and phylogenetic approaches without explicit reference to underlying mechanisms, today's principal research challenge is to fill this gap through experimental characterization of the proximate basis of life histories. The analysis of genetic, developmental, and physiological factors that shape life history traits will ultimately allow us to determine how evolutionary changes in such mechanisms generate, facilitate, or constrain the diversification of life histories. Integrating mechanistic and evolutionary analyses of life history variation is part of a global quest in biology that seeks a shared understanding of proximate and ultimate causes of phenotypic variation.

1.2 The life history framework

1.2.1 What is a life history?

A life history encompasses the life of an individual from its birth to its death, describing the age- or stage-specific patterns of maturation, reproduction, survival, and death. The major objective of life history research is to understand how evolution, given selection imposed by ecological challenges, shapes organisms to achieve reproductive success. The second objective of life history research is to understand whether and how, given internal trade-offs and constraints, selection can optimize a set of life history traits to maximize reproductive success. Since organisms dispose of limited resources, which must be competitively allocated to differing functions, such as growth, reproduction, survival, and maintenance, resources invested into one function cannot be invested into another, leading to trade-offs. In addition, life history research explores taxon-specific features of life cycles and life history decisions, including patterns of sex allocation, alternative phenotypes, or larva-to-adult transitions. For in-depth treatments of the evolution of life histories and life history theory see Stearns (1992), Roff (1992, 2002), and Charlesworth (1994).

1.2.2 Life history traits and fitness

Life history traits represent quantitative, demographic properties of organisms that are directly related to the two major components of fitness, i.e., survival and reproduction. Classical life history analysis considers the following to be the principal life history traits (Stearns 1992):

- size at birth
- growth pattern
- age and size at maturity
- number, size, and sex ratio of offspring
- age-and size-specific reproductive investments
- age- and size-specific mortality schedules
- length of life.

These traits essentially represent the demographic parameters required to estimate fitness as defined by the Malthusian parameter (or similar fitness measures). The Malthusian parameter (also called the instantaneous rate of natural increase, r) is the solution to the Euler–Lotka equation, which describes population growth by summing reproductive events and survival probabilities over the entire lifetime of individuals (Stearns 1992). Thus, life history traits are directly linked to fitness, with fitness being defined by population growth models from demography.

In contrast to classical life history traits, morphological, physiological, or behavioral traits are considered to contribute to fitness only indirectly (e.g., Roff 2007b). However, this distinction is somewhat arbitrary. For example, certain morphological traits such as body size or gonad size may correspond to life history traits (or at least are correlates thereof). In the literature, the term "life history trait" is often used interchangeably with fitness components, so that many phenotypic characters with major effects on reproduction and survival have been called life history traits.

Because of their complexity and demographic nature, life history traits are usually treated as quantitative, polygenic traits (Falconer and MacKay 1996). The expression of life history traits is also highly contingent on the environment, so that life history research places particular emphasis onto the concept of phenotypic plasticity, i.e., the ability of a single genotype to produce different phenotypes across environments (Stearns 1992). Plasticity is described by "reaction norms", mathematical functions that relate the phenotypic values adopted by a given genotype to changes in the environment. Selection shapes life history plasticity by acting on genetic variation for plasticity, which is present when the reaction norms that represent different genotypes are non-parallel across the same range of environments (so-called genotype by environment interactions, or G × E). Reaction norms (and thus plasticity) are considered to be optimal when they maximize fitness for each of the different environments (Stearns and Koella 1986).

1.2.3 Trade-offs and constraints

A key postulate of life history theory is that the values and combinations of life history traits are limited by factors internal to the organism, namely trade-offs and constraints. These intrinsic factors ultimately limit and direct the evolutionary response to the external force of selection. A life history trade-off occurs when an increased investment in one fitness component causes a reduced investment in another fitness component, i.e., a fitness benefit in one trait exacts a fitness cost in another. Examples of classical life history trade-offs are survival versus reproduction, number versus size of offspring, or current reproduction versus future reproduction (Stearns 1992).

Trade-offs are usually described as phenotypic or genetic covariances or correlations among traits, without reference to their causal relationships. If the relationship can be shown to be genetic, negative genetic covariance among traits is expected to limit the evolution of each of these traits. Such genetic or evolutionary trade-offs are considered at the population level, i.e., as defined by genetic correlations among individuals or correlated phenotypic responses to selection. Genetic trade-offs are traditionally assumed to stem from antagonistic pleiotropy or linkage disequilibrium. These trade-offs also manifest themselves at the physiological or individual level, for example when an individual with increased reproductive effort in one year exhibits a reduction in reproductive output in the next year. Such physiological trade-offs are thought to be due energy limitations, i.e., the allocation of resources among competing functions. Importantly, trade-offs may exist at population level, but not at individual, physiological level (Stearns 1989, Houle 1991, Stearns 1992).

In contrast to trade-offs, the term “constraint” is often used to described *absolute* limits to or biases upon trait expression and combination. Constraints may describe physical factors, developmental properties, or historical contingencies that prevent an organism from expressing a certain phenotype or a population from attaining a certain fitness optimum in response to selection (Maynard Smith *et al.* 1985). The distinction between trade-offs and constraints is not strict, and trade-offs are often regarded as one type of constraint. In the life history context, constraints usually refer to phylogenetic, lineage-specific characteristics that impose *absolute* limits on trait expression in a given organismal group.

1.2.4 Empirical approaches in life history research

Although classic life history analysis has been largely theory-driven, much empirical research has addressed the questions and predictions raised by life history theory, using both non-genetic and genetic approaches (Stearns 1992, Roff 1992, 2002, 2007b; also see Chapter 2). Non-genetic approaches include phenotypic correlations to examine patterns of life history trait covariation among populations and species, experimental phenotypic manipulations, and statistical tools from comparative analysis to control for phylogenetic history. Genetic approaches to the study of life history variation are predominantly based on the framework of quantitative genetics. Most of this work has concentrated on the detection and analysis of genetic trade-offs, either through the study of covariances and correlations among life history traits between relatives (e.g., pedigree analyses) or through correlated responses of life history traits to artificial selection or experimental evolution. This research framework has generated a substantial body of empirical evidence that has revealed how selection operates on life history traits, contingent on the environment and trade-offs (Stearns 1992, Roff 1992, 2002, 2007a,b). Despite these extensive efforts, very few studies have examined the mechanistic underpinnings of life history traits. For example, inferred interrelationships among life history traits rarely describe more than statistically determined associations. A major limitation common to the classical approaches in life history research is therefore the ignorance of the proximate causes that determine or modulate life histories and their evolution.

1.3 The study of causal mechanisms linking genotype to phenotype

Understanding how a genotype translates into a phenotype is one of the most fundamental problems in biology. In most cases, phenotypes cannot be simply inferred from their underlying genotypes, and vice versa, because the mapping of genotypes onto phenotypes is often a non-linear process, shaped by a multitude of complex genetic and environmental interactions. Moreover, a single genotype may generate multiple phenotypes and, conversely, multiple genotypes may generate a single phenotype. That such properties of the genotype–phenotype map are relevant for our understanding of the evolutionary process has been emphasized for a long time (e.g., Lewontin 1974, Houle 2001), but it is only relatively recently that the causal relationships between genotype and phenotype have received increased attention from evolutionary biologists (e.g., Pigliucci 2010). While research at the interface of development and evolution has begun to tackle the significance of the genotype–phenotype map in morphological evolution, the causal connection between genotypes and phenotypes for fitness components is still extremely rudimentary (e.g., Chapter 2 and Roff 2007b).

Traditionally, attempts to link the genotype with the phenotype have been regarded as the principal task of “reductionist” branches of biology, including molecular, cellular, and developmental biology. Developmental genetics in particular has emerged as the prime discipline in connecting gene function during development with phenotypic outcomes, primarily by relying on mutational analysis and forward genetics. The great power of this approach lies in the typically high degree of causal inference that can be made through carefully controlled manipulation of isolated genetic factors and their phenotypic effects. The general downside of this approach is that such studies are generally limited to the study of single, highly pleiotropic mutations with large phenotypic effects. In addition, developmental genetic analyses are generally limited to the study of a single or or a small number of laboratory populations in highly simplified artificial environments, aiming to reduce variation engendered by genetic background or environmental context as much as possible. This research approach starkly contrasts with that of evolutionary biologists, whose primary concern is the study of quantitative genotypic and phenotypic variation among populations or species. Here, in contrast to developmental genetics, the inferred genotype–phenotype relationships are generally of indirect, associative nature, rarely permitting inferences about the causal connections between genotypic and phenotypic variation.

As advocated in many chapters throughout this book, a better future understanding of many issues in life history evolution will require the integration of evolutionary and organismal biology with molecular and developmental biology (e.g., Dean and Thornton 2007). That unfortunate historical separations between biological disciplines can be overcome is well illustrated by the successful rapprochement of evolutionary and developmental biology (e.g., Raff and Kaufman 1983, Carroll *et al.* 2000, Stern 2010). Although initially mainly concerned with the description of evolutionary diversification or conservation of developmental mechanisms, the central aim of evolutionary developmental biology (evo-devo) has recently shifted to the experimental analysis of how properties of genetic and developmental architecture impact phenotypic evolution. Evo-devo therefore addresses specific issues directly relevant to the understanding of life history evolution, such as the mechanistic basis of developmental biases and constraints or phenotypic plasticity. More generally, as life history traits are high-level phenotypes that depend on the ensemble of morphological and physiological traits, the mechanistic analysis of life history evolution can consequently be regarded as an extension of the principal objective of evo-devo, namely to understand which developmental and genetic changes underlie phenotypic evolution.

Uncovering the mechanistic basis of life history variation is a non-trivial challenge. Life history traits were defined by evolutionary ecologists with the intent of reducing phenotypic complexity by focusing on a small number of traits that summarize the essential fitness components and by ignoring the underlying genetic, developmental, and physiological mechanisms that govern the expression of these traits. A given life history trait can thus be thought of as a functionally complex phenotype resulting from the integration of a suite of morphological, physiological, or behavioral phenotypes. At the level of the individual, their characteristics have therefore to be understood in terms of both the construction of multiple individual traits as well as their spatial and temporal integration into a higher-level phenotype. As such, life history traits are *a priori* composite, quantitative, polygenic traits whose expression is often highly contingent upon plasticity, pleiotropy, and epistasis. All these properties render the mechanistic analysis of life history traits extremely difficult in practice.

1.4 How can mechanistic insights contribute to understanding life history evolution?

Despite the inherent difficulties in studying the proximate basis of life histories, considerable progress has been made in our mechanistic understanding of life history evolution, with major contributions stemming from molecular genetic studies on experimental model organisms. Here we briefly discuss the importance of integrating such mechanistic information into organismal life history research; many more detailed examples can be found throughout the chapters in this book. For further reading on integrative approaches in life history biology we recommend the reviews by Houle (2001), Leroi (2001), Barnes and Partridge (2003), Harshman and Zera (2007), Chapter 5 in Van Straalen and Roelofs (2006), Roff (2007b), and Flatt and Schmidt (2009).

1.4.1 Why understanding mechanisms is important for answering evolutionary questions

While it is clear that knowledge of the proximate basis of life histories does not provide information about the ecological or evolutionary relevance of such mechanisms, it enables evolutionary biologists to address several fundamental questions about life history evolution, including, for example:

- What is the function of genes that are genetically variable in natural populations and that contribute to ecological adaptation?
- Are major candidate genes, as identified by molecular genetics, variable in natural populations?
- If so, do polymorphisms at these loci actually contribute to the evolution of life history traits in the wild?
- Are the genes that impact life history evolutionarily conserved or lineage-specific?
- What genetic and physiological mechanisms determine or modulate the expression of ecologically and evolutionarily important trade-offs?
- Are such trade-offs, as commonly assumed, resource based, or are they due to mechanisms independent of energy allocation?
- What are the mechanisms that mediate life history plasticity?

1.4.2 The molecular identity and function of genes that affect life history

Studies in molecular and developmental genetics inform us about the molecular identity and function of genes, including those that affect life history traits and other fitness components. The functionally best-understood genes that affect life history traits have been analyzed in model organisms such as *Arabidopsis*, *Drosophila*, or *C. elegans*. Information about the function of such genes is useful, for example, when evolutionary biologists want to investigate the consequences of allelic variation at such loci in natural populations. Although natural alleles might have much more subtle phenotypes than laboratory induced mutant alleles, detailed knowledge about gene function might help organismal biologists to understand whether and how particular genes contribute to ecologically relevant phenotypes and thus why selection acts on such loci. This does not mean that every gene with a major phenotypic effect on a fitness-related trait, as identified by molecular genetics, is in fact ecologically or evolutionarily relevant in natural populations; many such genes might not harbor standing genetic variation affecting life history phenotypes and might therefore not contribute to evolutionary change in the wild. Yet, it is also clear that loci that do contribute to phenotypic variation in fitness-related traits and thus to ecological adaptation in natural populations are a subset of all genes, including those that have been functionally studied by molecular geneticists (e.g., Stern 2000, Flatt 2004, Flatt and Schmidt 2009).

While developmental and molecular genetic approaches do inform us about the ecological or evolutionary significance of specific genes, they have proved powerful in identifying the molecular mechanisms that affect life history traits, for instance their endocrine regulation (Tatar *et al.* 2003, Fielenbach and Antebi 2008). Perhaps the best examples are genes known to affect adult survival and longevity in the nematode, fruit fly, and mouse; these have received particular attention, not only from biomedical researchers because of their potential implications for human gerontology (see Chapter 16), but also from evolutionary biologists because of their potential relevance for understanding the evolution of aging. During the past 20 years, numerous mutations that extend lifespan have been identified in diverse model organisms (e.g., Kenyon 2010; also see Chapter 14). Many of these mutations were found to affect a key metabolic pathway—the insulin/insulin-like growth factor signaling pathway—indicating that decreased effectiveness of insulin/IGF-like signaling causes lifespan extension, linked to correlated responses in reproduction, growth, and metabolism. These pivotal discoveries, many of which are discussed in this book, not only demonstrate the feasibility of molecular genetic analyses of complex life history traits such as lifespan, but also suggest that certain evolutionarily conserved signaling pathways are potential key regulators of major life history traits (also see Chapters 27 and 28). Many of these findings have also contributed to our understanding of life history trade-offs (see below and Chapters 11 and 13). The molecular genetic analysis of lifespan has thus rapidly become of great interest to many researchers studying life histories, and this interest is now paving the way for an integration of mechanistic and evolutionary approaches towards the understanding of life history variation (e.g., Partridge and Gems 2006, Flatt and Schmidt 2009).

In addition to functional studies of individual mutations, genome-wide gene expression analyses have also been widely used by both molecular and evolutionary biologists to investigate the proximate basis of life history variation (as is discussed in detail in Chapter 2). For example, genome-wide transcriptional profiling has been used to identify candidate genes involved in lifespan regulation (e.g. Murphy *et al.* 2003), or to describe gene expression patterns associated with particular life history stages, for example dauer larva formation in *C. elegans* (Wang and Kim 2003). Many of these studies illustrate the complex and manifold changes in gene expression associated with life history variation and further indicate that life history trade-offs might emerge through "conflicts over gene expression", i.e., antagonistic pleiotropic effects of genes involved in multiple functions (Stearns and Magwene 2003, Bochdanovits and de Jong 2004). However, the functional interpretation of such data remains challenging because the precise causal connections between transcriptional changes and the resulting phenotypes are rarely known. Thus, while it is clear from these few examples that we have learned a great deal about the molecular genetic basis of life history traits, a current key challenge is to integrate such mechanistic insights into the evolutionary framework (also see Chapters 27 and 28). One obvious question for the evolutionary biologist is, for example, whether the candidate genes identified by molecular geneticists actually matter in natural populations.

1.4.3 Are candidate life history genes ecologically and evolutionarily relevant?

Mutational, transgenic, and genomic analyses in model organisms have been successful in identifying at least some of the key mechanisms that affect life history traits. However, while many of these mechanisms show a surprisingly high degree of conservation across widely divergent taxa, their relevance in shaping evolutionary life history variation in natural populations is not yet sufficiently clear. Determining whether and how such mechanisms evolve to generate natural life history variation represents a promising starting point for the integration of functional and evolutionary analysis of life histories. In most cases, however, such studies are limited to model organisms. Such an analysis requires testing of whether the genes involved in these candidate mechanisms show actual variation in natural populations and, as a more challenging step, to functionally demonstrate that this allelic variation impacts the life history trait in question.

Several studies suggest that genes identified through molecular and developmental genetic analyses indeed harbor natural allelic variation that contributes to population variation in life history traits, for example in *Drosophila* (e.g., Schmidt *et al.* 2000, Paaby and Schmidt 2008, Paaby *et al.* 2010; also see Chapter 18), or in *Arabidopsis* (e.g., Todesco *et al.* 2010; also see Chapter 9). Although the screening of natural polymorphisms in candidate life history genes only provides a first glimpse of the molecular basis of life history variation, such initial findings are encouraging since they indicate that developmental and molecular genetic studies indeed generate valuable candidate genes of interest for evolutionary biologists.

In contrast to the analysis of natural allelic variants at major candidate loci identified by molecular and developmental genetics, quantitative trait locus (QTL) mapping provides a less biased, yet technically challenging, approach to the characterization of the genetic basis of polygenic quantitative traits, including life history traits (Falconer and Mackay 1996). While classical QTL mapping approaches have been useful in determining the basic genetic architecture of life history traits (e.g., the number and effect size of the involved loci), they rarely achieve sufficient resolution to pinpoint individual candidate genes (see discussion in Roff 2007b and Mackay *et al.* 2009). However, recent technological advances, such as rapid and cost-effective genotyping methods and refined statistical and mapping methods, have increased the feasibility of high-resolution mapping, now allowing the identification of candidate genes within QTL regions for organisms with well-annotated genomes, in some cases down to the level of single nucleotide polymorphisms (e.g., Mackay *et al.* 2009). High-resolution mapping through recombinant inbred lines and genome-wide association studies have already been successful in characterizing natural polymorphisms underlying genetic variation in complex developmental or life history traits in *C. elegans* (e.g., Kammenga *et al.* 2007, Palopoli *et al.* 2008), *Drosophila* (e.g., De Luca *et al.* 2003, Schmidt *et al.* 2008, also see Flatt and Schmidt 2009 for a recent review), and in *Arabidopsis* (e.g., Atwell *et al.* 2010, also see Chapter 9). Moreover, recent progress in genomic methods now allows the researcher to treat genome-wide expression patterns as complex quantitative traits (e.g., Rockman 2008).

The recent advent of refined QTL and genetical genomics approaches is emblematic for an integrative and novel research program, namely the use of natural genetic variation as a tool to understand the causal connection between genotype and phenotype. By explicitly taking evolutionary variation into account, this approach holds great promise for facilitating the detection of mechanistic features that are involved in phenotype construction. However, the identification of individual genes or nucleotide polymorphisms that contribute to quantitative trait variation remains a major challenge because of subtle phenotypic effects, complex genetic interactions, pleiotropy, and genotype-by-environment interactions (e.g., Weigel and Nordborg 2005, Mackay *et al.* 2009).

1.4.4 How do trade-offs work?

One central and recurring theme in this book is the mechanisms that underlie life history trade-offs (see the chapters in Part 6). Given the central importance of such trade-offs in life history evolution, uncovering their mechanistic basis is one of the most fundamental but unresolved problems in life history research (e.g., Stearns 2000, also see Chapters 27 and 28). Despite numerous and seemingly obvious trade-offs between life history traits in a wide range of taxa, most reported trade-off relationships basically describe no more than a statistically inferred negative correlation. The description of trade-offs by means of trait correlations or covariances is, however, insufficient for evaluating how genetic architecture influences evolutionary trajectories (e.g., see Chapter 2 and Roff 2007b). Specifically, it remains to be determined to what extent presumptive trade-offs are conclusively due to actual competition for limited resources or caused by alternative mechanisms, such as hormonal signaling independent of resource allocation (see Chapters 11, 13, 27, and 28). The very limited knowledge on the mechanistic underpinnings of trade-offs therefore represents a current key problem in our understanding of life history evolution (e.g., Stearns 2000, Flatt *et al.* 2005, Roff 2007b, Flatt and Schmidt 2009).

Recent progress in this area comes again from the molecular genetic analysis of lifespan. Several studies on the relationship between lifespan and reproduction in worms and flies have challenged the fundamental notion that reproduction exacts an energetic cost in terms of reduced survival (e.g., see Chapter 11, Leroi 2001, Barnes and Partridge 2003). Of particular relevance was the observation of a *C. elegans* insulin receptor mutant with extended lifespan (Kenyon *et al.* 1993). Although this mutant exhibited decreased fecundity—consistent with a resource-allocation trade-off where investment in longevity extension lowers investment in reproduction—detailed experimental analysis of this relationship indicates that decreased reproduction is not the causal agent in extending longevity (e.g., Kenyon *et al.* 1993, Leroi 2001). Therefore, reproductive versus somatic investment may not necessarily be coupled through resource competition but rather via independent underlying signaling processes (see Chapters 11, 13, and 24, and Hsin and Kenyon 1999, Flatt *et al.* 2008b). While these findings do not prove the absence of a cost of reproduction (Barnes and Partridge 2003, Flatt and Schmidt 2009), they underscore the difficulty of inferring resource-allocation trade-offs without a precise understanding of the proximate mechanisms involved. For example, a major technical challenge in demonstrating the resource basis of trade-offs is to experimentally track resource allocation to different organismal functions by detailed measurement of relevant parameters, such as nutrient ingestion and assimilation (see Chapter 24 and O’Brien *et al.* 2008).

Other valuable information on the mechanistic basis of life history trade-offs comes from research exploring the fitness consequences of organismal defensive mechanisms against pathogens, parasites, stresses, or toxins. For example, studies in both vertebrates and invertebrates indicate that elevated immune and other defense functions incur fitness costs in terms of reproduction and survival (see, for example, Chapters 2 and 23, Flatt *et al.* 2005, Harshman and Zera 2007). Similarly, the evolution of pesticide tolerance in insects often results in a fitness cost, which is generally supposed to stem from increased energy allocation to corresponding detoxification mechanisms. Remarkably, however, it turns out that such fitness costs can result from collateral metabolic costs rather than energetic costs due to the detoxification mechanism (Van Straalen and Hoffmann 2000).

Thus, while many observations support the existence and evolutionary relevance of life history trade-offs, their underlying causal mechanisms still remain rather poorly understood. Importantly, one of the central postulates of life history theory, namely that trade-offs are caused by competitive resource allocation, might not necessarily always hold. As discussed in many chapters throughout this book (e.g., Chapters 11, 13, 27, and 28), major efforts are currently under way to dissect the mechanistic basis of life history trade-offs.

1.5 Conclusions

Combining mechanistic and evolutionary analyses of life history variation is a fundamental yet ambitious aim in current biology. On the one hand, there are inherent biological and technical problems with studying complex quantitative phenotypes such as life history traits. On the other hand, there are cultural divides that necessitate a combination of diverse research approaches and concepts from both molecular and organismal biology. Despite these challenges, the chapters in this book illustrate that the successful integration of mechanisms into life history research is fully under way.

References

Abbasi, A. A., Prasad, A. S., Rabbani, P. & Dumouchelle, E. (1980) Experimental zinc deficiency in man. Effect on testicular function. *Journal of Laboratory and Clinical Medicine*, 96, 544–550.

Abbott, R. J. & Gomes, M. F. (1989) Population genetic structure and outcrossing rate of *Arabidopsis thaliana* (L.) Heynh. *Heredity*, 62, 411–418.

Abbott, A. L., Alvarez-Saavedra, E., Miska, E. A., Lau, N. C., Bartel, D. P., Horvitz, H. R. & Ambros, V. (2005) The *let-7* MicroRNA family members *mir-48*, *mir-84*, and *mir-241* function together to regulate developmental timing in *Caenorhabditis elegans*. *Developmental Cell*, 9, 403–414.

Abe, T., Suzuki, T., Unno, M., Tokui, T. & Ito, S. (2002) Thyroid hormone transporters: recent advances. *Trends in Endocrinology & Metabolism: TEM*, 13, 215–220.

Abouheif, E. & Wray, G. A. (2002) Evolution of the gene network underlying wing polyphenism in ants. *Science*, 297, 249–252.

Abrams, P. (1993) Does increased mortality favor the evolution of more rapid senescence *Evolution*, 47, 877–887.

Ackermann, M., Schauerte, A., Stearns, S. C. & Jenal, U. (2007) Experimental evolution of aging in a bacterium. *BMC Evolutionary Biology*, 7, 126.

Adamo, S. A. & Parsons, N. M. (2006) The emergency life history stage and immunity in the cricket, *Gryllus texensis*. *Animal Behaviour*, 72, 235–244.

Adamo, S. A., Fidler, T. L. & Forestell, C. A. (2007) Illness-induced anorexia and its possible function in the caterpillar, *Manduca sexta*. *Brain, Behavior, and Immunity*, 21, 292–300.

Adkins-Regan, E. (2005) *Hormones and Animal Social Behavior*. Princeton, Princeton University Press.

Adkins-Regan, E. (2008) Do hormonal control systems produce evolutionary inertia? *Philosophical Transactions of the Royal Society of London B*, 262, 1599–1609.

Adler, L. & Jarms, G. (2009) New insights into reproductive traits of scyphozoans: special methods of propagation in *Sanderia malayensis* GOETTE, 1886 (Pelagiidae, Semaeostomeae) enable establishing a new classification of asexual reproduction in the class Scyphozoa. *Marine Biology*, 156, 1411–1420.

Adolphs, R. (2003) Cognitive neuroscience of human social behavior. *Nature Reviews Neuroscience*, 4 165–178.

Aggarwal, K. & Silverman, N. (2008) Positive and negative regulation of the *Drosophila* immune response. *BMB Reports*, 41, 267–77.

Ahnesjo, J. & Forsman, A. (2003) Correlated evolution of colour pattern and body size in polymorphic pygmy grasshoppers, *Tetrix undulata*. *Journal of Evolutionary Biology*, 16, 1308–1318.

Aiello, L. C. & Wheeler, P. (1995) The expensive-tissue hypothesis: The brain and the digestive system in human and primate evolution. *Current Anthropology*, 36, 199–221.

Ailion, M., Inoue, T., Weaver, C. I., Holdcraft, R. W. & Thomas, J. H. (1999) Neurosecretory control of aging in *Caenorhabditis elegans*. *Proceedings of the National Academy of Sciences of the United States of America*, 96, 7394–7397.

Alabadi, D. & Blazquez, M. (2009) Molecular interactions between light and hormone signaling to control plant growth. *Plant Molecular Biology*, 69, 409–417.

Alcedo, J. & Kenyon, C. (2004) Regulation of *C. elegans* longevity by specific gustatory and olfactory neurons. *Neuron*, 41, 45–55.

Alcendor, R. R., Gao, S., Zhai, P., Zablocki, D., Holle, E., Yu, X., Tian, B., Wagner, T., Vatner, S. F. & Sadoshima, J. (2007) Sirt1 regulates aging and resistance to oxidative stress in the heart. *Circulation Research*, 100, 1512–1521.

Alemseged, Z., Spoor, F., Kimbe, W. H., Bobe, R., Geraads, D., Reed, D. & Wynn, J. G. (2006) A juvenile early hominin skeleton from Dikika, Ethiopia. *Nature*, 443, 296–301.

Alexander, R. D. (1974) The evolution of social behavior. *Annual Review of Ecology and Systematics*, 5, 352–383.

Alexander, R. D. (1979) *Darwinism and Human Affairs*. Seattle, University of Washington Press.

Alexander, R. D. (1989) Evolution of the human psyche. In Mellars, P. & Stringer, C. (Eds.) *The Human Revolution*. Chicago, University of Chicago Press.

Alexander, R. D. (1990) *How humans evolved: Reflections on the uniquely unique species. Museum of Zoology (Special Publication No. 1)*. Ann Arbor, The University of Michigan.

Alexander, R. D. (2005) Evolutionary selection and the nature of humanity. In Hosle, V. & Illies, C. (Eds.) *Darwinism and Philosophy*. South Bend, University of Notre Dame Press.

Alexander, R. D. & Noonan, K. M. (1979) Concealment of ovulation, parental care, and human social evolution. In Chagnon, N. & Irons, W. (Eds.) *Evolutionary Biology and Human Social Behavior*. North Scituate, Duxbury Press.

Alizon, S., Hurford, A., Mideo, N. & Van Baalen, M. (2009) Virulence evolution and the trade-off hypothesis: history, current state of affairs and the future. *Journal of Evolutionary Biology*, 22, 245–259.

Allard, J. S., Heilbronn, L. K., Smith, C., Hunt, N. D., Ingram, D. K., Ravussin, E. & De Cabo, R. (2008) In vitro cellular adaptations of indicators of longevity in response to treatment with serum collected from humans on calorie restricted diets. *PLoS One*, 3, e3211.

Allman, J., Rosin, A., Kumar, R. & Hasenstaub, A. (1998) Parenting and survival in anthropoid primates: Caretakers live longer. *Proceedings of the National Academy of Sciences of the United States of America*, 95, 6866–6869.

Alonso-Alvarez, C., Bertrand, S., Devevey, G., Prost, J., Faivre, B. & Sorci, G. (2004) Increased susceptibility to oxidative stress as a proximate cost of reproduction. *Ecology Letters*, 7, 363–368.

Alonso-Alvarez, C., Bertrand, S., Faivre, B., Chastel, O. & Sorci, G. (2007) Testosterone and oxidative stress: the oxidation handicap hypothesis. *Proceedings of the Royal Society of London B*, 274, 819–825.

Alonso-Blanco, C., Aarts, M. G. M., Bentsink, L., Keurentjes, J. J. B., Reymond, M., Vreugdenhil, D. & Koornneef, M. (2009) What has natural variation taught us about plant development, physiology, and adaptation? *Plant Cell*, 21, 1877–1896.

Alonso-Blanco, C., El-Assal, S. E. D., Coupland, G. & Koornneef, M. (1998) Analysis of natural allelic variation at flowering time loci in the Landsberg erecta and Cape Verde islands ecotypes of *Arabidopsis thaliana*. *Genetics*, 149, 749–764.

Alonzo, S. & Sinervo, B. (2001) Mate choice games, context-dependent good genes, and genetic cycles in the side-blotched lizard *Uta stansburiana*. *Behavioral Ecology and Sociobiology*, 49, 176–186.

Alonzo, S. & Sinervo, B. (2007) The effect of sexually antagonistic selection on adaptive sex ratio allocation. *Evolutionary Ecology Research*, 9, 1–21.

Alper, S., McElwee, M. K., Apfeld, J., Lackford, B., Freedman, J. H. & Schwartz, D. A. (2010) The *Caenorhabditis elegans* germ line regulates distinct signaling pathways to control lifespan and innate immunity. *Journal of Biological Chemistry*, 285, 1822–1828.

Al-Regaiey, K. A., Masternak, M. M., Bonkowski, M. S., Panici, J. A., Kopchick, J. J. & Bartke, A. (2007) Effects of caloric restriction and growth hormone resistance on insulin-related intermediates in the skeletal muscle. *Journal of Gerontology A*, 62, 18–26.

Amador-Cano, G., Carpizo-Ituarte, E. & Cristino-Jorge, D. (2006) Role of protein kinase C, G-protein coupled receptors, and calcium flux during metamorphosis of the sea urchin *Strongylocentrotus purpuratus*. *Biological Bulletin*, 210, 121–131.

Amador-Noguez, D., Dean, A., Huang, W., Setchell, K., Moore, D. & Darlington, G. (2007) Alterations in xenobiotic metabolism in the long-lived Little mice. *Aging Cell*, 6, 453–470.

Amdam, G. V. & Omholt, S. W. (2003) The hive bee to forager transition in honeybee colonies: the double repressor hypothesis. *Journal of Theoretical Biology*, 223, 451–464.

Amdam, G. V. & Page, R. E. J. (2005) Intergenerational transfers may have decoupled physiological and chronological age in a eusocial insect. *Aging Research Reviews*, 4, 398–408.

Amdam, G. V., Norberg, K., Fondrk, M. K. & Page, R. E. J. (2004) Reproductive ground plan may mediate colony-level selection effects on individual foraging behavior in honey bees. *Proceedings of the National Academy of Sciences of the United States of America*, 101, 11350–11355.

Amdam, G. V., Aase, A. L., Seehuus, S. C., Fondrk, M. K., Norberg, K. & Hartfelder, K. (2005) Social reversal of immunosenescence in honey bee workers. *Experimental Gerontology*, 40, 939–947.

Amdam, G. V., Norberg, K., Page, R. E. J., Erber, J. & Scheiner, R. (2006) Downregulation of vitellogenin gene activity increases the gustatory responsiveness of honey bee workers (*Apis mellifera*). *Behavioural Brain Research*, 169, 201–205.

Amdam, G. V., Nilsen, K. A., Norberg, K., Fondrk, M. K. & Hartfelder, K. (2007) Variation in endocrine signaling underlies variation in social life history. *The American Naturalist*, 170, 37–46.

Amdam, G. V., Ihle, K. E. & Page, R. E. J. (2009a) Regulation of honey bee (*Apis mellifera*) life histories by vitellogenin. In Pfaff, D., Arnold, A., Etgen, A., Fahrbach, S. E. & Rubin, R. (Eds.) *Hormones, Brains and Behavior*. 2 ed. San Diego, CA, Elsevier Academic Press.

Amdam, G. V., Rueppell, O., Fondrk, M. K., Page, R. E. J. & Nelson, C. M. (2009b) The nurse's load: early-life exposure to brood-rearing affects behavior and lifespan in honey bees (*Apis mellifera*). *Experimental Gerontology*, 44, 467–471.

Ament, S. A., Corona, M., Pollock, H. S. & Robinson, G. E. (2008) Insulin signaling is involved in the regulation of worker division of labor in honey bee colonies. *Proceedings of the National Academy of Sciences of the United States of America*, 105, 4226–4231.

Andersen, C. H., Jensen, C. S. & Petersen, K. (2004) Similar genetic switch systems might integrate the floral inductive pathways in dicots and monocots. *Trends in Plant Science*, 9, 105–107.

Anderson, K., Rosner, W., Khan, M., New, M., Pang, S., Wissel, P., & Kappas, A. (1987) Diet-hormone interactions: protein/carbohydrate ratio alters reciprocally the plasma levels of testosterone and cortisol and their respective binding globulins in man. *Life Sciences*, 40, 1761–1768.

Andreelli, F., Hanaire-Broutin, H., Laville, M., Tauber, J. P., Riou, J. P. & Thivolet, C. (2000) Normal reproductive function in leptin-deficient patients with lipoatropic diabetes. *Journal of Clinical Endocrinology and Metabolism* 85, 715–719.

Andrews, Z. B. & Horvath, T. L. (2009) Uncoupling protein-2 regulates lifespan in mice. *American Journal of Physiology. Endocrinology and Metabolism*, 296, E621–E627.

Andries, J. C. (1979) Effect of exogenous JHI on imaginal determination in *Aeshna cyanea*. *Journal of Insect Physiology*, 25, 261–267.

Angelo, G. & Van Gilst, M. R. (2009) Starvation protects germline stem cells and extends reproductive longevity in *C. elegans*. *Science*, 326, 954–958.

Angilletta, M. J., Steury, T. D. & Sears, M. W. (2004) Temperature, growth rate, and body size in ectotherms: Fitting pieces of a life history puzzle. *Integrative and Comparative Biology*, 44, 498–509.

Anstey, M. L., Rogers, S. M., Ott, S. R., Burrows, M. & Simpson, S. J. (2009) Serotonin mediates behavioral gregarization underlying swarm formation in desert locusts. *Science*, 323, 627–630.

Antebi, A., Culotti, J. G. & Hedgecock, E. M.(1998) daf-12 regulates developmental age and the dauer alternative in *C. elegans*. *Development*, 125, 1191–1205.

Antebi, A. (2006) Nuclear hormone receptors in *C. elegans*. In The *C. elegans* Research Community (Ed.), *WormBook*, doi/10.1895/wormbook.1.7.1, http://www.wormbook.org.

Apfeld, J. & Kenyon, C. (1999) Regulation of lifespan by sensory perception in *Caenorhabditis elegans*. *Nature*, 402, 804–809.

Apfeld, J., O'Connor, G., McDonagh, T., Distefano, P. S. & Curtis, R. (2004) The AMP-activated protein kinase AAK-2 links energy levels and insulin-like signals to lifespan in *C. elegans*. *Genes & Development*, 18, 3004–3009.

Apidianakis, Y., Mindrinos, M. N., Xiao, W., Lau, G. W., Baldini, R. L., Davis, R. W. & Rahme, L. G. (2005) Profiling early infection responses: *Pseudomonas aeruginosa* eludes host defenses by suppressing antimicrobial peptide gene expression. *Proceedings of the National Academy of Sciences of the United States of America*, 102, 2573–2578.

Appelmans, N. (1994) Sites of particle selection determined from observations of individual feeding larvae of the sand dollar *Dendraster excentricus*. *Limnology and Oceanography*, 39, 404–411.

Apter, D., Raisanen, I., Ylostalo, P. & Vihko, R. (1987) Follicular growth in relation to serum hormonal patterns in adolescents compared with adult menstrual cycles. *Fertility and Sterility*, 47, 82–88.

Aragona, B. J., Liu, Y., Curtis, J. T., Stephan, F. K. & Wang, Z. (2003) A critical role for nucleus accumbens dopamine in partner-preference formation in male prairie voles. *Journal of Neuroscience* 23, 3483–3490.

Arai, M. N. (1997) *A Functional Biology of Scyphozoa*. London, Chapman and Hall.

Arantes-Oliveira, N., Apfeld, J., Dillin, A. & Kenyon, C. (2002) Regulation of life-span by germ-line stem cells in *Caenorhabditis elegans*. *Science*, 295, 502–505.

Archer, J. (2006) Testosterone and human aggression: an evaluation of the challenge hypothesis. *Neuroscience and Biobehavioral Reviews*, 30, 319–345.

Archer, M. A., Phelan, J. P., Beckman, K. A. & Rose, M. R. (2003) Breakdown in correlations during laboratory evolution. II. Selection on stress resistance in *Drosophila* populations. *Evolution*, 57, 536–543.

Arking, R. & Giroux, C. (2001) Antioxidant genes, hormesis, and demographic longevity. *Journal of Anti-Aging Medicine*, 4, 125–136.

Arking, R. A., Burde, V., Graves, K., Hari, R., Feldmand, E., Zeevi, A., Soliman, S., Araiya, A., S., B., Vettraino, J., Sathrasala, K., Wehr, N. & Levine, R. L. (2000) Forward and reverse selection for longevity in *Drosophila* is characterized by alteration of antioxidant gene expression and oxidative damage pattern. *Experimental Gerontology*, 35, 167–185.

Arlotti, J. P., Cottrell, B. H., Lee, S. H. & Curtin, J. J. (1998) Breastfeeding among low-income women with and without peer support. *Journal of Community Health Nursing*, 15, 163–178.

Arlt, W., Martens, J. W., Song, M., Wang, J. T., Auchus, R. J. & Miller, W. L. (2002) Molecular evolution of adrenarche: structural and functional analysis of p450c17 from four primate species. *Endocrinology*, 143, 4665–4672.

Armstrong, N. & McClay, D. R. (1994) Skeletal pattern is specified autonomously by the primary mesenchyme cells in sea urchin embryos. *Developmental Biology*, 162, 329–338.

Armstrong, N., Hardin, J. & McClay, D. R. (1993) Cell–cell interactions regulate skeleton formation in the sea urchin embryo. *Development*, 119, 833–840.

Arnold, S. J. (1981) Behavioral variation in natual-populations II. The inheritance of feeding response in crosses between geographic races of the garter snake, *Thamnophis elegans*. *Evolution*, 35, 510–515.

Arquier, N., Geminard, C., Bourouis, M., Jarretou, G., Honegger, B., Paix, A. & Leopold, P. (2008) *Drosophila* ALS regulates growth and metabolism through functional interaction with insulin-like peptides *Cell Metabolism*, 7, 333–338.

Arum, O. & Johnson, T. E. (2007) Reduced expression of the *Caenorhabditis elegans* p53 ortholog cep-1 results in increased longevity. *Journal of Gerontology A* 62, 951–959.

Ashizawa, K. & Cheng, S. Y. (1992) Regulation of thyroid hormone receptor-mediated transcription by a cytosol protein. *Proceedings of the National Academy of Sciences of the United States of America*, 89, 9277–9281.

Ashizawa, K., McPhie, P., Lin, K. H. & Cheng, S. Y. (1991) An *in vitro* novel mechanism of regulating the activity of pyruvate kinase M2 by thyroid hormone and fructose 1, 6-bisphosphate. *Biochemistry*, 30, 7105–7111.

Ashok, M., Turner, C. & Wilson, T. G. (1998) Insect juvenile hormone resistance gene homology with the bHLH-PAS family of transcriptional regulators. *Proceedings of the National Academy of Sciences of the United States of America*, 95, 2761–2766.

Atkinson, D. (1994) Temperature and organism size – a biological law for Ectotherms. *Advances in Ecological Research*, 25, 1–58.

Attardo, G. M., Hansen, I. A. & Raikhel, A. S. (2005) Nutritional regulation of vitellogenesis in mosquitoes: Implications for anautogeny. *Insect Biochemistry & Molecular Biology*, 35, 661–675.

Atwell, S., Huang, Y. S., Vilhjalmsson, B. J., Willems, G., Horton, M., Li, Y., Meng, D., Platt, A., Tarone, A. M., Hu, T. T., Jiang, R., Muliyati, N. W., Zhang, X., Amer, M. A., Baxter, I., Brachi, B., Chory, J., Dean, C., Debieu, M., De Meaux, J., Ecker, J. R., Faure, N., Kniskern, J. M., Jones, J. D., Michael, T., Nemri, A., Roux, F., Salt, D. E., Tang, C., Todesco, M., Traw, M. B., Weigel, D., Marjoram, P., Borevitz, J. O., Bergelson, J. & Nordborg, M. (2010) Genome-wide association study of 107 phenotypes in *Arabidopsis thaliana* inbred lines. *Nature*, 465, 627–31.

Aubert, F. & Shine, R. (2009) Genetic assimilation and the postcolonization erosion of phenotypic plasticity in island tiger snakes. *Current Biology*, 19, 1932–1936.

Aukerman, M. J., Hirschfeld, M., Wester, L., Weaver, M., Clack, T., Amasino, R. M. & Sharrock, R. A. (1997) A deletion in the PHYD gene of the *Arabidopsis* Wassilewskija ecotype defines a role for phytochrome D in red/far-red light sensing. *Plant Cell*, 9, 1317–1326.

Austad, S. N. (1989) Life extension by dietary restriction in the bowl and doily spider, *Frontinella pyramitela*. *Experimental Gerontology*, 24, 83–92.

Austad, S. N. (1997) Comparative aging and life histories in mammals. *Experimental Gerontology*, 32, 23–38.

Austad, S. N. (1999) *Why we age: what science is discovering about the body's journey through life*. New York, Wiley.

Austad, S. N. & Finch, C. E. (2008) The evolutionary context of human aging and degenerative disease. In Stearns, S. C. & Koella, J. C. (Eds.) *Evolution in Health and Disease*. Oxford, Oxford University Press.

Austad, S. N. & Fischer, K. E. (1992) Primate longevity: its place in the mammalian scheme. *American Journal of Primatology*, 28, 251–261.

Averof, M. & Patel, N. H. (1997) Crustacean appendage evolution associated with changes in Hox gene expression. *Nature*, 388, 682–686.

Ayre, D. J. (1983) The effects of asexual reproduction and inter-genotypic aggression on the genotypic structure of populations of the sea anemone *Actinia tenebrosa*. *Oecologia*, 57, 158–165.

Ayres, J. S. & Schneider, D. S. (2008) A signaling protease required for melanization in *Drosophila* affects resistance and tolerance of infections. *PLoS Biology*, 6, 2764–2773.

Ayson, F. G. & Lam, T. J. (1993) Thyroxine injection of female rabbitfish (*Siganus guttatus*) broodstock: Changes in thyroid hormone levels in plasma, eggs, and yolk-sac larvae, and its effect on larval growth and survival. *Aquaculture*, 109, 83–93.

Babin, P. J. (1992) Binding of thyroxine and 3,5,3′-triiodothyronine to trout plasma lipoproteins. *American Journal of Physiology. Cell Physiology*, 262, E712–E720.

Badyaev, A. V. & Vleck, C. M. (2007) Context-dependent development of sexual ornamentation: implications for a trade-off between current and future breeding efforts. *Journal of Evolutionary Biology*, 20, 1277–1287.

Bagatell, C. J. & Bremner, W. J. (1990) Sperm counts and reproductive hormones in male marathoners and lean controls. *Fertility and Sterility*, 53, 688–692.

Baker, B. S. & Tata, J. R. (1990) Accumulation of proto-oncogene c-erb-A related transcripts during *Xenopus* development: association with early acquisition of response to thyroid hormone and estrogen. *EMBO Journal*, 9, 879–885.

Baker, B. S. & Tata, J. R. (1992) Prolactin prevents the autoinduction of thyroid hormone receptor mRNAs during amphibian metamorphosis. *Developmental Biology*, 149, 463–467.

Baker, J., Liu, J. P., Robertson, E. J. & Efstratiadis, A. (1993) Role of insulin-like growth factors in embryonic and postnatal growth. *Cell*, 75, 73–82.

Bakker, W. J., Harris, I. S. & Mak, T. (2007) FOXO3a is activated in response to hypoxic stress and inhibits HIF1-induced apoptosis via regulation of CITED2. *Molecular Cell*, 28, 941–953.

Balaban, R. S., Nemoto, S. & Finkel, T. (2005) Mitochondria, oxidants, and aging. *Cell*, 120, 483–495.

Balasubramanian, S., Sureshkumar, S., Agrawal, M., Michael, T. P., Wessinger, C., Maloof, J. N., Clark, R., Warthmann, N., Chory, J. & Weigel, D. (2006) The *PHYTOCHROME C* photoreceptor gene mediates natural variation in flowering and growth responses of *Arabidopsis thaliana*. *Nature Genetics*, 38, 711–715.

Baldal, E. A., Baktawar, W., Brakefield, P. M. & Zwaan, B. J. (2006) Methuselah life history in a variety of conditions, implications for the use of mutants in longevity research. *Experimental Gerontology*, 41, 1126–1135.

Bales, K. L., Kim, A. J., Lewis-Reese, A. D. & Carter, C. S. (2004) Both oxytocin and vasopressin may influence alloparental behavior in male prairie voles. *Hormones and Behavior*, 45, 354–361.

Ballard, P. L. (1979) Glucocorticoids and differentiation. In Baxter, J. D. & Rousseau, G. G. (Eds.) *Glucocorticoid Hormone Action*. New York, Springer.

Balon, E. K. (1999) Alternative ways to become a juvenile or a definitive phenotype (and on some persisting linguistic offenses). *Environmental Biology of Fishes*, 56, 17–38.

Balthazart, J., Baillien, M., Charlier, T. D., Cornil, C. A. & Ball, G. F. (2003) Multiple mechanisms control brain aromatase activity at the genomic and non-genomic level. *Journal of Steroid Biochemistry & Molecular Biology*, 86, 367–379.

Barbieri, M., Bonafe, M., Franceschi, C. & Paolisso, G. (2003) Insulin/IGF-1-signaling pathway: an evolutionarily conserved mechanism of longevity from yeast to humans. *American Journal of Physiology – Endocrinology and Metabolism*, 285, E1064–E1071.

Barchuk, A. R., Cristino, A. S., Kucharski, R., Costa, L. F., Simoes, Z. L. & Maleszka, R. (2007) Molecular determinants of caste differentiation in the highly eusocial honeybee *Apis mellifera*. *BMC Developmental Biology*, 7, 70.

Barger, J. L., Kayo, T., Vann, J. M., Arias, E. B., Wang, J., Hacker, T. A., Wang, Y., Raederstorff, D., Morrow, J. D., Leeuwenburgh, C., Allison, D. B., Saupe, K. W., Cartee, G. D., Weindruch, R. & Prolla, T. A. (2008) A low dose of dietary resveratrol partially mimics caloric restriction and retards aging parameters in mice. *PLoS One*, 3, e2264.

Bargmann, C.I. (2006) Chemosensation in *C. elegans*. In The *C. elegans* Research Community (Ed.), *WormBook*, doi/10.1895/wormbook.1.7.1, http://www.wormbook.org.

Barja, G. (2002) Endogenous oxidative stress: relationship to aging, longevity and caloric restriction. *Aging Research Reviews*, 1, 397–411.

Barja, G. (2004) Aging in vertebrates, and the effect of caloric restriction: a mitochondrial free radical production-DNA damage mechanism? *Biological Reviews of the Cambridge Philosophical Society*, 79, 235–251.

Barnes, A. I. & Partridge, L. (2003) Costing reproduction. *Animal Behaviour*, 66, 199–204.

Barnes, A. I., Boone, J. M., Jacobson, J., Partridge, L. & Chapman, T. (2006) No extension of lifespan by ablation of germ line in *Drosophila*. *Proceedings of the Royal Society of London B* 273, 939–947.

Barnes, A. I., Wigby, S., Boone, J. M., Partridge, L. & Chapman, T. (2008) Feeding, fecundity and lifespan in female *Drosophila melanogaster*. *Proceedings of the Royal Society of London B*, 275, 1675–1683.

Barrett, R. D. H., Rogers, S. M. & Schluter, D. (2008) Natural selection on a major armor gene in threespine stickleback. *Science*, 322, 255–257.

Barron, A. B., Maleszka, R., Vander Meer, R. K. & Robinson, G. E. (2007) Octopamine modulates honey bee dance behavior. *Proceedings of the National Academy of Sciences of the United States of America*, 104, 1703–1707.

Bartels, A. & Zeki, S. (2004) The neural correlates of maternal and romantic love. NeuroImage *NeuroImage*, 21, 1155–1166.

Bartke, A. (2008a) Impact of reduced insulin-like growth factor-1/insulin signaling on aging in mammals: novel findings. *Aging Cell*, 7, 285–290.

Bartke, A. (2008b) New findings in gene knockout, mutant and transgenic mice. *Experimental Gerontology*, 43, 11–14.

Bartke, A. (2008c) Insulin and aging. *Cell Cycle*, 7, 3338–3343.

Bartke, A., Wright, J. C., Mattison, J. A., Ingram, D. K., Miller, R. A. & Roth, G. S. (2001) Extending the lifespan of long-lived mice. *Nature*, 414, 412.

Bartke, A., Bonkowski, M. & Masternak, M. (2008) How diet interacts with longevity genes. *Hormones*, 7, 17–23.

Barzilai, N. & Bartke, A. (2009) Biological approaches to mechanistically understand the healthy lifespan extension achieved by calorie restriction and modulation of hormones. *Journal of Gerontology A* 64, 187–191.

Bass, T. M., Weinkove, D., Houthoofd, K., Gems, D. & Partridge, L. (2007) Effects of resveratrol on lifespan in *Drosophila melanogaster* and *Caenorhabditis elegans*. *Mechanisms of Ageing and Development*, 128, 546–552.

Bauer, J. H. & Helfand, S. L. (2006) New tricks of an old molecule: lifespan regulation by p53. *Aging Cell*, 5, 437–440.

Bauer, J. H., Poon, P. C., Glatt-Deeley, H., Abrams, J. M. & Helfand, S. L. (2005) Neuronal expression of p53 dominant-negative proteins in adult *Drosophila melanogaster* extends life span. *Current Biology*, 15, 2063–2068.

Bauer, J. H., Chang, C., Morris, S. N., Hozier, S., Andersen, S., Waitzman, J. S. & Helfand, S. L. (2007) Expression of dominant-negative Dmp53 in the adult fly brain inhibits insulin signaling. *Proceedings of the National Academy of Sciences of the United States of America*, 104, 13355–13360.

Bauer, J. H., Morris, S. N., Chang, C., Flatt, T., Wood, J. G. & Helfand, S. L. (2009) dSir2 and Dmp53 interact to mediate aspects of CR-dependent, lifespan extension in *D. melanogaster*. *Aging*, 1, 38–48.

Bauer, J. H., Chang, C., Bae, G., Morris, S. N., & Helfand, S. L. (2010). Dominant-negative Dmp53 extends life span through the dTOR pathway in *D. melanogaster*. *Mechanisms of Ageing and Development*, 131, 193–201.

Baumeister, R. F. (2005) *The Cultural Animal: Human Nature, Meaning, and Social Life*. New York, Oxford University Press.

Baur, J. A. & Sinclair, D. A. (2008) What is xenohormesis? *American Journal of Pharmacology and Toxicology*, 3, 152–159.

Baur, J. A., Pearson, K. J., Price, N. L., Jamieson, H. A., Lerin, C., Kalra, A., Prabhu, V. V., Allard, J. S., Lopez-Lluch, G., Lewis, K., Pistell, P. J., Poosala, S., Becker, K. G., Boss, O., Gwinn, D., Wang, M., Ramaswamy, S., Fishbein, K. W., Spencer, R. G., Lakatta, E. G., Le Couteur, D., Shaw, R. J., Navas, P., Puigserver, P., Ingram, D. K., De Cabo, R. & Sinclair, D. A. (2006) Resveratrol improves health and survival of mice on a high-calorie diet. *Nature*, 444, 337–342.

Baxter, G. & Morse, D. E. (1987) G-Protein and diacylglycerol regulate metamorphosis of planktonic Molluscan larvae. *Proceedings of the National Academy of Sciences of the United States of America*, 84, 1867–1870.

Bayer, C. A., Holley, B., and Fristrom, J.W. (1996) A switch in broad-complex Zinc-finger isoform expression is regulated post-transcriptionally during the metamorphosis of *Drosophila* imaginal discs. *Developmental Biology*, 177(1), 1–14.

Beadle, G., Tatum, E. & Clancy, C. (1938) Food level in relation to rate of development and eye pigmentation in *Drosophila melanogaster*. *Biological Bulletin*, 75, 447–462.

Beavis, W. D. (1994) The power and deceit of QTL experiments: lessons from comparative QTL studies. In Wilkison D. B. (Ed.) *49th Annual Corn and Sorghum Industry Research Conference*. American Seed Trade Association, Chicago.

Becker, K. B., Stephens, K. C., Davey, J. C., Schneider, M. J. & Galton, V. A. (1997) The type 2 and type 3 iodothyronine deiodinases play important roles in coordinating development in *Rana catesbeiana* tadpoles. *Endocrinology*, 138, 2989–2997.

Becker, T., Loch, G., Beyer, M., Zinke, I., Aschenbrenner, A. C., Carrera, P., Inhester, T., Schultze, J. L. & Hoch, M. (2010) FOXO-dependent regulation of innate immune homeostasis. *Nature*, 463, 369–373.

Behrends, A., Scheiner, R., Baker, N. & Amdam, G. V. (2007) Cognitive aging is linked to social role in honey bees (*Apis mellifera*). *Experimental Gerontology*, 42, 1146–1153.

Bell, G. (1985) The origin and early evolution of germ cells as illustrated by the Volvocales. In Halvorson, H. O. & Monroy A. (Eds.) *The Origin and Evolution of Sex*. Alan R. Liss, New York, pp. 221–256.

Bell, G. & Koufopanou, V. (1986) The cost of reproduction. In Dawkins, R. & Ridley, M. (Eds.) *Oxford Surveys in Evolutionary Biology*. Oxford, Oxford University Press.

Bell, R., Hubbard, A., Chettier, R., Chen, D., Miller, J. P., Kapahi, P., Tarnopolsky, M., Sahasrabuhde, S., Melov, S. & Hughes, R. E. (2009) A human protein interaction network shows conservation of aging processes between human and invertebrate species. *PLoS Genetics*, 5, e1000414.

Bellen, H. J., Vaessin, H., Bier, E., Kolodkin, A., Develyn, D., Kooyer, S. & Jan, Y. N. (1992) The *Drosophila couch potato* gene: an essential gene required for normal adult behavior. *Genetics*, 131, 365–375.

Belles, X. (2010) Beyond *Drosophila*: RNAi *in vivo* and functional genomics in insects. *Annual Review of Entomology*, 55, 111–128.

Bellizzi, D., Rose, G., Cavalcante, P., Covello, G., Dato, S., De Rango, F., Greco, V., Maggiolini, M., Feraco, E., Mari, V., Franceschi, C., Passarino, G. & De Benedictis, G. (2005) A novel VNTR enhancer within the SIRT3 gene, a human homologue of SIR2, is associated with survival at oldest ages. *Genomics*, 85, 258–263.

Belsky, J. (1997) Attachment, mating, and parenting: An evolutionary interpretation. *Human Nature*, 8, 361–381.

Belsky, J. (2005) Differential susceptibility to rearing influence: An evolutionary hypothesis and some evidence. In Ellis, B. J. & Bjorklund, D. F. (Eds.) *Origins of the Social Mind: Evolutionary Psychology and Child Development*. New York, Guilford Press.

Bely, A. E. & Nyberg, K. G. (2010) Evolution of animal regeneration: re-emergence of a field. *Trends in Ecology & Evolution*, 25, 161–170.

Belyaeva, E. S., Aizenzon, M. G., Semeshin, V. F., Kiss, I. I., Koczka, K., Baritcheva, E. M., Gorelova, T. D. and Zhimulev, I. F. (1980) Cytogenic analysis of the 2B3-4-2B11 region of the X chromosome of *Drosophila melanogaster*. I. Cytology of the region and mutant complementation groups. *Chromosoma*, 81, 281–306.

Bensaad, K., Tsuruta, A., Selak, M. A., Vidal, M. N., Nakano, K., Bartrons, R., Gottlieb, E. & Vousden, K. H.

(2006) TIGAR, a p53-inducible regulator of glycolysis and apoptosis. *Cell*, 126, 107–120.

Ben-Shahar, Y., Robichon, A., Sokolowski, M. B. & Robinson, G. E. (2002) Influence of gene action across different time scales on behavior. *Science*, 296, 741–744.

Ben-Shahar, Y., Leung, H. T., Pak, W. L., Sokolowski, M. B. & Robinson, G. E. (2003) cGMP-dependent changes in phototaxis: a possible role for the foraging gene in honey bee division of labor. *Journal of Experimental Biology*, 206, 2507–2515.

Ben-Shahar, Y., Dudek, N. L. & Robinson, G. E. (2004) Phenotypic deconstruction reveals involvement of manganese transporter malvolio in honey bee division of labor. *Journal of Experimental Biology*, 207, 3281–3288.

Bentley, G. R., Harrigan, A. M., Campbell, B. & Ellison, P. T. (1993) Seasonal effects on salivary testosterone levels among Lese males of the Ituri Forest, Zaire. *American Journal of Human Biology*, 5, 711–717.

Berdichevsky, A., Viswanathan, M., Horvitz, H. R. & Guarente, L. (2006) *C. elegans* SIR-2.1 interacts with 14-3-3 proteins to activate DAF-16 and extend life span. *Cell*, 125, 1165–1177.

Berenos, C., Schmid-Hempel, P. & Wegner, K. M. (2009) Evolution of host resistance and trade-offs between virulence and transmission potential in an obligately killing parasite. *Journal of Evolutionary Biology*, 22, 2049–2056.

Berg, B. N. & Simms, H. S. (1960) Nutrition and longevity in the rat. II. Longevity and onset of disease with different levels of food intake. *Journal of Nutrition*, 71, 255–263.

Berger, D., Walters, R. & Gotthard, K. (2008) What limits insect fecundity? Body size- and temperature-dependent egg maturation and oviposition in a butterfly. *Functional Ecology*, 22, 523–529.

Bergland, A. O., Agotsch, M., Mathias, D., Bradshaw, W. E. & Holzapfel, C. M. (2005) Factors influencing the seasonal life history of the pitcher-plant mosquito, *Wyeomyia smithii*. *Ecological Entomology*, 30, 129–137.

Bergland, A. O., Genissel, A., Nuzhdin, S. V. & Tatar, M. (2008) Quantitative trait loci affecting phenotypic plasticity and the allometric relationship of ovariole number and thorax length in *Drosophila melanogaster*. *Genetics*, 180, 567–582.

Bergot, B. J., Baker, F. C., Cerf, D. C., Jamieson, G. & Schooley, D. A. (1981) Qualitative and quantitative aspects of juvenile hormone titers in developing embryos of several insect species: discovery of a new Jh-like substance extracted from eggs of *Manduca sexta*. In Pratt, G. E. & Brooks, G. T. (Eds.) *Juvenile Hormone Biochemistry*. Amsterdam, Elsevier.

Berking, S., Czech, N., Gerharz, M., Herrmann, K., Hoffmann, U., Raifer, H., Sekul, G., Siefker, B., Sommerei, A. & Vedder, F. (2005) A newly discovered oxidant defence system and its involvement in the development of *Aurelia aurita* (Scyphozoa, Cnidaria): reactive oxygen species and elemental iodine control medusa formation. *International Journal of Developmental Biology*, 49, 969–976.

Berman, J. R. & Kenyon, C. (2006) Germ-cell loss extends *C. elegans* lifespan through regulation of DAF-16 by *kri-1* and lipophilic-hormone signaling. *Cell*, 124, 1055–1068.

Berreur, P., Porcheron, P., Berreur-Bonnenfant, J. & Simpson, P. (1979) Ecdysteroid levels and pupariation in *Drosophila melanogaster*. *Journal of Experimental Zoology*, 210, 347–352.

Bertram, D. F. & Strathmann, R. R. (1998) Effects of larval and maternal nutrition on growth and form of planktotrophic larvae. *Ecology*, 79, 315–327.

Bertram, D. F., Phillips, N. E. & Strathmann, R. R. (2009) Evolutionary and experimental change in egg volume, heterochrony of larval body and juvenile rudiment, and evolutionary reversibility in pluteus form. *Evolution & Development*, 11, 728–739.

Bertrand, J. F. & Woollacott, R. M. (2003) G protein-linked receptors and induction of metamorphosis in *Bugula stolonifera* (Bryozoa). *Invertebrate Biology*, 122, 380–385.

Berwaerts, K., Matthysen, E. & Van Dyck, H. (2008) Take-off flight performance in the butterfly *Pararge aegeria* relative to sex and morphology: a quantitative genetic assessment. *Evolution*, 62, 2525–2533.

Bethke, A., Fielenbach, N., Wang, Z., Mangelsdorf, D. J. & Antebi, A. (2009) Nuclear hormone receptor regulation of microRNAs controls developmental progression. *Science*, 324, 95–98.

Bhaskaran, G., Sparagana, S.P., Barrera, P. and Dahm, K.H. (1986) Change in *corpus allatum* function during metamorphosis of the tobacco hornworm, *Manduca sexta*. *Archives of Insect Biochemistry and Physiology* 3, 321–338.

Bianco, A. C., Salvatore, D., Gereben, B., Berry, M. J. & Larsen, P. R. (2002) Biochemistry, cellular and molecular biology, and physiological roles of the iodothyronine selenodeiodinases. *Endocrine Reviews*, 23, 38–89.

Bickler, P. E. & Buck, L. T. (2007) Hypoxia tolerance in reptiles, amphibians, and fishes: Life with variable oxygen availability. *Annual Review of Physiology*, 69, 145–170.

Biggers, W. J. & Laufer, H. (1999) Settlement and metamorphosis of Capitella larvae induced by juvenile hormone-active compounds is mediated by protein kinase C and ion channels. *Biological Bulletin*, 196, 187–198.

Bimbaum, K. D. & Sanchez Alvarado, A. (2008) Slicing across kingdoms: Regeneration in plants and animals. *Cell*, 132, 697–710.

Birnby, D. A., Link, E. M., Vowels, J. J., Tian, H., Colacurcio, P. L. & Thomas, J. H. (2000) A transmembrane guanylyl cyclase (DAF-11) and Hsp90 (DAF-21) regulate a common set of chemosensory behaviors in *C. elegans*. *Genetics*, 155, 85–104.

Bisgrove, B. W. & Burke, R. D. (1986) Development of Serotonergic neurons in embryos of the sea urchin, *Strongylocentrotus purpuratus*. *Development, Growth & Differentiation*, 28, 569–574.

Bisgrove, B. W. & Burke, R. D. (1987) Development of the nervous system of the pluteus larva of *Strongylocentrotus droebachiensis*. *Cell and Tissue Research*, 248, 335–343.

Bishop, N. A. & Guarente, L. (2007a) Genetic links between diet and lifespan: shared mechanisms from yeast to humans. *Nature Reviews Genetics*, 8, 835–844.

Bishop, N. A. & Guarente, L. (2007b) Two neurons mediate diet-restriction-induced longevity in *C. elegans*. *Nature*, 447, 545–549.

Bishop, C. D. & Hall, B. K. (2009) Sniffing out new data and hypotheses on the form, function, and evolution of the Echinopluteus post-oral vibratile lobe. *Biological Bulletin*, 216, 307–321.

Bishop, C. D., Erezyilmaz, D. F., Flatt, T., Georgiou, C. D., Hadfield, M. G., Heyland, A., Hodin, J., Jacobs, M. W., Maslakova, S. A., Pires, A., Reitzel, A. M., Santagata, S., Tanaka, K. & Youson, J. H. (2006a) What is metamorphosis? *Integrative and Comparative Biology*, 46, 655–661.

Bishop, C. D., Huggett, M., Heyland, A., Hodin, J. & Brandhorst, B. P. (2006b) Interspecific variation in metamorphic competence in marine invertebrates: the significance for comparative investigations of regulatory systems. *Integrative and Comparative Biology*, 46, 662–682.

Bjedov, I., Toivonen, J. M., Kerr, F., Slack, C., Jacobson, J., Foley, A. & Partridge, L. (2010) Mechanisms of lifespan extension by rapamycin in the fruit fly *Drosophila melanogaster*. *Cell Metabolism*, 11, 35–46.

Bjorklund, D. F. & Pellegrini, A. D. (2002) *The Origins of Human Nature: Evolutionary developmental psychology*. Washington, APA Press.

Black, R. E. & Bloom, L. (1984) Heat shock proteins in *Aurelia* (Cnidaria, Scyphozoa). *Journal of Experimental Zoology*, 230, 303–307.

Blackstone, N. W. (1999) Redox control in development and evolution: Evidence from colonial hydroids. *Journal of Experimental Biology*, 202, 3541–3553.

Blackstone, N. W. (2001) Redox state, reactive oxygen species and adaptive growth in colonial hydroids. *Journal of Experimental Biology*, 204, 1845–1853.

Blackstone, N. W. (2003) Redox signaling in the growth and development of colonial hydroids. *Journal of Experimental Biology*, 206, 651–658.

Blackstone, N. W. (2006) Multicellular redox regulation: integrating organismal biology and redox chemistry. *BioEssays*, 28, 72–77.

Blackstone, N. W. (2008) Metabolic gradients: A new system for old questions. *Current Biology*, 18, R351–R353.

Blackstone, N. W. & Bridge, D. M. (2005) Model systems for environmental signaling. *Integrative and Comparative Biology*, 45, 605–614.

Blackstone, N. W. & Jasker, B. D. (2003) Phylogenetic considerations of clonality, coloniality, and mode of germline development in animals. *Journal of Experimental Zoology B* 297B, 35–47.

Blackstone, N. W., Cherry, K. S. & Glockling, S. L. (2004a) Structure and signaling in polyps of a colonial hydroid. *Invertebrate Biology*, 123, 43–53.

Blackstone, N. W., Cherry, K. S. & Van Winkle, D. H. (2004b) The role of polyp-stolon junctions in the redox signaling of colonial hydroids, *Hydrobiologia*, 530, 291–298 (8).

Blakemore, S.-J., Winston, J. & Frith, U. (2004) Social cognitive neuroscience: Where are we heading? *Trends in Cognitive Neurosciences*, 8, 216–222.

Blanton, M. L. & Specker, J. L. (2007) The hypothalamic–pituitary–thyroid (HPT) axis in fish and its role in fish development and reproduction. *Critical Reviews in Toxicology*, 37, 97–115.

Blount, Z. D., Borland, C. Z. & Lenski, R. E. (2008) Historical contingency and the evolution of a key innovation in an experimental population of *Escherichia coli*. *Proceedings of the National Academy of Sciences of the United States of America*, 105, 7899–7906.

Bluher, M., Kahn, B. B. & Kahn, C. R. (2003) Extended longevity in mice lacking the insulin receptor in adipose tissue. *Science*, 299, 572–574.

Bochdanovits, Z. & De Jong, G. (2003) Experimental evolution in *Drosophila melanogaster*: interaction of temperature and food quality selection regimes. *Evolution*, 57, 1829–1836.

Bochdanovits, Z. & De Jong, G. (2004) Antagonistic pleiotropy for life history traits at the gene expression level. *Proceedings of the Royal Society of London B*, 271, S75–S78.

Bode, H. R. (2003) Head regeneration in *Hydra*. *Developmental Dynamics*, 226, 225–236.

Bode, H. R. (2009) Axial patterning in *Hydra*. *Cold Spring Harbor Perspectives in Biology*, 1, a000463.

Bodkin, N. L., Alexander, T. M., Ortmeyer, H. K., Johnson, E. & Hansen, B. C. (2003) Mortality and morbidity in laboratory-maintained Rhesus monkeys and effects of long-term dietary restriction. *Journal of Gerontology A*, 58, 212–219.

Boesch, C. & H. Boesch-Achermann (2000) *The Chimpanzees of the Taï Forest: Behavioural ecology and evolution*. Oxford, Oxford University Press.

Boggs, C. L. (2009) Understanding insect life histories and senescence through a resource allocation lens. *Functional Ecology*, 23, 27–37.

Bogin, B. (1994) Adolescence in evolutionary perspective. *Acta Paediatrica*, 406, 29–35.

Bogin, B. (1999) Evolutionary perspective on human growth. *Annual Review of Anthropology*, 28, 109–153.

Boidron-Metairon, I. F. (1988) Morphological plasticity in laboratory-reared echinoplutei of *Dendraster excentricus* (Eschscholtz) and *Lytechinus variegatus* (Lamarck) in response to food conditions. *Journal of Experimental Marine Biology and Ecology*, 119, 31–41.

Boily, G., Seifert, E. L., Bevilacqua, L., He, X. H., Sabourin, G., Estey, C., Moffat, C., Crawford, S., Saliba, S., Jardine, K., Xuan, J., Evans, M., Harper, M. E. & McBurney, M. W. (2008) SirT1 regulates energy metabolism and response to caloric restriction in mice. *PLoS One*, 3, e1759.

Bókony, V., Lendvai, Á. Z., Liker, A., Angelier, F., Wingfield, J. C. & Chastel, O. (2009) Stress response and the value of reproduction: are birds prudent parents? *The American Naturalist*, 173, 589–598.

Bole-Feysot, C., Fgroffin, V., Edery, M., Binart, N. & Kelley, P. A. (1998) Prolactin (PRL) and its receptor: Actions, signal transduction pathways and phenotypes observed in PRL receptor knockout mice. *Endocrine Reviews*, 3, 225–268.

Bolker, J. A. (2000) Modularity in development and why it matters to evo-devo. *American Zoologist*, 40, 770–776.

Bollback, J. P. & Huelsenbeck, P. (2009) Parallel genetic evolution within and between bacteriophage species of varying degrees of divergence. *Genetics*, 181, 225–234.

Bolton, J. P., Collie, N. L., Kawauchi, H. & Hirano, T. (1987) Osmoregulatory actions of growth hormone in rainbow trout (*Salmo gairdneri*). *Journal of Endocrinology*, 112, 63–68.

Bonafe, M. & Olivieri, F. (2009) Genetic polymorphism in long-lived people: cues for the presence of an insulin/IGF-pathway-dependent network affecting human longevity. *Molecular and Cellular Endocrinology*, 299, 118–123.

Bonafe, M., Barbieri, M., Marchegiani, F., Olivieri, F., Ragno, E., Giampieri, C., Mugianesi, E., Centurelli, M., Franceschi, C. & Paolisso, G. (2003) Polymorphic variants of insulin-like growth factor I (IGF-1) receptor and phosphoinositide 3-kinase genes affect IGF-1 plasma levels and human longevity: cues for an evolutionarily conserved mechanism of lifespan control. *Journal of Clinical Endocrinology and Metabolism*, 88, 3299–3304.

Bonett, R. M. & Chippindale, P. T. (2004) Speciation, phylogeography and evolution of life history and morphology in plethodontid salamanders of the *Eurycea multiplicata* complex. *Molecular Ecology*, 13, 1189–1203.

Bonkowski, M. S., Rocha, J. S., Masternak, M. M., Al Regaiey, K. A. & Bartke, A. (2006) Targeted disruption of growth hormone receptor interferes with the beneficial actions of calorie restriction. *Proceedings of the National Academy of Sciences of the United States of America*, 103, 7901–7905.

Bonsall, M. B. & Mangel, M. (2009) Density dependence, lifespan and the evolutionary dynamics of longevity. *Theoretical Population Biology*, 75, 46–55.

Booth, A. G., Shelley, A., Mazur, G., Tharp, G. & Kittock, R. (1989) Testosterone and winning and losing in human competition. *Hormones and Behavior* 23, 556–571.

Boots, M. (2008) Fight or learn to live with the consequences? *Trends in Ecology & Evolution*, 23, 248–250.

Boraas, M. E., Seale, D. B. & Boxhorn, J. E. (1998) Phagotrophy by a flagellate selects for colonial prey: A possible origin of multicellularity. *Evolutionary Ecology*, 12, 153–164.

Bordone, L., Motta, M. C., Picard, F., Robinson, A., Jhala, U. S., Apfeld, J., McDonagh, T., Lemieux, M., McBurney, M., Szilvasi, A., Easlon, E. J., Lin, S. J. & Guarente, L. (2006) Sirt1 regulates insulin secretion by repressing UCP2 in pancreatic beta cells. *PLoS Biology*, 4, e31.

Bordone, L., Cohen, D., Robinson, A., Motta, M. C., Van Veen, E., Czopik, A., Steele, A. D., Crowe, H., Marmor, S., Luo, J., Gu, W. & Guarente, L. (2007) SIRT1 transgenic mice show phenotypes resembling calorie restriction. *Aging Cell*, 6, 759–767.

Bosch, T. C. G. (2003) Ancient signals: peptides and the interpretation of positional information in ancestral metazoans. *Comparative Biochemistry and Physiology B*, 136, 185–196.

Bosch, T. C. G., Krylow, S. M., Bode, H. R. & Steele, R. E. (1988) Thermotolerance and synthesis of heat shock proteins: these responses are present in *Hydra attenuata* but Absent in *Hydra oligactis*. *Proceedings of the National Academy of Sciences of the United States of America*, 85, 7927–7931.

Boulétreau-Merle, J., Allemand, R., Cohet, Y. & David, J. R. (1982) Reproductive strategy in *Drosophila melanogaster* – significance of a genetic-divergence between temperate and tropical populations. *Oecologia*, 53, 323–329.

Bourke, A. F. G. & Franks, N. F. (1995) *Social Evolution in Ants*. Princeton, NJ, Princeton University Press.

Bower, F. O. 1908. The Origin of a Land Flora. MacMillan & Co, London.

Bownes, M. (1982) NJ Hormonal and genetic regulation of vitellogenesis in *Drosophila*. *Quarterly Review of Biology*, 57, 247–274.

Bownes, M., Scott, A. & Shirras, A. (1988) Dietary components modulate yolk protein gene transcription in *Drosophila melanogaster*. *Development*, 103, 119–128.

Bownes, M., Ronaldson, E. & Mauchline, D. (1996) 20-hydroxyecdysone, but not juvenile hormone, regulation of yolk protein gene expression can be mapped to cis-acting DNA sequences. *Developmental Biology*, 173, 475–489.

Braby, M. F. (2002) Life history strategies and habitat templets of tropical butterflies in north-eastern Australia. *Evolutionary Ecology*, 16, 399–413.

Braby, M. F. & Jones, R. E. (1994) Effect of temperature and hostplants on survival, development and body-size in 3 tropical satyrine butterflies from North-Eastern Australia. *Australian Journal of Zoology*, 42, 195–213.

Bradshaw, W. E. (1976) Geography of photoperiodic response in a diapausing mosquito. *Nature*, 262, 384–386.

Bradshaw, W. E., Holzapfel, C. M. & Mathias, D. (2006) Circadian rhythmicity and photoperioidism in the pitcher-plant mosquito: can the seasonal timer evolve independently of the circadian clock? *The American Naturalist* 167, 601–605.

Brakefield, P. M. (2005) Bringing Evo Devo to Life. PLoS Biology, 3, e340.

Brakefield, P. M. & Frankino, W. A. (2009) Polyphenisms in Lepidoptera: Multidisciplinary approaches to studies of evolution. In Ananthakrishnan, T. N. & Whitman, D. W. (Eds.) *Phenotypic Plasticity in Insects: Mechanisms and Consequences*. Plymouth, Science Publishers, Inc.

Brakefield, P. M. & Larsen, T. B. (1984) The evolutionary significance of dry and wet season forms in some tropical butterflies. *Biological Journal of the Linnean Society*, 22, 1–12.

Brakefield, P. M. & Reitsma, N. (1991) Phenotypic plasticity, seasonal climate and the population biology of *Bicyclus* butterflies (Satyridae) in Malawi. *Ecological Entomology*, 16, 291–303.

Brakefield, P. M., Gates, J., Keys, D., Kesbeke, F., Wijngaarden, P. J. & Al, E. (1996) Development, plasticity and evolution of butterfly eyespot patterns. *Nature*, 384, 236–242.

Brakefield, P. M., Kesbeke, F. & Koch, P. B. (1998) The regulation of phenotypic plasticity of eyespots in the butterfly *Bicyclus anynana*. *The American Naturalist*, 152, 853–860.

Brakefield, P. M., Gems, D., Cowen, T., Christensen, K., Grubeck-Loebenstein, B. & Al, E. (2005) What are the effects of maternal and pre-adult environments on aging in humans, and are there lessons from animal models?. *Mechanisms of Ageing and Development*, 126, 431–438.

Brakefield, P. M., Pijpe, J. & Zwaan, B. J. (2007) Developmental plasticity and acclimation both contribute to adaptive responses to alternating seasons of plenty and of stress in *Bicyclus* butterflies. *Journal of Biosciences*, 32, 465–475.

Brakefield, P. M., Beldade, P. & Zwaan, B. J. (2009) The African butterfly *Bicyclus anynana*: evolutionary genetics and evo-devo. In Behringer, R. R., Johnson, A. D. & Krumlauf, R. E. (Eds.) *Emerging Model Organisms: A Laboratory Manual*. New York, Cold Spring Harbor Laboratory Press.

Brand, M. D. (2000) Uncoupling to survive? The role of mitochondrial inefficiency in aging. *Experimental Gerontology*, 35, 811–820.

Brand, A. & Hawdon, J. M. (2004) Phosphoinositide-3-Oh-kinase inhibitor LY294002 prevents activation of *Ancylostoma caninum* and *Ancylostoma ceylanicum* third-stage infective larvae. *International Journal for Parasitology*, 34, 909–914.

Brand, M. D., Couture, P., Else, P. L., Withers, K. W. & Hulbert, A. J. (1991) Evolution of energy metabolism: Proton permeability of the inner membrane of the liver mitochondria is greater in mammal than in reptile. *Biochemistry Journal*, 275, 81–86.

Brandt, S. M., Dionne, M. S., Khush, R. S., Pham, L. N., Vigdal, T. J. & Schneider, D. S. (2004) Secreted bacterial effectors and host-produced Eiger/TNF drive death in a *Salmonella*-infected fruit fly. *PLoS Biology*, 2, e418.

Bremner, W. J., Vitiello, M. V. & Prinz, P. N. (1983) Loss of circadian rhythmicity in blood testosterone levels with aging in normal men. *Journal of Clinical Endocrinology and Metabolism*, 56, 1278–1281.

Brennan, C. A. & Anderson, K. V. (2004) *Drosophila*: the genetics of innate immune recognition and response. *Annual Review of Immunology*, 22, 457–483.

Brent, G. A. (2000) Tissue-specific actions of thyroid hormone: insights from animal models. *Reviews in Endocrine & Metabolic Disorders*, 1, 27–33.

Bretman, A., Fricke, C. & Chapman, T. (2009) Plastic responses of male *Drosophila melanogaster* to the level of sperm competition increase male reproductive fitness. *Proceedings of the Royal Society of London B*, 276, 1705–1711.

Breuker, C. J. & Brakefield, P. M. (2002) Female choice depends on size but not symmetry of dorsal eyespots in the butterfly *Bicyclus anynana*. *Proceedings of the Royal Society of London B*, 269, 1233–1239.

Breuner, C. W. & Orchinik, M. (2002) Plasma binding proteins as mediators of corticosteroid action in vertebrates. *Journal of Endocrinology*, 175, 99–112.

Breuner, C. W., Lynn, S. E., Julian, G. E., Cornelius, J. M., Heidinger, B. J., Love, O. P., Sprague, R. S., Wade, H. & Whitman, B. A. (2006) Plasma-binding globulins and acute stress response. *Hormone and Metabolic Research*, 38, 260–268.

Bribiescas, R. G. (1996) Testosterone levels among Aché hunter/gatherer men: a function interpretation of population variation among adult males. *Human Nature*, 7, 163–188.

Bribiescas, R. G. (2001) Reproductive ecology and life history of the human male. *Yearbook of Physical Anthropology*, 44, 148–176.

Bribiescas, R. G. (2006) On the evolution, life history, and proximate mechanisms of human male reproductive senescence. *Evolutionary Anthropology*, 15, 132–141.

Bribiescas, R. G. & Ellison, P. T. (2008) How hormones mediate trade-offs in human health and disease. In Stearns, S. C. & Koella, J. (Eds.) *Evolution in Health and Disease*, 2nd edn. New York, Oxford University Press.

Bridge, D., Cunningham, C. W., Schierwater, B., Desalle, R. & Buss, L. W. (1992) Class-level relationships in the phylum Cnidaria: evidence from mitochondrial genome structure. *Proceedings of the National Academy of Sciences of the United States of America*, 89, 8750–8753.

Bridges, R. S. (2008) *Neurobiology of the Parental Brain*. Maryland Heights, Academic Press.

Britton, J. R., Britton, H. L. & Gronwaldt, V. (2006) Breastfeeding, sensitivity, and attachment. *Pediatrics*, 118, 1436–1443.

Brogiolo, W., Stocker, H., Ikeya, T., Rintelen, F., Fernandez, R. & Hafen, E. (2001) An evolutionarily conserved function of the *Drosophila* insulin receptor and insulin-like peptides in growth control. *Current Biology*, 11, 213–221.

Brommer, J. E., Merila, J. & Kokko, H. (2002) Reproductive timing and individual fitness. *Ecology Letters*, 5, 802–810.

Bronikowski, A. M. (2000) Experimental evidence for the adaptive evolution of growth rate in the garter snake *Thamnophis elegans*. *Evolution*, 54, 1760–1767.

Bronikowski, A. M. (2008) The evolution of aging phenotypes in snakes: a review and synthesis with new data. *Age*, 30, 169–176.

Bronikowski, A. M. & Arnold, S. J. (1999) The evolutionary ecology of life history variation in the garter snake *Thamnophis elegans*. *Ecology*, 80, 2314–2325.

Bronikowski, A. M. & Arnold, S. J. (2001) Cytochrome b phylogeny does not match subspecific classification in the Western terrestrial garter snake, *Thamnophis elegans*. *Copeia*, 2001, 508–513.

Bronikowski, A. M. & Promislow, D. E. L. (2005) Testing evolutionary theories of aging in wild populations. *Trends in Ecology & Evolution*, 20, 271–273.

Bronikowski, A. M. and D. Vleck (2010). Metabolism, body size and life span: A case study in evolutionarily divergent populations of the garter snake (*Thamnophis elegans*) Integrative and Comparative Biology 50: 880–887.

Bronson, F. H. (1985) Mammalian reproduction: an ecological perspective. *Biology of Reproduction*, 32, 1–26.

Brookes, P. S., Buckingham, J. A., Tenreiro, A. M., Hulbert, A. J. & Brand, M. D. (1998) The proton permeability of the inner membrane of liver mitochondria from ectothermic and endothermic vertebrates and from obese rats: correlations with standard metabolic rate and phospholipid fatty acid composition. *Comparative Biochemistry and Physiology B, Biochemistry & Molecular Biology*, 119, 325–334.

Bross, T. G., Rogina, B. & Helfand, S. L. (2005) Behavioral, physical, and demographic changes in *Drosophila* populations through dietary restriction. *Aging Cell*, 4, 309–317.

Broughton, S. J., Piper, M. D., Ikeya, T., Bass, T. M., Jacobson, J., Driege, Y., Martinez, P., Hafen, E., Withers, D. J., Leevers, S. J. & Partridge, L. (2005) Longer lifespan, altered metabolism, and stress resistance in *Drosophila* from ablation of cells making insulin-like ligands. *Proceedings of the National Academy of Sciences of the United States of America*, 102, 3105–3110.

Broughton, S., Alic, N., Slack, C., Bass, T., Ikeya, T., Vinti, G., Tommasi, A. M., Driege, Y., Hafen, E. & Partridge, L. (2008) Reduction of DILP2 in *Drosophila* triages a metabolic phenotype from lifespan revealing redundancy and compensation among DILPs. *PLoS One*, 3, e3721.

Browder, M. H., D'Amico, L. J. & Nijhout, H. F. (2001) The role of low levels of juvenile hormone esterase in the metamorphosis of *Manduca sexta*. *Journal of Insect Science*, 1–11.

Brown, D. D. (1997) The role of thyroid hormone in zebrafish and axolotl development. *Proceedings of the National Academy of Sciences of the United States of America*, 94, 13011–13016.

Brown, D. D. (2005) The role of deiodinases in amphibian metamorphosis. *Thyroid*, 15, 815–821.

Brown, D. D. & Cai, L. (2007) Amphibian metamorphosis. *Developmental Biology*, 306, 20–33.

Brown, R. P. & Griffin, S. (2005) Lower selected body temperatures after food deprivation in the lizard *Anolis carolinensis*. *Journal of Thermal Biology*, 30, 79–83.

Brown, C. L., Doroshov, S. I., Nunez, J. M., Hadley, C., Vaneenennaam, J., Nishioka, R. S. & Bern, H. A. (1988) Maternal triiodothyronine injections cause increases in swimbladder inflation and survival rates in larval striped bass, *Moronev saxatilis*. *Journal of Experimental Zoology*, 248, 168–176.

Brown, D. D., Cai, L., Das, B., Marsh-Armstrong, N., Schreiber, A. M. & Juste, R. (2005) Thyroid hormone controls multiple independent programs required for limb development in *Xenopus laevis* metamorphosis. *Proceedings of the National Academy of Sciences of the United States of America*, 102, 12455–12458.

Brunet, A., Sweeney, L. B., Sturgill, J. F., Chua, K. F., Greer, P. L., Lin, Y., Tran, H., Ross, S. E., Mostoslavsky, R., Cohen, H. Y., Hu, L. S., Cheng, H. L., Jedrychowski, M. P., Gygi, S. P., Sinclair, D. A., Alt, F. W. & Greenberg, M. E. (2004) Stress-dependent regulation of FOXO transcription factors by the SIRT1 deacetylase. *Science*, 303, 2011–2015.

Bruning, E., Saxer, A. & Lanzrein, B. (1985) Methyl farnesoate and juvenile hormone III in the normal and precocene treated embryos of the ovoviviparous cockroach *Nauphoeta cinerea*. *International Journal of Invertebrate Reproduction and Development*, 8, 269–278.

Bryant, M. & Reznick, D. (2004) Comparative studies of senescence in natural populations of guppies. *The American Naturalist*, 163, 55–68.

Bubliy, O. A. & Loeschcke, V. (2005) Correlated responses to selection for stress resistance and longevity in a laboratory population of *Drosophila melanogaster*. *Journal of Evolutionary Biology*, 18, 789–803.

Buchan, J. C., Alberts, S. C., Silk, J. B. & Altmann, J. (2003) True paternal care in a multi-male primate society. *Nature*, 425, 179–181.

Buchholz, D. R. & Hayes, T. B. (2002) Evolutionary patterns of diversity in spadefoot toad metamorphosis (Anura: Pelobatidae). *Copeia*, 2002, 180–189.

Buchholz, D. R. & Hayes, T. B. (2005) Variation in thyroid hormone action and tissue content underlies species differences in the timing of metamorphosis in desert frogs. *Evolution & Development*, 7, 458–467.

Buchholz, D. R., Hsia, S. C., Fu, L. & Shi, Y. B. (2003) A dominant-negative thyroid hormone receptor blocks amphibian metamorphosis by retaining corepressors at target genes. *Molecular and Cellular Biology*, 23, 6750–6758.

Buchholz, D. R., Tomita, A., Fu, L., Paul, B. D. & Shi, Y. B. (2004) Transgenic analysis reveals that thyroid hormone receptor is sufficient to mediate the thyroid hormone signal in frog metamorphosis. *Molecular and Cellular Biology*, 24, 9026–9037.

Buchholz, D. R., Paul, B. D. & Shi, Y. B. (2005) Gene-specific changes in promoter occupancy by thyroid hormone receptor during frog metamorphosis. Implications for developmental gene regulation. *Journal of Biological Chemistry*, 280, 41222–41228.

Buchholz, D. R., Paul, B. D., Fu, L. & Shi, Y. B. (2006) Molecular and developmental analyses of thyroid hormone receptor function in *Xenopus laevis*, the African clawed frog. *General and Comparative Endocrinology*, 145, 1–19.

Buckbinder, L. & Brown, D. D. (1993) Expression of the *Xenopus laevis* prolactin and thyrotropin genes during metamorphosis. *Proceedings of the National Academy of Sciences of the United States of America*, 90, 3820–3824.

Buena, F., Swerdloff, R. S., Steiner, B. S., Lutchmansingh, P., Peterson, M. A., Pandian, M. R., Galmarini, M. & Bhasin, S. (1993) Sexual function does not change when serum testosterone levels are pharmacologically varied within the normal male range. *Fertility and Sterility*, 59, 1118–1123.

Bullen, B. A., Skrinar, G. S., Beitins, I. Z., Von Mering, G., Turnbull, B. A. & McArthur, J. W. (1985) Induction of menstrual disorders by strenuous exercise in untrained women. *New England Journal of Medicine*, 312, 1349–1353.

Bult, A. & Lynch, C. B. (1996) Multiple selection responses in house mice bidirectionally selected for thermoregulatory nest-building behavior: crosses of replicate lines. *Behavior Genetics*, 26, 439–446.

Bult, A. & Lynch, C. B. (2000) Breaking through artificial selection limits of an adaptive behavior in mice and the consequences for correlated responses. *Behavior Genetics*, 30, 193–206.

Burdge, G. C., Hanson, M. A., Slater-Jefferies, J. L. & Lillycrop, K. A. (2007) Epigenetic regulation of transcription: a mechanism for inducing variations in phenotype (fetal programming) by differences in nutrition during early life? *British Journal of Nutrition*, 97, 1036–1046.

Burke, R. D. (1978) The structure of the nervous system of the pluteus larva of *Strongylocentrotus purpuratus*. *Cell and Tissue Research*, 191, 233–247.

Burke, R. D. (1980) Neural control of Echinoid metamorphosis. *American Zoologist*, 20, 911.

Burke, R. D. (1983a) Development of the larval nervous system of the sand dollar, *Dendraster excentricus*. *Cell and Tissue Research*, 229, 145–154.

Burke, R. D. (1983b) The induction of metamorphosis of marine invertebrate larvae – stimulus and response. *Canadian Journal of Zoology–Revue Canadienne De Zoologie*, 61, 1701–1719.

Burke, R. D., Brand, D. G. & Bisgrove, B. W. (1986) Structure of the nervous system of the Auricularia larva of *Parasticopus californicus*. *Biological Bulletin*, 170, 450–460.

Burn, J. E., Smyth, D. R., Peacock, W. J. & Dennis, E. S. (1993) Genes conferring late flowering in *Arabidopsis thaliana*. *Genetica*, 90, 147–155.

Burton, P. & Finnerty, J. (2009) Conserved and novel gene expression between regeneration and asexual fission in *Nematostella vectensis*. *Development, Genes and Evolution*, 219, 79–87.

Buss, D. M. & Schmitt, D. P. (1993) Sexual strategies theory: an evolutionary perspective on human mating. *Psychological Review*, 100, 204–232.

Butcher, R. A., Fujita, M., Schroeder, F. C. & Clardy, J. (2007) Small-molecule pheromones that control dauer development in *Caenorhabditis elegans*. *Nature Chemical Biology*, 3, 420–422.

Butcher, R. A., Ragains, J. R., Li, W., Ruvkun, G., Clardy, J. & Mak, H. Y. (2009) Biosynthesis of the *Caenorhabditis elegans* dauer pheromone. *Proceedings of the National Academy of Sciences of the United States of America*, 106, 1875–1879.

Byrne, M., Cisternas, P. & Koop, D. (2001) Evolution of larval form in the sea star genus *Patiriella*: conservation and change in the larval nervous system. *Development, Growth & Differentiation*, 43, 459–468.

Byrne, M., Sewell, M. A. & Prowse, T. A. A. (2008) Nutritional ecology of sea urchin larvae: influence of endogenous and exogenous nutrition on echinopluteal growth and phenotypic plasticity in *Tripneustes gratilla*. *Functional Ecology*, 22, 643–648.

Cai, L. & Brown, D. D. (2004) Expression of type II iodothyronine deiodinase marks the time that a tissue responds to thyroid hormone-induced metamorphosis in *Xenopus laevis*. *Developmental Biology*, 266, 87–95.

Caicedo, A. L., Stinchcombe, J. R., Olsen, K. M., Schmitt, J. & Purugganan, M. D. (2004) Epistatic interaction between *Arabidopsis FRI* and *FLC* flowering time genes generates a latitudinal cline in a life history trait. *Proceedings of the National Academy of Sciences of the United States of America*, 101, 15670–15675.

Caicedo, A. L., Richards, C., Ehrenreich, I. M. & Purugganan, M. D. (2009) Complex rearrangements lead to novel chimeric gene fusion polymorphisms at the *Arabidopsis thaliana* MAF2-5 flowering time gene cluster. *Molecular Biology and Evolution*, 26, 699–711.

Calboli, F. C., Gilchrist, G. W. & Partridge, L. (2003) Different cell size and cell number contribution in two newly established and one ancient body size cline of *Drosophila subobscura*. *Evolution*, 57, 566–573.

Calder, W. A. (1984) *Size, Function and Life History*. Cambridge, MA, Harvard University Press.

Caldwell, P. E., Walkiewicz, M. & Stern, M. (2005) Ras activity in the *Drosophila* prothoracic gland regulates body size and developmental rate via ecdysone release. *Current Biology*, 15, 1785–1795.

Callaini, G. & Dallai, R. (1987) Cuticle formation during the embryonic development of the dipteran *Ceratitis capitata. Italian Journal of Zoology*, 54, 221–227.

Callery, E. M. & Elinson, R. P. (2000) Thyroid hormone-dependent metamorphosis in a direct developing frog. *Proceedings of the National Academy of Sciences of the United States of America*, 97, 2615–2620.

Callery, E. M., Fang, H. & Elinson, R. P. (2001) Frogs without polliwogs: evolution of anuran direct development. *BioEssays*, 23, 233–241.

Calsbeek, R. & Sinervo, B. (2004) Within clutch variation in offspring sex determined by differences in sire body size: cryptic mate choice in the wild. *Journal of Evolutionary Biology*, 17, 464–470.

Campbell, A. (2002) *A Mind of her Own: The Evolutionary Psychology of Women*. New York, Oxford University Press.

Campbell, B. C. (2006) Adrenarche and the evolution of human life history. *American Journal of Human Biology*, 18, 569–589.

Campbell, B. C., Gillett-Netting, R. & Meloy, M. (2004) Timing of reproductive maturation in rural versus urban Tonga boys, Zambia. *Annals of Human Biology*, 31, 213–227.

Campbell, B. C., Leslie, P. W., Little, M. A. & Campbell, K. L. (2005) Pubertal timing, hormones, and body composition among adolescent Turkana males. *American Journal of Physical Anthropology*, 128, 896–905.

Canoine, V., Fusani, L., Schlinger, B. & Hau, M. (2007) Low sex steroids, high steroid receptors: Increasing the sensitivity of the nonreproductive brain. *Developmental Neurobiology*, 67, 57–67.

Capella, I. C. S. & Hartfelder, K. (2002) Juvenile-hormone-dependent interaction of actin and spectrin is crucial for polymorphic differentiation of the larval honeybee ovary. *Cell and Tissue Research*, 307, 265–272.

Capy, P., Pla, E. & David, J. R. (1993) Phenotypic and genetic variability of morphometrical traits in natural populations of *Drosophila melanogaster* and *D. simulans*. I. Geographic variations. *Genetics, Selection, Evolution*, 25, 517–536.

Carani, C., Scuteri, A., Marrama, P. & Bancroft, J. (1990) The effects of testosterone administration and visual erotic stimuli on nocturnal penile tumescence in normal men. *Hormones and Behavior*, 24, 435–441.

Carbone, M. A., Jordan, K. W., Lyman, R. F., Harbison, S. T., Leips, J., Morgan, T. J., De Luca, M., Awadelia, P. & Mackay, T. F. C. (2006) Phenotypic variation and natural selection at *Catsup*, a pleiotropic quantitative trait gene in *Drosophila*. *Current Biology*, 16, 912–919.

Caretta, N., Palego, P., Roverato, A., Selice, R., Ferlin, A. & Foresta, C. (2006) Age-matched cavernous peak systolic velocity: a highly sensitive parameter in the diagnosis of arteriogenic erectile dysfunction. *International Journal of Impotence Research* 18, 306–310.

Cariou, B., Bouchaert, E., Abdelkarim, M., Dumont, J., Caron, S., Fruchart, J. C., Burcelin, R., Kuipers, F. & Staels, B. (2007) FXR-deficiency confers increased susceptibility to torpor. *FEBS Letters*, 581, 5191–5198.

Carius, H. J., Little, T. J. & Ebert, D. (2001) Genetic variation in a host-parasite association: potential for coevolution and frequency-dependent selection. *Evolution*, 55, 1136–1145.

Carles, C. C., Choffnes-Inada, D., Reville, K., Lertpiriyapong, K. & Fletcher, J. C. (2005) ULTRAPETALA1 encodes a SAND domain putative transcriptional regulator that controls shoot and floral meristem activity in *Arabidopsis*. *Development*, 132, 897–911.

Carney, G. E. & Bender, M. (2000) The *Drosophila ecdysone receptor* (*EcR*) gene is required maternally for normal oogenesis. *Genetics*, 154, 1203–1211.

Caro, P., Gomez, J., Lopez-Torres, M., Sanchez, I., Naudi, A., Jove, M., Pamplona, R. & Barja, G. (2008) Forty percent and eighty percent methionine restriction decrease mitochondrial ROS generation and oxidative stress in rat liver. *Biogerontology*, 9, 183–196.

Carr, B. R. (1998) Disorders of the ovaries and female reproductive tract. In Larsen, P. R., Kronenberg, H. M., Melmed, S. & Polonsky, K. S. (Eds.) *Williams Textbook of Endocrinology*. 9 ed. Philadelphia, Saunders.

Carroll, S. B. (2005) *Endless forms most beautiful: the new science of evo devo*. New York, London, W. W. Norton and Company.

Carroll, S. B. (2008) Evo-devo and an expanding evolutionary synthesis: a genetic theory of morphological evolution. *Cell*, 134, 25–36.

Carroll, S. B., Grenier, J. K. & Weatherbee, S. D. (2000) *From DNA to Diversity: Molecular Genetics and the Evolution of Animal Design*, Oxford, Wiley Blackwell.

Carson, D. D., Farach, M. C., Earles, D. S., Decker, G. L. & Lennartz, W. J. (1985) A monoclonal antibody inhibits calcium accumulation and skeleton formation in cultured embryonic cells of the sea urchin. *Cell*, 41, 639–648.

Carter, C. S. (2002) Neuroendocrine perspectives on social attachment and love. In Cacioppo, J. T., Berntson, G. G., Adolphs, R., Carter, C. S., Davidson, R. J., McClintock, M. K., Mcewen, B. S., Meaney, M. J., Schacter, D. L., Sternberg, McEwen., Suomi, S. S. & Taylor, S. E. (Eds.) *Foundations in Social Neuroscience*. Cambridge, MIT Press.

Carter, M. E. & Brunet, A. (2007) FOXO transcription factors. *Current Biology*, 17, R113–R114.

Carter, H. B., Pearson, J. D., Metter, E. J., Chan, D. W., Andres, R., Fozard, J. L., Rosner, W. & Walsh, P. C. (1995) Longitudinal evaluation of serum androgen levels in men with and without prostate cancer. *Prostate*, 27, 25–31.

Cartland-Shaw, L. K., Cree, A., Skeaff, C. M. & Grimmond, N. M. (1998) Differences in dietary and plasma fatty acids between wild and captive populations of a rare reptile, the tuatara (*Sphenodon punctatus*). *Journal of Comparative Physiology B*, 168, 569–580.

Cartwright, P. (2003) Developmental insights into the origin of complex colonial Hydrozoans. *Integrative and Comparative Biology*, 43, 82–86.

Cartwright, P., Schierwater, B. & Buss, L. W. (2006) Expression of a Gsx parahox gene, Cnox-2, in colony ontogeny in *Hydractinia* (Cnidaria: Hydrozoa). *Journal of Experimental Zoology B*, 306B, 460–469.

Carvalho, G. B., Kapahi, P. & Benzer, S. (2005) Compensatory ingestion upon dietary restriction in *Drosophila melanogaster*. *Nature Methods*, 2, 813–815.

Carvalho, G. B., Kapahi, P., Anderson, D. J. & Benzer, S. (2006) Allocrine modulation of feeding behavior by the sex peptide of *Drosophila*. *Current Biology*, 16, 692–696.

Casey, M. L. & MacDonald, P. C. (1998) Endocrine changes of pregnancy. In Larsen, P. R., Kronenberg, H. M., Melmed, S. & Polonsky, K. S. (Eds.) *Williams Textbook of Endocrinology*, 9th edn. Philadelphia, Saunders.

Castoe, T. A., De Koning, A. P. J., Kim, H. M., Gu, W., Noonan, B. P., Naylor, G., Jiang, Z. J., Parkinson, C. L. & Pollock, D. D. (2009) Evidence for an ancient adaptive episode of convergent molecular evolution. *Proceedings of the National Academy of Sciences of the United States of America*, 106, 8986–8991.

Caswell, H. (1981) The evolution of 'mixed' life histories in marine invertebrates and elsewhere. *The American Naturalist*, 117, 529–536.

Catoni, C., Peters, A. & Martin Schaefer, H. (2008) Life history trade-offs are influenced by the diversity, availability and interactions of dietary antioxidants. *Animal Behaviour*, 76, 1107–1119.

Cavalieri, V., Spinelli, G. & Di Bernardo, M. (2003) Impairing Otp homeodomain function in oral ectoderm cells affects skeletogenesis in sea urchin embryos. *Developmental Biology*, 262, 107–118.

Cavalieri, V., Di Bernardo, M. & Spinelli, G. (2007) Regulatory sequences driving expression of the sea urchin *Otp* homeobox gene in oral ectoderm cells. *Gene Expression Patterns*, 7, 124–130.

Cavaliere, V., Bernardi, F., Romani, P., Duchi, S. & Gargiulo, G. (2008) Building up the *Drosophila* eggshell: first of all the eggshell genes must be transcribed. *Developmental Dynamics*, 237, 2061–2072.

Centanin, L., Ratcliffe, P. J. & Wappner, P. (2005) Reversion of lethality and growth defects in Fatiga oxygen-sensor mutant flies by loss of hypoxia-inducible factor-alpha/Sima. *EMBO Reports*, 6, 1070–1075.

Chamberlain, N. L., Hill, R. I., Kapan, D. D., Gilbert, L. E. & Kronforst, M. R. (2009) Polymorphic butterfly reveals the missing link in ecological speciation. *Science*, 326, 847–850.

Champlin, D. T. & Truman, J. W. (1998a) Ecdysteroid control of cell proliferation during optic lobe neurogenesis in the moth *Manduca sexta*. *Development*, 125, 269–277.

Champlin, D. T. & Truman, J. W. (1998b) Ecdysteroids govern two phases of eye development during metamorphosis of the moth, *Manduca sexta*. *Development*, 125, 2009–2018.

Chandler, J., Wilson, A. & Dean, C. (1996) *Arabidopsis* mutants showing an altered response to vernalization. *Plant Journal*, 10, 637–644.

Chang, C. W., Moseley, J. L., Wykoff, D. & Grossman, A. R. (2005) The LPB1 gene is important for acclimation of *Chlamydomonas reinhardtii* to phosphorus and sulfur deprivation. *Plant Physiology*, 138, 319–329.

Chapais, B. (2008) *Primeval Kinship*. Cambridge, Harvard University Press.

Chapelle, G. & Peck, L. S. (1999) Polar gigantism dictated by oxygen availability. *Nature*, 399, 114–115.

Chapman, T. & Partridge, L. (1996) Female fitness in *Drosophila melanogaster*: an interaction between the effect of nutrition and of encounter rate with males. *Proceedings of the Royal Society of London B*, 263, 755–759.

Chapman, T., Hutchings, J. & Partridge, L. (1993) No reduction in the cost of mating for *Drosophila melanogaster* females mating with spermless males. *Proceedings of the Royal Society of London B*, 253, 211–217.

Chapman, T., Liddle, L. F., Kalb, J. M., Wolfner, M. F. & Partridge, L. (1995) Cost of mating in *Drosophila melanogaster* females is mediated by male accessory-gland products. *Nature*, 373, 241–244.

Chapman, T., Miyatake, T., Smith, H. K. & Partridge, L. (1998) Interactions of mating, egg production and death rates in females of the Mediterranean fruit fly, *Ceratitis capitata*. *Proceedings of the Royal Society of London B*, 265, 1879–1894.

Chapman, J. A., Kirkness, E. F., Simakov, O., Hampson, S. E., Mitros, T., Weinmaier, T., Rattei, T., Balasubramanian, P. G., Borman, J., Busam, D., Disbennett, K., Pfannkoch, C., Sumin, N., Sutton, G. G., Viswanathan, L. D., Walenz, B., Goodstein, D. M., Hellsten, U., Kawashima, T., Prochnik, S. E., Putnam, N. H., Shu, S., Blumberg, B., Dana, C. E., Gee, L., Kibler, D. F., Law, L., Lindgens, D., Martinez, D. E., Peng, J., Wigge, P. A., Bertulat, B., Guder, C., Nakamura, Y., Ozbek, S., Watanabe, H., Khalturin, K., Hemmrich, G., Franke, A., Augustin, R., Fraune, S., Hayakawa, E., Hayakawa, S., Hirose, M., Hwang, J. S., Ikeo, K., Nishimiya-Fujisawa, C., Ogura, A., Takahashi, T., Steinmetz, P. R. H., Zhang, X., Aufschnaiter, R., Eder, M. K., Gorny, A. K., Salvenmoser, W., Heimberg, A. M., Wheeler, B. M., Peterson, K. J., Bottger, A., Tischler, P., Wolf, A., Gojobori, T., Remington, K. A., Strausberg, R. L., Venter, J. C., Technau, U., Hobmayer, B., Bosch, T. C. G., Holstein, T. W., Fujisawa, T., Bode, H. R., David, C. N., Rokhsar, D. S. & Steele, R. E. (2010) The dynamic genome of Hydra. *Nature*, 464, 592–596.

Charlesworth, B. (1980) *Evolution in Age-structured Populations*. First edition Cambridge, Cambridge University Press.

Charlesworth, B. (1990) Optimization models, quantitative genetics, and mutation. *Evolution*, 44, 520–538.

Charlesworth, B. C. (1994) *Evolution in Age-structured Populations*. Second edition, Cambridge, Cambridge University Press.

Charlesworth, B. & Hughes, K. A. (2000) The maintenance of genetic variation in life history traits. In Singh, R. S. & Krimbas, C. B. (Eds.) *Evolutionary Genetics: From Molecules to Morphology*. Cambridge, U.K., Cambridge University Press.

Charnov, E. L. (1991) Evolution of life history variation among female mammals. *Proceedings of the National Academy of Sciences of the United States of America*, 88, 1134–1137.

Charnov, E. L. (1993) *Life History Invariants: Some Explorations of Symmetry in Evolutionary Ecology*. New York, Oxford University Press.

Charnov, E. L. (2009) Optimal (plastic) life histories in growing versus stable populations. *Evolutionary Ecology Research*, 11, 983–987.

Charnov, E. L. & Berrigan, D. (1992) Why do female primates have such long lifespans and so few babies? Or life in the slow lane. *Evolutionary Anthropology*, 2, 191–194.

Charnov, E. L. & Bull, J. (1977) When is sex environmentally determined? *Nature*, 266, 829–830.

Charnov, E. L., Smith, J. M. & Bull, J. J. (1976) Why be an hermaphrodite? *Nature*, 263, 125–126.

Chatterton, R. T., Vogelsong, K. M., Lu, Y. C. & Hudgens, G. A. (1997) Hormonal responses to psychological stress in men preparing for skydiving. *Journal of Clinical Endocrinology and Metabolism*, 82, 2503–2509.

Chee, F. & Byrne, M. (1999a) Development of the larval serotonergic nervous system in the sea star *Patiriella regularis* as revealed by confocal imaging. *Biological Bulletin*, 197, 123–131.

Chee, F. & Byrne, M. (1999b) Serotonin-like immunoreactivitiy in the brachiolaria larvae of *Patiriella regularis*. *Invertebrate Reproduction & Development*, 36, 111–115.

Cheers, M. S. & Ettensohn, C. A. (2005) P16 is an essential regulator of skeletogenesis in the sea urchin embryo. *Developmental Biology*, 283, 384–396.

Chen, J. & Caswell-Chen, E. P. (2004) Facultative vivipary is a life history trait in *Caenorhabditis elegans*. *Journal of Nematology*, 36, 107–113.

Chen, D. & Zhao, J. (2008) Free IAA in stigmas and styles during pollen germination and pollen tube growth of *Nicotiana tabacum*. *Physiologia Plantarum*, 134, 202–215.

Chen, C., Jack, J. & Garofalo, R. S. (1996) The *Drosophila* insulin receptor is required for normal growth. *Endocrinology*, 137, 846–856.

Chen, D., Steele, A. D., Lindquist, S. & Guarente, L. (2005) Increase in activity during calorie restriction requires Sirt1. *Science*, 310, 1641.

Chen, J. J., Senturk, D., Wang, J. L., Muller, H. G., Carey, J. R., Caswell, H. & Caswell-Chen, E. P. (2007) A demographic analysis of the fitness cost of extended longevity in *Caenorhabditis elegans*. *Journal of Gerontology A*, 62, 126–135.

Chen, D., Steele, A. D., Hutter, G., Bruno, J., Govindarajan, A., Easlon, E., Lin, S. J., Aguzzi, A., Lindquist, S. & Guarente, L. (2008) The role of calorie restriction and SIRT1 in prion-mediated neurodegeneration. *Experimental Gerontology*, 43, 1086–1093.

Chen, M., Payne, W. S., Dunn, J. R., Chang, S., Zhang, H. M., Hunt, H. D. & Dodgson, J. B. (2009) Retroviral delivery of RNA interference against Marek's disease virus *in vivo*. *Poultry Science*, 88, 1373–1380.

Chia, F. S. & Rice, M. E. (Eds.) (1978) *Settlement and Metamorphosis of Marine Invertebrate Larvae*. New York, Elsevier.

Chiang, A. S. & Schal, C. (1994) Cyclic volumetric changes in corpus allatum cells in relation to juvenile hormone biosynthesis during ovarian cycles in cockroaches. *Archives of Insect Biochemistry and Physiology*, 27, 53–64.

Chiang, A. S., Gadot, M., Burns, E. L., & Schal, C. (1991) Sexual differentiation of nymphal corpora allata and the effects of ovariectomy on adult gland morphometrics in *Blattella germanica*. *Experientia*, 47, 81–83.

Chiang, G. C. K., Barua, D., Kramer, E. M., Amasino, R. M. & Donohue, K. (2009) Major flowering time gene, *Flowering Locus C*, regulates seed germination in *Arabidopsis thaliana*. *Proceedings of the National Academy of Sciences of the United States of America*, 106, 11661–11666.

Chiappe, D. & MacDonald, K. (2005) The evolution of domain-general mechanisms in intelligence and learning. *Journal of General Psychology*, 132, 5–40.

Chihara, C. J., Fristrom, J. W., Petri, W. H. & King, D. S. (1972) The assay of ecdysones and juvenile hormones on *Drosophila* imaginal disks *in vitro*. *Journal of Insect Physiology*, 18, 1115–1123.

Chino, Y., Saito, M., Yamasu, K., Suyemitsu, T. & Ishihara, K. (1994) Formation of the adult rudiment of sea urchins is influenced by thyroid hormones. *Developmental Biology*, 161, 1–11.

Chiori, R., Jager, M., Denker, E., Wincker, P., Da Silva, C., Le Guyader, H., Manuel, M. & Queinnec, E. (2009) Are Hox genes ancestrally involved in axial patterning? Evidence from the hydrozoan *Clytia hemisphaerica* (Cnidaria). *PLoS One*, 4, e4231.

Chown, S. L. & Gaston, K. J. (2010) Body size variation in insects: a macroecological perspective. *Biological Reviews of the Cambridge Philosophical Society*, 85, 139–169.

Christiansen, F. B. & Fenchel, T. M. (1979) Evolution of marine invertebrate reproductive patterns. *Theoretical Population Biology*, 16, 267–282.

Chung, H., Bogwitz, M. R., McCart, C., Andrianopoulos, A., Ffrench-Constant, R. H., Batterham, P. & Daborn, P. J. (2007) Cis-regulatory elements in the *Accord* retrotransposon result in tissue-specific expression of the *Drosophila melanogaster* insecticide resistance gene *Cyp6g1*. *Genetics*, 175, 1071–1077.

Cisternas, P. & Byrne, M. (2003) Peptidergic and serotonergic immunoreactivity in the metamorphosing ophiopluteus of *Ophiactis resiliens* (Echinodermata, Ophiuroidea). *Invertebrate Biology*, 122, 177–185.

Cisternas, P., Selvakumaraswamy, P. & Byrne, M. (2001) Localisation of the neuropeptide S1 in an ophiruoid larva. In Barker, M. (Ed.) *Echinoderms 2000*. Rotterdam, Swets and Seitlinger.

Clancy, D. J., Gems, D., Harshman, L. G., Oldham, S., Stocker, H., Hafen, E., Leevers, S. J. & Partridge, L. (2001) Extension of life-span by loss of CHICO, a *Drosophila* insulin receptor substrate protein. *Science*, 292, 104–106.

Clancy, D. J., Gems, D., Hafen, E., Leevers, S. J. & Partridge, L. (2002) Dietary restriction in long-lived dwarf flies. *Science*, 296, 319.

Clare, A. S. (1996a) Natural product antifoulants: Status and potential. *Biofouling*, 9, 211–229.

Clare, A. S. (1996b) Signal transduction in barnacle settlement: Calcium re-visited. *Biofouling*, 10, 141–159.

Clark, A. G. (1987) Senescence and the genetic-correlation hang-up. *The American Naturalist*, 129, 932–940.

Clark, A. G. (1990) Genetic components of variation in energy storage in *Drosophila melanogaster*. *Evolution*, 44, 637–650.

Clark, M. M. & Galef, B. G. (1999) A testosterone-mediated trade-off between parental and sexual effort in male mongolian gerbils (*Meriones unguiculatus*). *Journal of Comparative Psychology*, 113, 388–395.

Clark, R. D. & Hatfield, E. (1989) Gender differences in receptivity to sexual offers. *Journal of Psychology and Human Sexuality* 2, 39–55.

Clark, A. G., Suzumski, F. M., Bell, K. A., Keith, L. E., Houtz, S. & Merriwether, D. A. (1990) Direct and correlated responses to artificial selection on lipid and glycogen contents in *Drosophila melanogaster*. *Genetical Research*, 56, 49–56.

Clark, K. M., Castillo, M., Calatroni, A., Walter, T., Cayazzo, M., Pino, P. & Lozoff, B. (2006) Breast-feeding and mental and motor development at 5 1/2 years. *Ambulatory Pediatrics*, 6, 65–71.

Clayton, W. S. J. (1985) Pedal laceration by the anemone *Aiptasia pallida*. *Marine Ecology Progress Series*, 21, 75–80.

Clemons, G. K. & Nicoll, C. S. (1977) Development and preliminary application of a homologous radioimmunoassay for bullfrog prolactin. *General and Comparative Endocrinology*, 32, 531–535.

Clutton-Brock, T. H. (1988) *Reproductive Success: Studies of individual variation in contrasting breeding systems*. Chicago, University of Chicago Press.

Clutton-Brock, T. (2009) Structure and function in mammalian societies. *Philosophical Transactions of the Royal Society B*, 364, 3229–3242.

Clyne, J. D. & Miesenböck, G. (2009) Postcoital finesse. *Neuron*, 61, 491–493.

Cohen, H. Y., Miller, C., Bitterman, K. J., Wall, N. R., Hekking, B., Kessler, B., Howitz, K. T., Gorospe, M., De Cabo, R. & Sinclair, D. A. (2004) Calorie restriction promotes mammalian cell survival by inducing the SIRT1 deacetylase. *Science*, 305, 390–392.

Cohen, M., Reale, V., Olofsson, B., Knights, A., Evans, P. & De Bono, M. (2009) Coordinated regulation of foraging and metabolism in *C. elegans* by RFamide neuropeptide signaling. *Cell Metabolism*, 9, 375–385.

Cole, L. C. (1954) The population consequences of life history phenomena. *Quarterly Review of Biology*, 29, 103–137.

Colman, R. J., Anderson, R. M., Johnson, S. C., Kastman, E. K., Kosmatka, K. J., Beasley, T. M., Allison, D. B., Cruzen, C., Simmons, H. A., Kemnitz, J. W. & Weindruch, R. (2009) Caloric restriction delays disease onset and mortality in rhesus monkeys. *Science*, 325, 201–204.

Colombani, J., Bianchini, L., Layalle, S., Pondeville, E., Dauphin-Villemant, C., Antoniewski, C., Carré, C., Noselli, S. & Leopold, P. (2005) Antagonistic actions of ecdysone and insulins determine final size in *Drosophila*. *Science*, 310, 667–670.

Comendant, T., Sinervo, B., Svensson, E. I. & Wingfield, J. (2003) Social competition, corticosterone and survival in female lizard morphs. *Journal of Evolutionary Biology*, 16, 948–955.

Conlon, I. & Raff, M. (1999) Size control in animal development. *Cell*, 96, 235–244.

Cook, C. E., Yue, Q. & M.E., A. (2005) Mitochondrial genomes suggest that hexapods and crustaceans are mutually paraphyletic. *Proceedings of the Royal Society of London B*, 272, 1295–1304.

Cooper, V., Reiskind, M., Miller, J., Shelton, K., Walther, B., Elkinton, J. & Ewald, P. (2002) Timing of transmission and the evolution of virulence of an insect virus. *Proceedings of the Royal Society of London B*, 269, 1161–1165

Cooper, T. M., Mockett, R. J., Sohal, B. H., Sohal, R. S. & Orr, W. C. (2004) Effect of caloric restriction on lifespan of the housefly, *Musca domestica*. *FASEB Journal*, 18, 1591–1593.

Cooper, T. F., Remold, S. K., Lenski, R. E. & Schneider, D. (2008) Expression profiles reveal parallel evolution of epistatic interactions involving the CRP regulon in *Escherichia coli*. *PLoS Genetics*, 4, e35.

Corbo, R. M., Ulizzi, L., Piombo, L. & Scacchi, R. (2008) Study on a possible effect of four longevity candidate genes (ACE, PON1, Ppar-gamma, and APOE) on human fertility. *Biogerontology*, 9, 317–323.

Corl, A., Davis, A., Kuchta, S., Comendant, T. & Sinervo, B. (2009) Alternative mating strategies and the evolution of sexual size dimorphism in the side-blotched lizard, *Uta stansburiana*: a population-level comparative analysis. *Evolution*, 64, 79–96.

Corl, A., Davis, A., Kuchta, S. & Sinervo, B. (2010) Selective loss of polymorphic mating types is associated with rapid phenotypic evolution during morphic speciation. *Proceedings of the National Academy of Sciences of the United States of America*, 107, 4254–4259.

Cornwallis, C. K. & Uller, T. (2010) Towards an evolutionary ecology of sexual traits. *Trends in Ecology & Evolution* 25, 145–152.

Corona, M., Hughes, K. A., Weaver, D. B. & Robinson, G. E. (2005) Gene expression patterns associated with queen honey bee longevity. *Mechanisms of Ageing and Development*, 126, 1230–1238.

Corona, M., Velarde, R. A., Remolina, S., Moran-Lauter, A., Wang, Y., Hughes, K. A. & Robinson, G. E. (2007) Vitellogenin, juvenile hormone, insulin signaling, and queen honey bee longevity. *Proceedings of the National Academy of Sciences of the United States of America*, 104, 7128–7133.

Coschigano, K. T., Clemmons, D., Bellush, L. L. & Kopchick, J. J. (2000) Assessment of growth parameters and lifespan of GHR/BP gene-disrupted mice. *Endocrinology*, 141, 2608–26013.

Costanzo, K. & Monteiro, A. (2007) The use of chemical and visual cues in female choice in the butterfly *Bicyclus anynana*. *Proceedings of the Royal Society of London B*, 274, 845–851.

Costanzo, J. P., Baker, P. J. & Lee, R. E. (2006) Physiological responses to freezing in hatchlings of freeze-tolerant and-intolerant turtles. *Journal of Comparative Physiology. B*, 176, 697–707.

Cotter, S. C., Kruuk, L. E. B. & Wilson, K. (2004) Costs of resistance: genetic correlations and potential trade-offs in an insect immune system. *Journal of Evolutionary Biology*, 17, 421–429.

Couper, J. M. & Leise, E. M. (1996) Serotonin injections induce metamorphosis in larvae of the Gastropod mollusc *Ilyanassa obsoleta*. *Biological Bulletin*, 191, 178–186.

Cowan, D. B., Jones, M., Garcia, L. M., Noria, S., Del Nido, P. J. & McGowan, F. X. (2003) Hypoxia and stretch regulate intercellular communication in vascular smooth muscle cells through reactive oxygen species formation. *Arteriosclerosis, Thrombosis and Vascular Biology*, 23, 1754–1760.

Coyne, J. A. & Beecham, E. (1987) Heritability of two morphological characters within and among natural populations of *Drosophila melanogaster*. *Genetics*, 117, 727–737.

Craig, S. F., Slobodkin, L. B., Wray, G. A. & Biermann, C. H. (1997) The 'paradox' of polyembryony: a review of the cases and a hypothesis of its evolution. *Evolutionary Ecology*, 11, 127–143.

Crailsheim, K. (1986) Dependence of Protein-Metabolism on Age and Season in the Honeybee (*Apis mellifica carnica*). *Journal of Insect Physiology*, 32, 629–634.

Crain, D. A., Bolten, A. B., Bjorndal, K. A., Guillerte, L. J. & Gross, T. S. (1995) Size-dependent, sex-dependent, and seasonal changes in Insulin-like Growth Factor I in the loggerhead sea turtle (*Caretta caretta*). *General and Comparative Endocrinology*, 98, 219–226.

Crawford, D., Libina, N. & Kenyon, C. (2007) *Caenorhabditis elegans* integrates food and reproductive signals in lifespan determination. *Aging Cell*, 6, 715–721.

Creel, S. (2001) Social dominance and stress hormones. *Trends in Ecology & Evolution*, 16, 491–497.

Cresko, W. A., Amores, A., Wilson, C., Murphy, J., Currey, M., Phillips, P., Bell, M. A., Kimmel, C. B. & Postlethwait, J. H. (2004) Parallel genetic basis for repeated evolution of armor loss in Alaskan threespine stickleback populations. *Proceedings of the National Academy of Sciences of the United States of America*, 101, 6050–6055.

Crews, D. E. (2003) *Human Senescence: Evolutionary and biocultural perspectives*. New York, Cambridge University Press.

Criscuolo, F., Gonzalez-Barroso, M. D., Bouillaud, F., Ricquier, D., Miroux, B. & Sorci, G. (2005) Mitochondrial uncoupling proteins: new perspectives for evolutionary ecologists. *The American Naturalist*, 166, 686–699.

Crow, J. F. (1992) Twenty-five years ago in genetics: identical triplets. *Genetics*, 124, 395–398.

Cullen, C. F. & Milner, M. J. (1991) Parameters of growth in primary cultures and cell-lines established from *Drosophila* imaginal disks. *Tissue & Cell*, 23, 29–39.

Currie, D. A., Milner, M. J. & Evans, C. W. (1988) The growth and differentiation *in vitro* of leg and wing imaginal disk cells from *Drosophila melanogaster*. *Development*, 102, 805–814.

Curtis, T. J. & Wang, Z. (2003) The neurochemistry of pair bonding. *Current Directions in Psychological Science*, 12, 49–53.

Cutler, W. B., Garcia, C. R., Huggins, G. R. & Preti, G. (1986) Sexual behavior and steroid levels among gynecologically mature premenopausal women. *Fertility and Sterility*, 45, 496–502.

Czihak, G. (1962) Entwicklungphysiologie der Echinodermen. *Fortschritte der Zoologie*, 14, 238–267.

Dabbs, J. M. & Dabbs, M. G. (2000) *Heroes, Rogues, and Lovers: Testosterone and Behavior*. New York, McGraw-Hill.

Dabbs, J. M. & Mohammed, S. (1992) Male and female salivary testosterone concentrations before and after sexual activity. *Physiological Behavior*, 52, 195–197.

Daffre, S., Kylsten, P., Samakovlis, C. & Hultmark, D. (1994) The lysozyme locus in *Drosophila melanogaster*: an expanded gene family adapted for expression in the digestive tract. *Molecular and General Genetics*, 242, 152–162.

D'Agati, P. & Cammarata, M. (2006) Comparative analysis of thyroxine distribution in Ascidian larvae. *Cell and Tissue Research*, 323, 529–535.

Daitoku, H., Hatta, M., Matsuzaki, H., Aratani, S., Ohshima, T., Miyagishi, M., Nakajima, T. & Fukamizu, A. (2004) Silent information regulator 2 potentiates Foxo1-mediated transcription through its deacetylase activity. *Proceedings of the National Academy of Sciences of the United States of America*, 101, 10042–10047.

D'Amico, L. J., Davidowitz, G. & Nijhout, H. F. (2001) The developmental and physiological basis of body size evolution in an insect. *Proceedings of the Royal Society of London B*, 268, 1589–1593.

Danilova, N. (2006) The evolution of immune mechanisms. *Journal of Experimental Zoology B*, 306, 496–520.

Danks, H. V. (1987) *Insect Dormancy: An Ecological Perspective*. Ottawa, Biological Survey of Canada.

Danks, H.V. (1991) Winter habitats and ecological adaptations for winter survival. In Lee, R. E.& Delinger, D. L. (Eds.) *Insects at Low Temperature*. Chapman and Hall, New York and London. pp. 231–259

Danks, H.V. (1994) *Insect life-cycle polymorphism: theory, evolution and ecological consequences for seasonality and diapause control*. Dordrecht, Kluwer.

Danks, H.V. (2002) The range of insect dormancy responses. *European Journal of Entomology*, 99, 127–142.

Danks, H. V. (2005) How similar are daily and seasonal biological clocks? *Journal of Insect Physiology*, 51, 609–619.

Darwin, C. (1859) *On the Origin of Species by Means of Natural Selection*. London, J. Murray.

Das, N., Levine, R. L., Orr, W. C. & Sohal, R. S. (2001) Selectivity of protein oxidative damage during aging in *Drosophila melanogaster*. *Biochemical Journal*, 360, 209–216.

Das, B., Schreiber, A. M., Huang, H. & Brown, D. D. (2002) Multiple thyroid hormone-induced muscle growth and death programs during metamorphosis in *Xenopus laevis*. *Proceedings of the National Academy of Sciences of the United States of America*, 99, 12230–12235.

Das, R. M., Van Hateren, N. J., Howell, G. R., Farrell, E. R., Bangs, F. K., Porteous, V. C., Manning, E. M., McGrew, M. J., Ohyama, K., Sacco, M. A., Halley, P. A., Sang, H. M., Storey, K. G., Placzek, M., Tickle, C., Nair, V. K. & Wilson, S. A. (2006) A robust system for RNA interference in the chicken using a modified microRNA operon. *Developmental Biology*, 294, 554–563.

Davey, J. C., Becker, K. B., Schneider, M. J., St Germain, D. L. & Galton, V. A. (1995) Cloning of a cDNA for the type II iodothyronine deiodinase. *Journal of Biological Chemistry*, 270, 26786–26789.

David, J. R. (1970) Le nombre d'ovarioles ches la drosophile en relation avec la fecondite et la valeur adaptive. *Archives de Zoologie Experimentale et Generale*, 111, 357–370.

David, J. R. & Capy, P. (1988) Genetic variation of *Drosophila melanogaster* natural populations. *Trends in Genetics*, 4, 106–111.

Davidowitz, G. & Nijhout, H. F. (2004) The physiological basis of reaction norms: The interaction among growth rate, the duration of growth and body size. *Integrative and Comparative Biology*, 44, 443–449.

Davidowitz, G., D'Amico, L. J., Roff, D. A. & Nijhout, H. F. (2002) The physiological regulation of insect body size. *Integrative and Comparative Biology*, 42, 1217–1217.

Davidowitz, G., D'Amico, L. J. & Nijhout, H. F. (2004) The effects of environmental variation on a mechanism that controls insect body size. *Evolutionary Ecology Research*, 6, 49–62.

Davidowitz, G., Roff, D. A. & Nijhout, H. F. (2005) A physiological perspective on the response of body size and development time to simultaneous directional selection. *Integrative and Comparative Biology*, 45, 525–531.

Davidson, B. & Swalla, B. J. (2002) A molecular analysis of ascidian metamorphosis reveals activation of an innate immune response. *Development*, 129, 4739–4751.

Davidson, J. M., Camargo, C. A. & Smith, E. R. (1978) Effects of androgen on sexual behavior in hypogonadal men. *Journal of Clinical Endocrinology and Metabolism* 48, 955–958.

Davidson, E. H., Cameron, R. A. & Ransick, A. (1998) Specification of cell fate in the sea urchin embryo: summary and some proposed mechanisms. *Development*, 125, 3269–3290.

Davidson, B., Jacobs, M. & Swalla, B. J. (2002) *The Individual as a Module: Metazoan evolution and coloniality*. Chicago, University of Chicago Press.

Davies, J. P., Yildiz, F. H. & Grossman, A. (1996) Sac1, a putative regulator that is critical for survival of *Chlamydomonas reinhardtii* during sulfur deprivation. *EMBO Journal*, 15, 2150–2159.

Davis, P. J., Leonard, J. L. & Davis, F. B. (2008) Mechanisms of nongenomic actions of thyroid hormone. *Frontiers in Neuroendocrinology*, 29, 211–218.

Day, T. & Rowe, L. (2002) Developmental Thresholds and the Evolution of Reaction Norms for Age and Size at Life History Transitions. *The American Naturalist*, 159, 338–350.

Deacon, T. W. (1997) *The Symbolic Species: The Co-evolution of Language and the Brain*. New York, Norton.

Dean, A. M. & Thornton, J. W. (2007) Mechanistic approaches to the study of evolution: the functional synthesis. *Nature Reviews Genetics*, 8, 675–688.

Dean, C., Leakey, M. G., Reid, D., Schrenk, F., Schwartz, G. T., Stringer, C. & Walker, A. (2001) Growth processes in teeth distinguish modern humans from *Homo erectus* and earlier hominins. *Nature*, 414, 628–631.

de Azevedo, S. V. & Hartfelder, K. (2008) The insulin signaling pathway in honey bee (*Apis mellifera*) caste development - differential expression of insulin-like peptides and insulin receptors in queen and worker larvae. *Journal of Insect Physiology*, 54, 1064–1071.

De Bono, M. & Bargmann, C. I. (1998) Natural variation in a neuropeptide Y receptor homolog modifies social behavior and food response in *C. elegans*. *Cell*, 94, 679–689.

De Gregorio, E., Spellman, P. T., Rubin, G. M. & Lemaitre, B. (2001) Genome-wide analysis of the *Drosophila* immune response by using oligonucleotide microarrays. *Proceedings of the National Academy of Sciences of the United States of America*, 98, 12590–12595.

De Groef, B., Goris, N., Arckens, L., Kuhn, E. R. & Darras, V. M. (2003) Corticotropin-releasing hormone (CRH)-induced thyrotropin release is directly mediated through CRH receptor type 2 on thyrotropes. *Endocrinology*, 144, 5537–5544.

de Heinzelin, J., Clark, J. D., White, T., Hart, W., Renne, P., Wolde Gabriel, G., Beyene, Y. & Vrba, E. (1999) Environment and behavior of 2.5-million-year-old Bouri hominids. *Science*, 284, 625–629.

de Jesus, E. G. (1994) Thyroid hormone surges during milkfish metamorphosis. *Israeli Journal of Aquaculture-Bamidgeh*, 46, 59–63.

de Jesus, E. G., Toledo, J. D. & Simpas, M. S. (1998) Thyroid hormones promote early metamorphosis in grouper (*Epinephelus coioides*) larvae. *General and Comparative Endocrinology*, 112, 10–16.

de Jong, M. A., Kesbeke, F. M. N. H., Brakefield, P. M., and Zwaan, B. J. (2010) Geographic variation in thermal plasticity of life history and wing pattern in *Bicyclus anynana. Climate Research* 43: 91–102.

de Jong, G. & Bochdanovits, Z. (2003) Latitudinal clines in *Drosophila melanogaster*: body size, allozyme frequencies, inversion frequencies, and insulin-signalling pathway. *Journal of Genetics*, 82, 207–223.

De Jong, G. & Van Noordwijk, A. J. (1992) Acquisition and allocation of resources: Genetic (co)variances, selections, and life histories. *The American Naturalist*, 139, 749–770.

Dekker, T., Geier, M. & Carde, R. T. (2005) Carbon dioxide instantly sensitizes female yellow fever mosquitoes to human skin odours. *Journal of Experimental Biology*, 208, 2963–2972.

Delahunty, K. M., McKay, D. W., Noseworthy, D. E. & Storey, A. E. (2007) Prolactin responses to infant cues in men and women: effects of parental experience and recent infant contact. *Hormones and Behavior*, 51, 213–220.

de La Rochebrochard, E., De Mouzon, J., Thepot, F. & Thonneau, P. (2006) Fathers over 40 and increased failure to conceive: the lessons of in vitro fertilization in France. *Fertility and Sterility*, 85, 1420–1424.

Delmotte, F., Leterme, N., Bonhomme, J., Rispe, C. & Simon, J.-C. (2001) Multiple routes to asexuality in an aphid species. *Proceedings of the Royal Society of London B*, 268, 2291–2299.

De Luca, M., Roshina, N. V., Geiger-Thornsberry, G. L., Lyman, R. F., Pasyukova, E. G. & Mackay, T. F. (2003) Dopa decarboxylase (Ddc) affects variation in *Drosophila* longevity. *Nature Genetics*, 34, 429–433.

De Martinis, D., Cotti, G., Heker, S. T., Harren, F. J. M. & Mariani, C. (2002) Ethylene response to pollen tube growth in *Nicotiana tabacum* flowers. *Planta*, 214, 806–812.

Demas, G. E. (2004) The energetics of immunity: A neuroendocrine link between energy balance and immune function. *Hormones and Behavior*, 43, 75–80.

Denlinger, D. L. (1986) Dormancy in tropical insects. *Annual Review of Entomology*, 31, 239–264.

Denlinger, D. L. (2002) Regulation of diapause. *Annual Review of Entomology*, 47, 93–122.

Denlinger, D. L., Yocum, G. D. & Rinehart, J. P. (2004) Hormonal control of diapause. In Gilbert, L. I., Iatrou, K. & Gill, S. S. (Eds.) *Comprehensive Molecular Insect Science*. Amsterdam, Elsevier.

Dennis, G., Sherman, B. T., Hosack, D. A., Yang, J., Gao, W., Lane, H. C. & Lempicki, R. A. (2003) DAVID: Database for Annotation, Visualization, and Integrated Discovery. *Genome Biology*, 4, P3.

Dent, J. N., Etkin, W. & Gilbert, L. I. (1968) A Survey of Amphibian Metamorphosis. In Gilbert, L. I. & Frieden, E. (Eds.) *Metamorphosis: A Problem in Developmental Biology*. New York, Plenum Press.

Denver, R. J. (1988) Several hypothalamic peptides stimulate in vitro thyrotropin secretion by pituitaries of anuran amphibians. *General and Comparative Endocrinology*, 72, 383–393.

Denver, R. J. (1996) Neuroendocrine Control of Amphibian Metamorphosis. In Gilbert, L. I., Tata, J. R. & Atkinson, B. G. (Eds.) *Metamorphosis: Postembryonic Reprogramming of Gene Expression in Amphibian and Insect Cells*. San Diego, Academic Press.

Denver, R. J. (2000) Evolution of the corticotropin-releasing hormone signaling and its role in stress-induced developmental plasticity. *American Zoologist* 40, 995–996.

Denver, R. J. (2009) Stress hormones mediate environment-genotype interactions during amphibian development. *General and Comparative Endocrinology*, 164, 20–31.

Denver, R. J., Glennmeier, K. A., Boorse, G. C. (2002) Endocrinology of Complex Life Cycles: Amphibians. In Pfaff, D. W., Arnold, A. P., Etgen, A. M., Fahrbach, S. E. & Ruben, R. T. (Eds.) *Hormones, Brain and Behavior*. USA, Elsevier.

Denver, R. J. & Licht, P. (1989a) Neuropeptide stimulation of thyrotropin secretion in the larval bullfrog: evidence for a common neuroregulator of thyroid and interrenal activity in metamorphosis. *Journal of Experimental Zoology*, 252, 101–104.

Denver, R. J. & Licht, P. (1989b) Neuropeptides influencing *in vitro* pituitary hormone secretion in hatchling turtles. *Journal of Experimental Zoology*, 251, 306–315.

Derby, A. (1975) An *in vitro* quantitative analysis of the response of tadpole tissue to thyroxine. *Journal of Experimental Biology*, 168, 147–156.

Déry, M. A., Michaud, M. D. & Richard, D. E. (2005) Hypoxia-inducible factor 1: regulation by hypoxic and non-hypoxic activators. *International Journal of Biochemistry & Cell Biology*, 37, 535–540.

Desalvo, M. K., Voolstra, C. R., Sunagawa, S., Schwarz, J. A., Stillman, J. H., Coffroth, M. A., Szmant, A. M. & Medina, M. (2008) Differential gene expression during thermal stress and bleaching in the Caribbean coral. *Montastraea faveolata*. *Molecular Ecology*, 17, 3952–3971.

De Witt, T. J. & Scheiner, S. M. (eds.). 2004. *Phenotypic plasticity: functional and conceptual approaches.* Oxford, Oxford University Press.

De Witt, T. J., Sih, A. & Wilson, D. S. (1998) Costs and limits of phenotypic plasticity. *Trends in Ecology & Evolution*, 13, 77–81.

Dibello, P. L. R., Withers, D. A., Bayer, C. A., Fristrom, J. W. & Guild, G. M. (1991) The *Drosophila broad-complex* encodes a family of related proteins containing zinc fingers. *Genetics* 129, 385–397.

Di Bernardo, M., Castagnetti, S., Bellomonte, D., Oliveri, P., Melfi, R., Palla, F. & Spinelli, G. (1999) Spatially restricted expression of PlOtp, a *Paracentrotus lividus* orthopedia-related homeobox gene, is correlated with oral ectodermal patterning and skeletal morphologenesis in late-cleavage sea urchin embryos. *Development*, 126, 2171–2179.

Dijkstra, C., Bult, A., Bijlsma, S., Daan, S., Meijer, T. & Zijlstra, M. (1990) Brood size manipulations in the kestrel (*Falco tinnunculus*) - effects on offspring and parent survival. *Journal of Animal Ecology*, 59, 269–285.

Dill, A. & Sun, T. P. (2001) Synergistic derepression of gibberellin signaling by removing *RGA* and *GAI* function in *Arabidopsis thaliana*. *Genetics*, 159, 777–785.

Dillin, A., Crawford, D. K. & Kenyon, C. (2002) Timing requirements for insulin/ IGF-1 signaling in *C. elegans*. *Science*, 298, 830–834.

Dillon, R. J. & Dillon, V. M. (2004) The gut bacteria of insects: nonpathogenic interactions. *Annual Review of Entomology*, 49, 71–92.

Dingemanse, N. J., Edelaar, P. & Kempenaers, B. (2010b) Why is there variation in baseline glucocorticoid levels? *Trends in Ecology & Evolution*, 25, 261–262.

Dingemanse, N. J., Kazem, A. J. N., Reale, D. & Wright, J. C. (2010a) Behavioural reaction norms: animal personality meets individual plasticity. *Trends in Ecology & Evolution*, 25, 81–89.

Diola, V., Orth, A. I. & Guerra, M. P. (2008) Reproductive biology in monoecious and gynoecious cucumber cultivars as a result of IBA application. *Horticultura Brasileira*, 26, 30–34.

Dionne, M. S. & Schneider, D. S. (2008) Models of infectious diseases in the fruit fly *Drosophila melanogaster*. *Disease Models and Mechanisms*, 1, 43–49.

Dionne, M. S., Pham, L. N., Shirasu-Hiza, M. M. & Schneider, D. S. (2006) Akt and FOXO dysregulation contribute to infection-induced wasting in *Drosophila*. *Current Biology*, 16, 1977–1985.

Dittami, J. P. & Gwinner, E. (1985) Annual cycles in the African stonechat *Saxicola torquata axillaris* and their relationship to environmental factors. *Journal of Zoology*, 207, 357–370.

Djawdan, M., Sugiyama, T., Schlaeger, L., Bradley, T. & Rose, M. (1996) Metabolic aspects of the trade-off between fecundity and longevity in *Drosophila melanogaster*. *Physiological Zoology*, 69, 1176–1195.

Djawdan, M., Chippindale, A. K., Rose, M. R. & Bradley, T. J. (1998) Metabolic reserves and evolved stress resistance in *Drosophila melanogaster*. *Physiological Zoology*, 71, 584–594.

Doane, W. W. (1960) Developmental physiology of the mutant *female sterile (2) adipose* of *Drosophila melanogaster* I. Adult morphology, longevity, egg production, and egg lethality. *Journal of Experimental Zoology*, 145, 1–21.

Dobretsov, S., Teplitski, M. & Paul, V. J. (2009) Mini-review: quorum sensing in the marine environment and its relationship to biofouling. *Biofouling*, 25, 413–427.

Dodd, M. H. I., & Dodd, J. M. (1976) The biology of metamorphosis. In Lofts, B. (Ed.) *Physiology of the Amphibia* vol. III. New York, Academic Press.

Domanitskaya, E. V., Liu, H., Chen, S. & Kubli, E. (2007) The hydroxyproline motif of male sex peptide elicits the innate immune response in *Drosophila* females. *FEBS Journal*, 274, 5659–5668.

Dominici, F. P., Hauck, S., Argentino, D. P., Bartke, A. & Turyn, D. (2002) Increased insulin sensitivity and upregulation of insulin receptor, insulin receptor substrate (IRS)-1 and IRS-2 in liver of Ames dwarf mice. *Journal of Endocrinology*, 173, 81–94.

Dominick, O. S. & Truman, J. W. (1986a) The physiology of wandering behavior in *Manduca sexta*, 3. Organization of wandering behavior in the larval nervous-system. *Journal of Experimental Biology*, 121, 115–132.

Dominick, O. S. & Truman, J. W. (1986b) The physiology of wandering behavior in *Manduca sexta*, 4. Hormonal induction of wandering behavior from the isolated nervous system. *Journal of Experimental Biology*, 121, 133–151.

Donahue, S. P. & Phillips, L. S. (1989) Response of IGF-1 to nutritional support in malnourished hospital patients: a possible indicator of short-term changes in nutritional status. *American Journal of Clinical Nutrition*, 50, 962–969.

Donehower, L. A., Harvey, M., Slagle, B. L., McArthur, M. J., Montgomery, C. A. J., Butel, J. S. & Bradley, A. (1992) Mice deficient for p53 are developmentally normal but susceptible to spontaneous tumours. *Nature*, 356, 215–221.

Donohue, K., Dorn, L., Griffith, C., Kim, E., Aguilera, A., Polisetty, C. R., Schmitt, J. & Galloway, L. (2005) Environmental and genetic influences on the germination of *Arabidopsis thaliana* in the field. *Evolution*, 59, 740–757.

Donovan, B. T. & van der Werff ten Bosch, J. J. (1965) *Physiology of puberty*. Baltimore, Williams and Wilkins.

Dorn, A. (1983) Hormones during embryogenesis of the milkweed bug, *Oncopeltus fasciatus* (Heteroptera: Lygaeidae). *Entomologia Generalis* 8, 193–214.

Dover, G. (2000) How genomic and developmental dynamics affect evolutionary processes. *BioEssays*, 22, 1153–1159.

Dowling, D. K. & Simmons, L. W. (2009) Reactive oxygen species as universal constraints in life history evolution. *Proceedings of the Royal Society of London B*, 276, 1737–1745.

Doyle, M. R., Bizzell, C. M., Keller, M. R., Michaels, S. D., Song, J., Noh, Y. S., & Amasino, R. M. (2005) HUA2 is required for the expression of floral repressors in *Arabidopsis thaliana. Plant Journal*, 41, 376–385.

Draper, P. & Harpending, H. (1988) A sociobiological perspective on the development of human reproductive strategies. In MacDonald, K. B. (Ed.) *Sociobiological*

Perspectives on Human Development. New York, Springer.

Draper, I., Kurshan, P. T., McBride, E., Jackson, F. R. & Kopin, A. S. (2007) Locomotor activity is regulated lay D2-like receptors in *Drosophila*: An anatomic and functional analysis. *Developmental Neurobiology*, 67, 378–393.

Drnevich, J. M., Reedy, M. M., Ruedi, E. A., Rodriguez-Zas, S. & Hughes, K. A. (2004) Quantitative evolutionary genomics: differential gene expression and male reproductive success in *Drosophila melanogaster*. *Proceedings of the Royal Society of London B*, 271, 2267–2273.

Drummond, A. J., Ashton, B., Buxton, S., Cheung, M., Heled, J., Kearse, M., Thierer, T. & Wilson, A. (2010) *Geneious v4.8*, available from http://www.geneious.com.

Drummond-Barbosa, D. (2008) Stem cells, their niches and the systemic environment: An aging network. *Genetics*, 180, 1787–1797.

Drummond-Barbosa, D. & Spradling, A. C. (2001) Stem cells and their progeny respond to nutritional changes during *Drosophila* oogenesis. *Developmental Biology*, 231, 265–278.

Duboc, V., Röttinger, E. & Lepage, T. (2004) Nodal and BMP2/4 signaling organizes the oral-aboral axis of the sea urchin embryo. *Development Cell*, 6, 397–410.

Dudas, S. P. & Arking, R. A. (1995) A coordinate upregulation of antioxidant gene activity is associated with the delayed onset of senescence in a long-lived strain of *Drosophila*. *Journal of Gerontology A*, 50A, B117–B127.

Dudley, R. (1998) Atmospheric oxygen, giant Paleozoic insects and the evolution of aerial locomotor performance. *Journal of Experimental Biology*, 201, 1043–1050.

Duellman, W. E. & Trueb, L. (1994) *Biology of Amphibians*. Baltimore, Johns Hopkins University Press.

Dufour, S. & Rousseau, K. (2007) Neuroendocrinology of fish metamorphosis and puberty: Evolutionary and ecophysiological perspectives. *Journal of Marine Science and Technology*, 15, 55–68.

Duloquin, L., Lhomond, G. & Gache, C. (2007) Localized VEGF signaling from ectoderm to mesenchyme cells controls morphogenesis of the sea urchin embryo skeleton. *Development*, 134, 2293–2302.

Dunbar, R. I. M. (1998) The social brain hypothesis. *Evolutionary Anthropology*, 6, 178–190.

Duncan, L., Nishii, I., Harryman, A., Buckley, S., Howard, A., Friedman, N. R. & Miller, S. M. (2007) The VARL gene family and the evolutionary origins of the master cell-type regulatory gene, regA, in *Volvox carteri*. *Journal of Molecular Evolution*, 65, 1–11.

Dunkov, B. & Georgieva, T. (2006) Insect iron binding proteins: insights from the genomes. *Insect Biochemistry & Molecular Biology*, 36, 300–309.

Dunlap, J. C. (1999) Molecular bases for circadian clocks. *Cell*, 96, 271–290.

Dunlop, E. S., Heino, M. & Dieckmann, U. (2009) Eco-genetic modeling of contemporary life-history evolution. *Ecological Applications*, 19, 1815–1834.

Dupont, S., Wilson, K., Obst, M., Skold, H., Nakano, H. & Thorndyke, M. C. (2007) Marine ecological genomics: when genomics meets marine ecology. *Marine Ecology Progress Series*, 332, 257–273.

Dupont, S., Thorndyke, W., Thorndyke, M. C. & Burke, R. D. (2009) Neural development of the brittlestar *Amphiura filiformis*. *Development, Genes and Evolution*, 219, 159–166.

Dykhuizen, D. E. & Dean, A. M. (2009) Experimental evolution from the bottom up. In Garland, T. & Rose, M. R. (Eds.) *Experimental Evolution: Methods and Applications*. Berkeley, University of California Press.

Eales, J. G. (1997) Iodine metabolism and thyroid-related functions in organisms lacking thyroid follicles: Are thyroid hormones also vitamins? *Proceedings of the Society for Experimental Biology and Medicine*, 214, 302–317.

Eales, J. G. & Brown, S. B. (1993) Measurement and regulation of thyroidal status in teleost fish. *Reviews in Fish Biology and Fisheries*, 3, 299–347.

Eales, J. G., Holmes, J. A., McLeese, J. M. & Youson, J. H. (1997) Thyroid hormone deiodination in various tissues of larval and upstream-migrant sea lampreys, *Petromyzon marinus*. *General and Comparative Endocrinology*, 106, 202–210.

Eales, J. G., McLeese, J. M., Holmes, J. A. & Youson, J. H. (2000) Changes in intestinal and hepatic thyroid hormone deiodination during spontaneous metamorphosis of the sea Lamprey, *Petromyzon marinus. Journal of Experimental Zoology*, 286, 305–312.

Eanes, W. F. (1999) Analysis of selection on enzyme polymorphisms. *Annual Review of Ecology and Systematics*, 30, 301–326.

Ebbesson, L. O. E., Bjoernsson, B. T., Ekstroem, P. & Stefansson, S. O. (2008) Daily endocrine profiles in parr and smolt Atlantic salmon. *Comparative Biochemistry and Physiology A*, 151, 698–704.

Eberhard, S., Finazzi, G. & Wollman, F. A. (2008) The dynamics of photosynthesis. *Annual Review of Genetics*, 42, 463–515.

Ebert, D. & Mangin, K. (1997) The influence of host demography on the evolution of virulence of a microsporidian gut parasite. *Evolution*, 51, 1828–1837.

Edeline, E., Bardonnet, A., Bolliet, V., Dufour, S. & Pierre, E. (2005) Endocrine control of *Anguilla anguilla* glass eel dispersal: Effect of thyroid hormones on locomotor activity and rheotactic behavior. *Hormones and Behavior*, 48, 53–63.

Edgar, B. A. (1999) From small flies come big discoveries about size control. *Nature Cell Biology*, 1, E191–E193.

Edgar, B. A. (2006) How flies get their size: genetics meets physiology. *Nature Reviews Genetics*, 7, 907–916.

Edwards, J. S. & Chen, S.-W. (1979) Embryonic development of an insect sensory system, the abdominal cerci of *Acheta domesticus*. *Roux's Archives of Developmental Biology*, 186, 151–178.

Ehrenreich, I. M. & Purugganan, M. D. (2006) The molecular genetic basis of plant adaptation. *American Journal of Botany*, 93, 953–962.

Ehrenreich, I. M., Honzawa, Y., Chou, L., Roe, J. L., Kover, P. X. & Purugganan, M. D. (2009) Candidate gene association mapping of *Arabidopsis* flowering time. *Genetics*, 183, 325–335.

Eigenmann, J. E., Patterson, D. F. & Froesch, E. R. (1984a) Body size parallels insulin-like growth factor 1 levels but not growth hormone secretory capacity. *Acta Endocrinologica*, 106, 448–453.

Eigenmann, J. E., Patterson, D. F., Zapf, J. & Froesch, E. R. (1984b) Insulin-like growth factor 1 in the dog - a study in different dog breeds and in dogs with growth hormone elevation *Acta Endocrinologica*, 105, 294–301.

El-Assal, S. E. D., Alonso-Blanco, C., Peeters, A. J. M., Raz, V. & Koornneef, M. (2001) A QTL for flowering time in *Arabidopsis* reveals a novel allele of *CRY2*. *Nature Genetics*, 29, 435–440.

El-Assal, S. E. D., Alonso-Blanco, C., Peeters, A. J. M., Wagemaker, C., Weller, J. L. & Koorneef, M. (2004) The role of cryptochrome 2 in flowering in *Arabidopsis*. *Plant Physiology*, 134, 539–539.

Elia, M. (1992) Organ and tissue contribution to metabolic rate. In McKinney, J. M. & Tucker, H. N. (Eds.) *Energy Metabolism: Tissue Determinents and Cellular Corollaries*. New York, Raven Press.

Elia, L., Selvakumaraswamy, P. & Byrne, M. (2009) Nervous system development in feeding and nonfeeding asteroid larvae and the early juvenile. *Biological Bulletin*, 216, 322–334.

Elinson, R. P. (2001) Direct development: an alternative way to make a frog. *Genesis* 29, 91–95.

Ellers, J. & Boggs, C. L. (2004) Functional ecological implications of intraspecific differences in wing melanization in *Colias* butterflies. *Biological Journal of the Linnean Society*, 82, 79–87.

Ellis, B. J. & Garber, J. (2000) Psychosocial antecedents of variation in girls' pubertal timing: maternal depression, stepfather presence, and marital and family stress. *Child Development*, 71, 485–501.

Ellison, P. T. (1982) Skeletal growth, fatness, and menarcheal age: a comparison of two hypotheses. *Human Biology*, 54, 269–281.

Ellison, P. T. (1990) Human ovarian function and reproductive ecology: new hypotheses. *American Anthropologist*, 92, 933–952.

Ellison, P. T. (2001) *On fertile ground, a natural history of human reproduction*. Cambridge, Harvard University Press.

Ellison, P. T. (2003) Energetics and reproductive effort. *American Journal of Human Biology*, 15, 342–351.

Ellison, P. T. & Lager, C. (1986) Moderate recreational running is associated with lowered salivary progesterone profiles in women. *American Journal of Obstetrics and Gynecology*, 154, 1000–1003.

Ellison, P. T. & Panter-Brick, C. (1996) Salivary testosterone levels among Tamang and Kami males of central Nepal. *Human Biology*, 68, 955–965.

Ellison, P. T. & Valeggia, C. R. (2003) C-peptide levels and the duration of lactational amenorrhea. *Fertility and Sterility*, 80, 1279–1280.

Ellison, P. T., Bribiescas, R. G., Bentley, G. R., Campbell, B. C., Lipson, S. F., Panter-Brick, C. & Hill, K. (2002) Population variation in age-related decline in male salivary testosterone. *Human Reproduction*, 17, 3251–3253.

Elzinga, J. A., Atlan, A., Biere, A., Gigord, L., Weis, A. E. & Bernasconi, G. (2007) Time after time: flowering phenology and biotic interactions. *Trends in Ecology & Evolution*, 22, 432–439.

Emerson, K. J., Bradshaw, W. E. & Holzapfel, C. M. (2009a) Complications of complexity: integrating environmental, genetic and hormonal control of insect diapause. *Trends in Genetics*, 25, 217–225.

Emerson, K. J., Uyemra, A. M., McDaniel, K. L., Schmidt, P. S., Bradshaw, W. E. & Holzapfel, C. M. (2009b) Environmental control of ovarian dormacy in natural populations of *Drosophila melanogaster*. *Journal of Comparative Physiology A*, 196, 825–829.

Emlen, D. J. & Allen, C. E. (2003) Genotype to phenotype: Physiological control of trait size and scaling in insects. *Integrative and Comparative Biology*, 43, 617–634.

Emlen, D. J., Lavine, L. C. & Ewen-Campen, B. (2007) On the origin and evolutionary diversification of beetle horns. *Proceedings of the National Academy of Sciences of the United States of America*, 104, 8661–8668.

Emlet, R. B. (1986) Facultative planktotrophy in the tropical Echinoid *Clypeaster rosaceus* (Linnaeus) and a comparison with obligate planktotrophy in *Clypeaster subdepressus* (Gray) (Clypeasteroida, Echinoidea).

Journal of Experimental Marine Biology and Ecology, 95, 183–202.

Emlet, R. B. (1995) Larval spicules, cilia, and symmetry as remnants of indirect development in the direct developing sea urchin *Heliocidaris erythrogramma*. *Developmental Biology*, 167, 405–415.

Endler, J. A. (1986) *Natural selection in the wild*. Monographs in population biology. Princeton, Princeton University Press.

Endler, J. A. (1995) Multiple-trait coevolution and environmental gradients in guppies. *Trends in Ecology & Evolution*, 10, 22–29.

Engelmann, K. & Purugganan, M. (2006) The molecular evolutionary ecology of plant development: flowering time in *Arabidopsis thaliana*. *Advances in Botanical Research*, 44, 507–526.

Eraso, P. & Gancedo, J. M. (1985) Use of glucose analogs to study the mechanism of glucose-mediated cAMP increase in yeast. *FEBS Letters*, 191, 51–54.

Erezyilmaz, D. F. (2006) Imperfect eggs and oviform nymphs: a history of ideas about the origins of insect metamorphosis. *Integrative and Comparative Biology*, 46, 795–807.

Erezyilmaz, D. F., Riddiford, L. M. & Truman, J. W. (2004) Juvenile hormone acts at embryonic molts and induces the nymphal cuticle in the direct-developing cricket. *Development, Genes and Evolution*, 214, 313–323.

Erezyilmaz, D. F., Riddiford, L. M. & Truman, J. W. (2006) The pupal specifier broad directs progressive morphogenesis in a direct-developing insect. *Proceedings of the National Academy of Sciences of the United States of America*, 103, 6925–6930.

Erezyilmaz, D. F., Rynerson, M. R., Truman, J. W. and Riddiford, L. M. (2010). The Role of the Pupal Determinant Broad During Embryonic Development of a Direct-Developing Insect. *Development, Genes and Evolution*. 219 (535–544).

Eri, R., Arnold, J. M., Hinman, V. F., Green, K. M., Jones, M. K., Degnan, B. M. & Lavin, M. F. (1999) Hemps, a novel Egf-like protein, plays a central role in Ascidian metamorphosis. *Development*, 126, 5809–5818.

Ernande, B., Clobert, J., McCombie, H. & Boudry, P. (2003) Genetic polymorphism and trade-offs in the early life history strategy of the Pacific oyster, *Crassostrea gigas* (Thunberg, 1795): a quantitative genetic study. *Journal of Evolutionary Biology*, 16, 399–414.

Escriva, H., Manzon, L., Youson, J. & Laudet, V. (2002) Analysis of lamprey and hagfish genes reveals a complex history of gene duplications during early vertebrate evolution. *Molecular Biology and Evolution*, 19, 1440–1450.

Essers, M. A., De Vries-Smits, L. M., Barker, N., Polderman, P. E., Burgering, B. M. & Korswagen, H. C. (2005) Functional interaction between beta-catenin and FOXO in oxidative stress signaling. *Science*, 308, 1181–1184.

Essner, J. J., Breuer, J. J., Essner, R. D., Fahrenkrug, S. C. & Hackett, P. B. (1997) The zebrafish thyroid hormone receptor alpha 1 is expressed during early embryogenesis and can function in transcriptional repression. *Differentiation*, 62, 107–117.

Essner, J. J., Johnson, R. G. & Hackett, P. B. (1999) Overexpression of thyroid hormone receptor alpha 1 during zebrafish embryogenesis disrupts hindbrain patterning and implicates retinoic acid receptors in the control of hox gene expression. *Differentiation*, 65, 1–11.

Ettensohn, C. A. (2009) Lessons from a gene regulatory network: echinoderm skeletogenesis provides insights into evolution, plasticity and morphogenesis. *Development*, 136, 11–21.

Ettensohn, C. A. & McClay, D. R. (1986) The regulation of primary mesenchyme cell migration in the sea urchin embryo: transplantations of cells and latex beads. *Developmental Biology*, 117, 380–391.

Evans, J. D. & Wheeler, D. E. (1999) Differential gene expression between developing queens and workers in the honey bee, *Apis mellifera*. *Proceedings of the National Academy of Sciences of the United States of America*, 96, 5575–5580.

Evans, J. D., Aronstein, K., Chen, Y. P., Hetru, C., Imler, J. L., Jiang, H., Kanost, M., Thompson, G. J., Zou, Z. & Hultmark, D. (2006) Immune pathways and defence mechanisms in honey bees *Apis mellifera*. *Insect Molecular Biology*, 15, 645–656.

Everitt, A. V. & Le Couteur, D. G. (2007) Life extension by calorie restriction in humans. *Annals of the New York Academy of Sciences*, 1114, 428–433.

Evgen'ev, M. B., Garbuz, D. G., Shilova, V. Y. & Zatsepina, O. G. (2007) Molecular mechanisms underlying thermal adaptation of xeric animals. *Journal of Biosciences*, 32, 489–499.

Fahrbach, S. E., Strande, J. L. & Robinson, G. E. (1995) Neurogenesis is absent in the brains of adult honey bees and does not explain behavioral neuroplasticity. *Neuroscience Letters*, 197, 145–148.

Fahrbach, S. E., Moore, D., Capaldi, E. A., Farris, S. M. & Robinson, G. E. (1998) Experience-expectant plasticity in the mushroom bodies of the honeybee. *Learning & Memory*, 5, 115–123.

Falconer, D. S. (1981) *Introduction to Quantitative Genetics*. London, Longman.

Falconer, D. S. & Mackay, T. F. C. (1996) *Introduction to Quantitative Genetics*. Fourth Edition, Essex, Pearson Prentice Hall.

Falster, D. S., Moles, A. T. & Westoby, M. (2008) A general model for the scaling of offspring size and adult size. *The American Naturalist*, 172, 299–317.

Farley, J. (1982). Gametes and spores: ideas about sexual reproduction 1750–1914. Johns Hopkins Univ Press, *Baltimore* USA.

Faulks, S. C., Turner, N., Else, P. L. & Hulbert, A. J. (2006) Calorie restriction in mice: effects on body composition, daily activity, metabolic rate, mitochondrial reactive oxygen species production, and membrane fatty acid composition. *Journal of Gerontology A*, 61, 781–794.

Fautin, D. G. (2002) Reproduction of Cnidaria. *Canadian Journal of Zoology-Revue Canadienne de Zoologie*, 80, 1735–1754.

Feder, M. E. & Walser, J.-C. (2005) The biological limitations of transcriptomics in elucidating stress and stress responses. *Journal of Evolutionary Biology*, 18, 901–910.

Fedorka, K. M., Linder, J. E., Winterhalter, W. E. & Promislow, D. (2007) Post-mating disparity between potential and realized immune response in *Drosophila melanogaster*. *Proceedings of the Royal Society of London B*, 274, 1211–1217.

Feldman, H. A., Longcope, C., Derby, C. A., Johannes, C. B., Araujo, A. B., Coviello, A. D., Bremner, W. J. & McKinlay, J. B. (2002) Age trends in the level of serum testosterone and other hormones in middle-aged men: longitudinal results from the Massachusetts male aging study. *Journal of Clinical Endocrinology and Metabolism* 87, 587–598.

Fell, D. (2003) *Understanding the Control of Metabolism*. Portland, Portland Press.

Felley, J. (1980) Analysis of morphology and asymmetry in bluegill sunfish (*Lepomis macrochirus*) in the southeastern United States. *Copeia*, 1980, 18–29.

Fellowes, M. D. E., Kraaijeveld, A. R. & Godfray, H. C. J. (1998) Trade-off associated with selection for increased ability to resist parasitoid attack in *Drosophila melanogaster*. *Proceedings of the Royal Society of London B*, 265, 1553–1558.

Fellowes, M. D. E., Kraaijeveld, A. R. & Godfray, H. C. J. (1999a) Cross-resistance following artificial selection for increased defense against parasitoids in *Drosophila melanogaster*. *Evolution*, 53, 966–972.

Fellowes, M. D. E., Kraaijeveld, A. R. & Godfray, H. C. J. (1999b) The relative fitness of *Drosophila melanogaster* (Diptera, Drosophilidae) that have successfully defended themselves against the parasitoid *Asobara tabida* (Hymenoptera, Braconidae). *Journal of Evolutionary Biology*, 12, 123–128.

Fenaux, L., Strathmann, M. F. & Strathmann, R. R. (1994) Five tests of food-limited growth of larvae in coastal waters by comparisons of rates of development and form of echinoplutei. *Limnology and Oceanography*, 39, 84–98.

Fenner, F. (1983) The Florey Lecture, 1983 - biological-control, as exemplified by smallpox eradication and myxomatosis. *Proceedings of the Royal Society of London B*, 218, 259–285.

Ferea, T. L., Botstein, D., Brown, P. O. & Rosensweig, R. F. (1999) Systematic changes in gene expression and patterns following adaptive evolution in yeast. *Proceedings of the National Academy of Sciences of the United States of America*, 96, 9721–9726.

Ferrandon, D., Jung, A. C., Criqui, M., Lemaitre, B., Uttenweiler-Joseph, S., Michaut, L., Reichhart, J. M. & Hoffmann, J. A. (1998) A drosomycin-GFP reporter transgene reveals a local immune response in *Drosophila* that is not dependent on the Toll pathway. *EMBO Journal*, 17, 1217–1227.

Ferrandon, D., Imler, J. L., Hetru, C. & Hoffmann, J. A. (2007) The *Drosophila* systemic immune response: sensing and signalling during bacterial and fungal infections. *Nature Reviews Immunology*, 7, 862–874.

Ferrari, J., Darby, A. C., Daniell, T. J., Godfray, H. C. J. & Douglas, A. E. (2004) Linking the bacterial community in pea aphids with host-plant use and natural enemy resistance. *Ecological Entomology*, 29, 60–65.

Ferretti, P. & Geraudie, J. (2001) *Cellular and Molecular Basis of Regeneration: From Invertebrates to Humans*. New York, John Wiley and Sons.

Ferveur, J. F. (2005) Cuticular hydrocarbons: their evolution and roles in *Drosophila* pheromonal communication. *Behavioral Genetics*, 35, 279–295.

Festucci-Buselli, R. A., Carvalho-Dias, A. S., De Oliveira-Andrade, M., Caixeta-Nunes, C., Li, H. M., Stuart, J. J., Muir, W., Scharf, M. E. & Pittendrigh, B. R. (2005) Expression of Cyp6g1 and Cyp12d1 in DDT resistant and susceptible strains of *Drosophila melanogaster*. *Insect Molecular Biology*, 14(1), 69–77

Fewell, J. H. & Page, R. E. J. (1993) Genotypic variation in foraging responses to environmental stimuli by honey bees, *Apis mellifera*. *Experientia*, 49, 1106–1112.

Fewell, J. H. & Winston, M. L. (1992) Colony state and regulation of pollen foraging in the honey bee, *Apis mellifera* L. *Behavioral Ecology and Sociobiology*, 30, 387–393.

Ffrench-Constant, R. H. (2007) Which came first: insecticides or resistance? *Trends in Genetics*, 23, 1–4.

Fielenbach, N. & Antebi, A. (2008) *C. elegans* dauer formation and the molecular basis of plasticity. *Genes & Development*, 22, 2149–2165.

Fielenbach, N., Guardavaccaro, D., Neubert, K., Chan, T., Li, D., Feng, Q., Hutter, H., Pagano, M. & Antebi, A. (2007) DRE-1: an evolutionarily conserved F box protein that regulates *C. elegans* developmental age. *Developmental Cell*, 12, 443–455.

Finch, C. E. (1990) *Longevity, senescence and the genome*. Chicago, IL, University of Chicago Press.

Finch, C. E. & Rose, M. R. (1995) Hormones and the physiological architecture of life history evolution. *Quarterly Review of Biology*, 70, 1–52.

Finkel, T. & Holbrook, N. J. (2000) Oxidants, oxidative stress and the biology of aging. *Nature*, 408, 239–247.

Finnerty, J. R., Paulson, D., Burton, P., Pang, K. & Martindale, M. Q. (2003) Early evolution of a homeobox gene: the parahox gene *Gsx* in the Cnidaria and the Bilateria. *Evolution & Development*, 5, 331–345.

Finnerty, J. R., Pang, K., Burton, P., Paulson, D. & Martindale, M. Q. (2004) Origins of bilateral symmetry: Hox and dpp expression in a sea anemone. *Science*, 304, 1335–1337.

Fischer, K., Bot, A. N. M., Brakefield, P. M. & Zwaan, B. J. (2003a) Fitness consequences of temperature-mediated egg size plasticity in a butterfly. *Functional Ecology*, 17, 803–810.

Fischer, K., Brakefield, P. M. & Zwaan, B. J. (2003b) Plasticity in butterfly egg size: Why larger offspring at lower temperatures? *Ecology*, 84, 3138–3147.

Fischer, K., Eenhoorn, E., Bot, A. N. M., Brakefield, P. M. & Zwaan, B. J. (2003c) Cooler butterflies lay larger eggs: developmental plasticity versus acclimation. *Proceedings of the Royal Society of London B*, 270, 2051–2056.

Fischer, K., Bot, A. N. M., Brakefield, P. M. & Zwaan, B. J. (2006) Do mothers producing large offspring have to sacrifice fecundity? *Journal of Evolutionary Biology*, 19, 380–391.

Fisher, R. A. (1930) *The genetical theory of natural selection*. Oxford, Claredon Press.

Fisher, H. (2002) *Why we love: the nature and chemistry of romantic love*. New York, Henry Holt and Company.

Fisher, S. E. (2005) On genes, speech, and language. *New England Journal of Medicine*, 353, 1655–1657.

Fitzpatrick, M. J., Feder, E., Rowe, L. & Sokolowski, M. B. (2007) Maintaining a behaviour polymorphism by frequency-dependent selection on a single gene. *Nature*, 447, 210–212.

Fiumera, A. C., Dumont, B. L. & Clark, A. G. (2006) Natural variation in male-induced 'cost-of-mating' and allele-specific association with male reproductive genes in *Drosophila melanogaster*. *Philosophical Transactions of the Royal Society of London B*, 361, 355–361.

Fivizzani, A. J., Colwell, M. A. & Oring, L. W. (1986) Plasma steroid hormone levels in free-living Wilson's Phalaropes *Phalaropus tricolor*. *General and Comparative Endocrinology*, 62, 137–144.

Flachsbart, F., Caliebe, A., Kleindorp, R., Blanche, H., Von Eller-Eberstein, H., Nikolaus, S., Schreiber, S. & Nebel, A. (2009) Association of FOXO3A variation with human longevity confirmed in German centenarians. *Proceedings of the National Academy of Sciences of the United States of America*, 106, 2700–2705.

Flannagan, R. D., Tammariello, S. P., Joplin, K. H., Cikra-Ireland, R. A., Yocum, G. D. & Denlinger, D. L. (1998) Diapause-specific gene expression in pupae of the flesh fly *Sarcophaga crassipalpis*. *Proceedings of the National Academy of Sciences of the United States of America*, 95, 5616–5620.

Flatt, T. (2004) Assessing natural variation in genes affecting *Drosophila* lifespan. *Mechanisms of Ageing Development*, 125, 155–159.

Flatt, T. (2005) The evolutionary genetics of canalization. *Quarterly Review of Biology*, 80, 287–316.

Flatt, T. (2009) Aging: Diet and longevity in the balance. *Nature*, 462, 989–990.

Flatt, T. & Kawecki, T. J. (2007) Juvenile hormone as a regulator of the trade-off between reproduction and lifespan in *Drosophila melanogaster*. *Evolution*, 61, 1980–1991.

Flatt, T. & Promislow, D. E. (2007) Physiology: Still pondering an age-old question. *Science*, 318, 1255–1256.

Flatt, T. & Schmidt, P. S. (2009) Integrating evolutionary and molecular genetics of aging. *Biochimica et Biophysica Acta*, 1790, 951–962.

Flatt, T., Tu, M. P. & Tatar, M. (2005) Hormonal pleiotropy and the juvenile hormone regulation of *Drosophila* development and life history. *BioEssays*, 27, 999–1010.

Flatt, T., Heyland, A., Rus, F., Porpiglia, E., Sherlock, C., Yamamoto, R., Garbuzov, A., Palli, S. R., Tatar, M. & Silverman, N. (2008a) Hormonal regulation of the humoral innate immune response in *Drosophila melanogaster*. *Journal of Experimental Biology*, 211, 2712–2724.

Flatt, T., Min, K. J., D'Alterio, C., Villa-Cuesta, E., Cumbers, J., Lehmann, R., Jones, D. L. & Tatar, M. (2008b) *Drosophila*, germ-line modulation of insulin signaling and lifespan. *Proceedings of the National Academy of Sciences of the United States of America*, 105, 6368–6373.

Flatt, T., Moroz, L. L., Tatar, M., & Heyland, A. (2006). Comparing thyroid and insect hormone signaling. *Integrative & Comparative Biology*, 46: 777–794.

Fleming, A. S., Ruble, D., Krieger, H. & Wong, P. Y. (1997) Hormonal and experimential correlates of maternal responsiveness during pregnancy and puerperium in human mothers. *Hormones and Behavior*, 31, 145–158.

Fleming, A. S., O'Day, D. H. & Kraemer, G. W. (1999) Neurobiology of mother-infant interactions: Experience and central nervous system plasticity across development and generations. *Neuroscience and Biobehavioral Reviews*, 23, 673–685.

Flinn, M. V. (2006) Cross-cultural universals and variations: The evolutionary paradox of informational novelty. *Psychological Inquiry*, 17, 118–123.

Flinn, M. V. & Alexander, R. D. (2007) Runaway social selection. In Gangestad, S. W. & Simpson, J. A. (Eds.) *The Evolution of Mind*. New York, Guilford Press.

Flinn, M. V. & Coe, K. C. (2007) The linked red queens of human cognition, coalitions, and culture. In Gangestad, S. W. & Simpson, J. A. (Eds.) *The Evolution of Mind*. New York, Guilford Press.

Flinn, M. V. & Ward, C. V. (2005) Evolution of the social child. In Ellis, B. & Bjorklund, D. (Eds.) *Origins of the Social Mind: Evolutionary Psychology and Child Development*. London, Guilford Press.

Flinn, M. V., Geary, D. C. & Ward, C. V. (2005) Ecological dominance, social competition, and coalitionary arms races: Why humans evolved extraordinary intelligence. *Evolution and Human Behavior*, 26, 10–46.

Flowers, J. M., Sezgin, E., Kumagai, S., Duvernell, D. D., Matzkin, L. M., Schmidt, P. S. & Eanes, W. F. (2007) Adaptive evolution of metabolic pathways in *Drosophila*. *Molecular Biology and Evolution*, 24, 1347–1354.

Foerster, K., Coulson, T., Sheldon, B., Pemberton, J. M., Clutton-Brock, T. H. & Kruuk, L. E. B. (2007) Sexually antagonistic genetic variation in the red deer. *Nature*, 447, 1107–1111.

Foley, P. A. & Luckinbill, L. S. (2001) The effects of selection for larval behavior on adult life history features in *Drosophila melanogaster*. *Evolution*, 55, 2493–2502.

Folstad, I. & Karter, A. J. (1992) Parasites, bright males, and the immunocompetence handicap. *The American Naturalist*, 139, 603–622.

Fong, S. S., Joyce, A. R. & Palsson, B. O. (2005) Parallel adaptive evolution cultures of Escherichia coli lead to convergent growth phenotypes with different gene expression states. *Genome Research*, 15, 1365–1372.

Fontana, L., Weiss, E. P., Villareal, D. T., Klein, S. & Holloszy, J. O. (2008) Long-term effects of calorie or protein restriction on serum IGF-1 and IGFBP-3 concentration in humans. *Aging Cell*, 7, 681–687.

Force, A. G., Staples, T., Soliman, T. & Arking, R. A. (1995) A comparative biochemical and stress analysis of genetically selected *Drosophila* strains with different longevities. *Developmental Genetics*, 17, 340–351.

Foucher, F., Morin, J., Courtiade, J., Cadioux, S., Ellis, N., Banfield, M. J. & Rameau, C. (2003) *DETERMINATE* and *LATE FLOWERING* are two *TERMINAL FLOWER1/CENTRORADIALIS* homologs that control two distinct phases of flowering initiation and development in pea. *The Plant Cell*, 15, 2742–2754.

Fowler, K. & Partridge, L. (1989) A cost of mating in female fruit-flies. *Nature*, 338, 760–761.

Francis, L. (1979) Contrast between solitary and clonal lifestyles in the sea anemone *Anthopleura elegantissima*. *American Zoologist*, 19, 669–681.

Francis, L. (1988) Cloning and aggression among sea anemones (Coelenterata: Actiniaria) of the rocky shore. *Biological Bulletin*, 174, 241–253.

Frank, S. A. (1991) Ecological and genetic models of host-pathogen coevolution. *Heredity*, 67, 73–83.

Frankino, W. A., Emlen, D. & Shingleton, A. (2009) Experimental approached to studing the evolution of animal form: The shape of things to come. In Garland, T. & Rose, M. R. (Eds.) *Experimental Evolution: Concepts, Methods and Applications of Selection Experiments*. Berkley and Los Angeles, University of California Press.

Fraser, S. E., Green, C. R., Bode, H. R. & Gilula, N. B. (1987) Selective disruption of gap junctional communication interferes with a patterning process in *Hydra*. *Science*, 237, 49–55.

Fraser, A. M., Brockert, J. E. & Ward, R. H. (1995) Association of young maternal age with adverse reproductive outcomes. *New England Journal of Medicine*, 332, 1113–1117.

Fraser, H. B., Khaitovich, P., Plotkin, J. B., Paabo, S. & Eisen, M. B. (2005) Aging and gene expression in the primate brain. *PLoS Biology*, 3, e274.

Frazier, M. R., Harrison, J. F., Kirkton, S. D. & Roberts, S. P. (2008) Cold rearing improves cold-flight performance in *Drosophila* via changes in wing morphology. *Journal of Experimental Biology*, 211, 2116–2122.

Freeman, S. & Herron, J. C. (2007) *Evolutionary Analysis*. Upper Saddle River, NJ Pearson Prentice Hall.

Freeman, G. & Ridgway, E. B. (1990) Cellular and intracellular pathways mediating the metamorphic stimulus in Hydrozoan planulae. *Roux's Archives of Developmental Biology*, 199, 63–79.

Freitak, D., Wheat, C. W., Heckel, D. G. & Vogel, H. (2007) Immune system responses and fitness costs associated with consumption of bacteria in larvae of *Trichoplusia ni*. *BMC Biology*, 5, 56.

Fricke, C., Perry, J., Chapman, T. & Rowe, L. (2009) The conditional economics of sexual conflict. *Biology Letters*, 5, 671–674.

Fricke, C., Bretman, A. & Chapman, T. (2010) Female nutritional status determines the magnitude and sign of responses to a male ejaculate signal in *Drosophila melanogaster*. *Journal of Evolutionary Biology*, 23, 157–165.

Friedman, D. B. & Johnson, T. E. (1988) A mutation in the *age-1* gene in *Caenorhabditis elegans* lengthens life and reduces hermaphrodite fertility. *Genetics*, 118, 75–86.

Friedman, W. E. & Williams, J. H. (2003) Modularity of the angiosperm female gametophyte and its bearing on the early evolution of endosperm in flowering plants. *Evolution*, 57, 216–230.

Friesema, E. C., Docter, R., Moerings, E. P., Verrey, F., Krenning, E. P., Hennemann, G. & Visser, T. J. (2001) Thyroid hormone transport by the heterodimeric human system L amino acid transporter. *Endocrinology*, 142, 4339–4348.

Frisch, R. E. & McArthur, J. W. (1974) Menstrual cycles: fatness as a determinant of minimum weight for height necessary for their maintenance or onset. *Science*, 185, 949–951.

Frisch, R. E. & Revelle, R. (1971) Height and weight at menarche and a hypothesis of menarche. *Archive of Disease in Childhood*, 46, 695–701.

Fritzenwanker, J. H., Genikhovich, G., Kraus, Y. & Technau, U. (2007) Early development and axis specification in the sea anemone *Nematostella vectensis*. *Developmental Biology*, 310, 264–279.

Frost, S. D. W. (1999) The immune system as an inducible defense. In Tollrian, R. & Harvel, C. D. (Eds.) *The Ecology and Evolution of Inducible Defense*. Princeton, NJ, Princeton University Press.

Fumagalli, M., Cagliani, R., Pozzoli, U., Riva, S., Comi, G. P., Menozzi, G., Bresolin, N. & Sironi, M. (2009) Widespread balancing selection and pathogen-driven selection at blood group antigen genes. *Genome Research*, 19, 199–212.

Furlow, J. D. & Neff, E. S. (2006) A developmental switch induced by thyroid hormone: *Xenopus laevis* metamorphosis. *Trends in Endocrinology & Metabolism*, 17, 40–47.

Furtado, O. V., Polcheira, C., Machado, D. P., Mourao, G. & Hermes-Lima, M. (2007) Selected oxidative stress markers in a South American crocodilian species. *Comparative Biochemistry and Physiology C*, 146, 241–254.

Fussnecker, B. & Grozinger, C. (2008) Dissecting the role of Kr-h1 brain gene expression in foraging behavior in honey bees (*Apis mellifera*). *Insect Biochemistry & Molecular Biology*, 17, 515–522.

Gadgil, M. & Bossert, W. H. (1970) Life historical consequences of natural selection. *The American Naturalist*, 104, 1–24.

Gadot, M., Chiang, A. S., Burns, E. L. & Schal, C. (1991) Cyclic juvenile hormone biosynthesis in the cockroach, *Blattella germanica*: effects of ovariectomy and corpus allatum denervation. *General and Comparative Endocrinology*, 82, 163–171.

Gahete, M. D., Duran-Prado, M., Luque, R. M., Martinez-Fuentes, A. J., Quintero, A., Gutierrez-Pascual, E., Cordoba-Chacon, J., Malagon, M. M., Gracia-Navarro, F. & Castano, J. P. (2009) Understanding the multifactorial control of growth hormone release by somatotropes: lessons from comparative endocrinology. *Annals of the New York Academy of Sciences*, 1163, 137–153.

Gahr, M. (2001) Distribution of sex steroid hormone receptors in the avian brain: Functional implications for neural sex differences and sexual behaviors. *Microscopy Research and Technique*, 55, 1–11.

Galton, V. A. (1990) Mechanisms underlying the acceleration of thyroid hormone-induced tadpole metamorphosis by corticosterone. *Endocrinology*, 127, 2997–3002.

Galton, V. A. (1992) Thyroid hormone receptors and iodothyronine deiodinases in the developing Mexican axolotl, *Ambystoma mexicanum*. *General and Comparative Endocrinology*, 85, 62–70.

Galton, V. A. (2005) The roles of the iodothyronine deiodinases in mammalian development. *Thyroid*, 15, 823–834.

Garamszegi, L. Z., Hirschenhauser, K., Bokony, V., Eens, M., Hurtrez-Bousses, S., Moller, A. P., Oliveira, R. F. & Wingfield, J. C. (2008) Latitudinal distribution, migration, and testosterone levels in birds. *The American Naturalist*, 172, 533–546.

Garigan, D., Hsu, A. L., Fraser, A. G., Kamath, R. S., Ahringer, J. & Kenyon, C. (2002) Genetic analysis of tissue aging in *Caenorhabditis elegans*: a role for heat-shock factor and bacterial proliferation. *Genetics*, 161, 1101–1112.

Garrigan, D. & Hedrick, P. W. (2003) Perspective: detecting adaptive molecular polymorphism: lessons from the MHC. *Evolution*, 57, 1707–1722.

Garstang, W. 1928. The origin and evolution of larval forms. Report of the British Association for the Advancement of Science (D) 77–98.

Gateño, D. & Rinkevich, B. (2003) Coral polyp budding is probably promoted by a canalized ratio of two morphometric fields. *Marine Biology*, 142, 971–973.

Gauchat, D., Mazet, F., Berney, C., Schummer, M., Kreger, S., Pawlowski, J. & Galliot, B. (2000) Evolution of Antp-class genes and differential expression of *Hydra* Hox/paraHox genes in anterior patterning. *Proceedings of the National Academy of Sciences of the United States of America*, 97, 4493–4498.

Gazzani, S., Gendall, A. R., Lister, C. & Dean, C. (2003) Analysis of the molecular basis of flowering time variation in *Arabidopsis* accessions. *Plant Physiology*, 132, 1107–1114.

Geary, D. C. (2005) *The Origin of Mind: Evolution of brain, cognition, and general intelligence*. Washington D.C., The American Psychological Association.

Geary, D. C. & Bjorklund, D. F. (2000) Evolutionary developmental psychology. *Child Development*, 71, 57–65.

Geary, D. C. & Flinn, M. V. (2001) Evolution of human parental behavior and the human family. *Parenting, Science and Practice*, 1, 5–61.

Geary, D. C. & Flinn, M. V. (2002) Sex differences in behavioral and hormonal response to social threat. *Psychological Review*, 109, 745–750.

Geary, D. C. & Huffman, K. J. (2002) Brain and cognitive evolution: forms of modularity and functions of mind. *Psychological Bulletin*, 128, 667–698.

Geiser, F. (2004) Metabolic rate and body temperature reduction during hibernation and daily torpor. *Annual Review of Physiology*, 66, 239–274.

Geiser, F. & Learmonth, R. P. (1994) Dietary fats, selected body temperature and tissue fatty acid composition of agamid lizards (*Amphibolurus nuchalis*). *Journal of Comparative Physiology B*, 164, 55–61.

Geiser, F., Firth, B. T. & Seymour, R. S. (1992) Polyunsaturated dietary lipids lower the selected body temperature of a lizard. *Journal of Comparative Physiology B*, 162, 1–4.

Geister, T. L., Lorenz, M. W., Hoffmann, K. H. & Fischer, K. (2008a) Effects of the NMDA receptor antagonist MK-801 on female reproduction and juvenile hormone biosynthesis in the cricket *Gryllus bimaculatus* and the butterfly *Bicyclus anynana*. *Journal of Experimental Biology*, 211, 1587–1593.

Geister, T. L., Lorenz, M. W., Meyering-Vos, M., Hoffmann, K. H. & Fischer, K. (2008b) Effects of temperature on reproductive output, egg provisioning, juvenile hormone and vitellogenin titres in the butterfly *Bicyclus anynana*. *Journal of Insect Physiology*, 54, 1253–1260.

Geister, T. L., Lorenz, M. W., Hoffmann, K. H. & Fischer, K. (2009) Energetics of embryonic development: effects of temperature on egg and hatchling composition in a butterfly. *Journal of Comparative Physiology B*, 179, 87–98.

Geller, J. B. & Walton, E. D. (2001) Breaking up and getting together: evolution of symbiosis and cloning by fission in sea anemones (Genus *Anthopleura*). *Evolution*, 55, 1781–1794.

Geller, J. B., Fitzgerald, L. J. & King, C. E. (2005) Fission in sea anemones: integrative studies of life cycle evolution. *Integrative and Comparative Biology*, 45, 615–622.

Gems, D., Pletcher, S. & Partridge, L. (2002) Interpreting interactions between treatments that slow aging. *Aging Cell*, 1, 1–9.

Gems, D., Sutton, A. J., Sundermeyer, M. L., Albert, P. S., King, K. V., Edgley, M. L., Larsen, P. L. & Riddle, D. L. (1998) Two pleiotropic classes of *daf-2* mutation affect larval arrest, adult behavior, reproduction and longevity in *C. elegans*. *Genetics*, 150, 129–155.

Genade, T., Benedetti, M., Terzibasi, E., Roncaglia, P., Valenzano, D. R., Cattaneo, A. & Cellerino, A. (2005) Annual fishes of the genus *Nothobranchius* as a model system for aging research. *Aging Cell*, 4, 223–233.

George, S. B. (1994) Phenotypic plasticity in the larvae of *Luidia foliolata* (Echinodermata: Asteroidea). In David, B., Guille, A., Féral, J. & Roux, M. (Eds.) *Echinoderms Through Time*. Rotterdam, Balkema.

George, S. B. (1999) Egg quality, larval growth and phenotypic plasticity in a forcipulate seastar. *Journal of Experimental Marine Biology and Ecology*, 237, 203–224.

Geraldo, N., Baurle, I., Kidou, S.-I., Hu, X. Y. & Dean, C. (2009) *FRIGIDA* delays flowering in *Arabidopsis* via a cotranscriptional mechanism involving direct interaction with the nuclear cap-binding complex. *Plant Physiology*, 150, 1611–1618.

Gerisch, B. & Antebi, A. (2004) Hormonal signals produced by DAF-9/cytochrome P450 regulate *C. elegans* dauer diapause in response to environmental cues. *Development*, 131, 1765–1776.

Gerisch, B., Rottiers, V., Li, D. L., Motola, D. L., Cummins, C. L., Lehrach, H., Mangelsdorf, D. J. & Antebi, A. (2007) A bile acid-like steroid modulates *Caenorhabditis elegans* lifespan through nuclear receptor signaling. *Proceedings of the National Academy of Sciences of the United States of America*, 104, 5014–5019.

Geven, E. J. W., Nguyen, N. K., Van Den Boogaart, M., Spanings, F. A. T., Flik, G. & Klaren, P. H. M. (2007) Comparative thyroidology: thyroid gland location and iodothyronine dynamics in Mozambique tilapia (*Oreochromis mossambicus* Peters) and common carp (*Cyprinus carpio* L.). *Journal of Experimental Biology*, 210, 4005–4015.

Ghazanfar, A. A. & Santos, L. R. (2004) Primate brains in the wild: The sensory bases for social interactions. *Nature Reviews Neuroscience*, 5, 603–616.

Ghazi, A., Henis-Korenblit, S. & Kenyon, C. (2009) A transcription elongation factor that links signals from the reproductive system to lifespan extension in *Caenorhabditis elegans*. *PLoS Genetics*, 5, e1000639.

Giannakou, M. E. & Partridge, L. (2007) Role of insulin-like signalling in *Drosophila* lifespan. *Trends in Biochemical Sciences*, 32, 180–188.

Giannakou, M. E., Goss, M., Junger, M. A., Hafen, E., Leevers, S. J. & Partridge, L. (2004) Long-lived *Drosophila* with overexpressed dFOXO in adult fat body. *Science*, 305, 361.

Giannakou, M. E., Goss, M., Jacobson, J., Vinti, G., Leevers, S. J. & Partridge, L. (2007) Dynamics of the action of dFOXO on adult mortality in *Drosophila*. *Aging Cell*, 6, 429–438.

Giannakou, M. E., Goss, M. & Partridge, L. (2008) Role of dFOXO in lifespan extension by dietary restriction in *Drosophila melanogaster*: not required, but its activity modulates the response. *Aging Cell*, 7, 187–198.

Gifondorwa, D. J., Robinson, M. B., Hayes, C. D., Taylor, A. R., Prevette, D. M., Oppenheim, R. W., Caress, J. & Milligan, C. E. (2007) Exogenous delivery of heat shock protein 70 increases lifespan in a mouse model of amyotrophic lateral sclerosis. *Journal of Neuroscience*, 27, 13173–13180.

Gilbert, S. F. & Epel, D. (2009) *Ecological developmental biology: integrating epigenetics, medicine, and evolution*. Sunderland, Sinauer Associates.

Gilchrist, A. S. & Partridge, L. (1999) A comparison of the genetic basis of wing size divergence in three parallel body size clines of *Drosophila melanogaster*. *Genetics*, 153, 1775–1787.

Gilchrist, G. W., Huey, R. B. & Serra, L. (2001) Rapid evolution of wing size clines in *Drosophila subobscura*. *Genetica*, 112, 273–286.

Gilchrist, G. W., Huey, R. B., Balanya, J., Pascual, M. & Serra, L. (2004) A time series of evolution in action: a latitudinal cline in wing size in South American *Drosophila subobscura*. *Evolution*, 58, 768–780.

Gillooly, J. F., Charnov, E. L., West, G. B., Savage, V. M. & Brown, J. H. (2002) Effects of size and temperature on developmental time. *Nature*, 417, 70–73.

Glennemeier, K. A. & Denver, R. J. (2002) Small changes in whole-body corticosterone content affect larval *Rana pipiens* fitness components. *General and Comparative Endocrinology*, 127, 16–25.

Gluckman, P. D., Hanson, M. A. & Spencer, H. G. (2005) Predictive adaptive responses and human evolution. *Trends in Ecology & Evolution*, 20, 527–533.

Gockel, J., Kennington, W. J., Hoffman, A. A., Goldstein, D. B. & Partridge, L. (2001) Non-clinality of molecular variation implicates selection in maintaining a morphological cline of *Drosophila melanogaster*. *Genetics*, 158, 319–323.

Golden, J. W. & Riddle, D. L. (1984) The *C. elegans* dauer larva: developmental effects of pheromone, food, and temperature. *Developmental Biology*, 102, 368–378.

Gomez-Merino, D., Drogou, C., Chennaoui, M., Tiolloer, E., Mathieu, J. & Guezennec, C. Y. (2005) Effects of combined stress during intense training on cellular immunity, hormones and respiratory infections. *Neuroimmunomodulation*, 12, 164–172.

Good, R. A. & Lorenz, E. (1992) Nutrition and cellular immunity. *International Journal of Immunopharmacology*, 14, 361–366.

Goodrick, C. L. (1978) Body weight increment and length of life: the effect of genetic constitution and dietary protein. *Journal of Gerontology*, 33, 184–190.

Gorbman, A. & Bern, H. A. (1962) *A textbook of comparative endocrinology*. New York, John Wiley and Sons, Inc.

Gordon, M. D., Dionne, M. S., Schneider, D. S. & Nusse, R. (2005) WntD is a feedback inhibitor of Dorsal/NF-kappaB in *Drosophila* development and immunity. *Nature*, 437, 746–749.

Gordon, M. D., Ayres, J. S., Schneider, D. S. & Nusse, R. (2008) Pathogenesis of *Listeria*-infected *Drosophila* wntD mutants is associated with elevated levels of the novel immunity gene *edin*. *PLoS Pathogens*, 4, e1000111.

Goto, S. G., Yoshida, K. M. & Kimura, M. T. (1998) Accumulation of Hsp70 mRNA under environmental stresses in diapausing and nondiapausing adults of *Drosophila triauraria*. *Journal of Insect Physiology*, 44, 1009–1015.

Gotthard, K. (2008) Adaptive growth decisions in butterflies. *Bioscience, Biotechnology, and Biochemistry*, 58, 222–230.

Gotthard, K., Nylin, S. & Wiklund, C. (1994) Adaptive variation in growth rate: life history costs and consequences in the speckled wood butterfly, *Pararge aegeria*. *Oecologia*, 99, 281–289.

Govindarajan, V., Ramachandran, R. K., George, J. M., Shakes, D. C. & Tomlinson, C. R. (1995) An ECM-bound, PDGF-like growth factor and a TGF-alpha-like growth factor are required for gastrulation and spiculogenesis in the Lytechinus embryo. *Developmental Biology*, 172, 541–551.

Goymann, W. (2009) Social modulation of androgens in male birds. *General and Comparative Endocrinology*, 163, 149–157.

Goymann, W., Moore, I. T., Scheuerlein, A., Hirschenhauser, K., Grafen, A. & Wingfield, J. C. (2004) Testosterone in tropical birds: effects of environmental and social factors. *The American Naturalist*, 164, 327–334.

Goymann, W., Geue, D., Schwabl, I., Flinks, H., Schmidl, D., Schwabl, H. & Gwinner, E. (2006) Testosterone and corticosterone during the breeding cycle of equatorial and European stonechats (*Saxicola torquata axillaris* and *S. t. rubicola*). *Hormones and Behavior*, 50, 779–785.

Gräff, J., Jemielity, S., Parker, J. D., Parker, K. M. & Keller, L. (2007) Differential gene expression between adult queens and workers in the ant *Lasius niger*. *Molecular Ecology*, 16, 675–683.

Grandison, R. C., Piper, M. D. W. & Partridge, L. (2009) Amino-acid imbalance explains extension of lifespan by dietary restriction in *Drosophila*. *Nature*, 462, 1061–1064.

Grasso, L., Maindonald, J., Rudd, S., Hayward, D., Saint, R., Miller, D. & Ball, E. (2008) Microarray analysis identifies candidate genes for key roles in coral development. *BMC Genomics*, 9, 540.

Gray, P. B. (2003) Marriage, parenting, and testosterone variation among Kenyan Swahili men. *American Journal of Physical Anthropology*, 122, 279–286.

Gray, P. B. & Campbell, B. C. (2009) Human male testosterone, pair bonding and fatherhood. In Ellison, P. T. & Gray, P. B. (Eds.) *Endocrinology of Social Relationships*. Cambridge, Harvard University Press.

Gray, S. M. & McKinnon, J. S. (2007) Linking color polymorphism maintenance and speciation. *Trends in Ecology & Evolution*, 22, 71–79.

Gray, A., Feldman, H. A., McKinlay, J. B. & Longcope, C. (1991) Age, disease, and changing sex hormone levels in middle-aged men: results of the Massachusetts Male Aging Study. *Journal of Clinical Endocrinology and Metabolism*, 73, 1016–1025.

Gray, P. B., Kahlenberg, S. M., Barrett, E. S., Lipson, S. F. & Ellison, P. T. (2002) Marriage and fatherhood are associated with lower testosterone in males. *Evolution and Human Behavior*, 23, 193–201.

Gray, D. A., Tsirigotis, M. & Woulfe, J. (2003) Ubiquitin, proteasomes, and the aging brain. *Science of Aging Knowledge Environment*, 34, p. rE6.

Gray, P. B., Yang, C. F. & Pope, H. G. J. (2006) Fathers have lower salivary testosterone levels than unmarried men and married non-fathers in Beijing, China. *Proceedings of the Royal Society of London B*, 273, 333–339.

Gray, P. B., Parkin, J. C. & Samms-Vaughan, M. E. (2007) Hormonal correlates of human paternal interactions: a hospital-based investigation in urban Jamaica. *Hormones and Behavior*, 52, 499–507.

Green, R. F. & Noakes, D. L. G. (1995) Is a little bit of sex as good as a lot? *Journal of Theoretical Biology*, 174, 87–96.

Greene, E. (1996) Effect of light quality and larval diet on morph induction in the polymorphic caterpillar *Nemoria arizonaria* (Lepidoptera: Geometridae). *Biological Journal of the Linnean Society*, 58, 277–285.

Greer, E. L. & Brunet, A. (2008a) FOXO transcription factors in aging and cancer. *Acta Physiologica*, 192, 19–28.

Greer, E. L. & Brunet, A. (2008b) Signaling networks in aging. *Journal of Cell Science*, 121, 407–412.

Greer, E. L. & Brunet, A. (2009) Different dietary restriction regimens extend lifespan by both independent and overlapping genetic pathways in *C. elegans*. *Aging Cell*, 8, 113–127.

Greer, E. L., Dowlatshahi, D., Banko, M. R., Villen, J., Hoang, K., Blanchard, D., Gygi, S. P. & Brunet, A. (2007) An AMPK-FOXO pathway mediates longevity induced by a novel method of dietary restriction in *C. elegans*. *Current Biology*, 17, 1646–1656.

Grimaldi, D. & Engel, M. S. (2005) *Evolution of the Insects*. Cambridge University Press, Cambridge, USA

Grönke, S., Clarke, D. F., Andrews, T. D., Broughton, S., Andrews, D. & Partridge, L. (2010) Molecular evolution and mutagenesis of *Drosophila* insulin-like peptides. *PLoS Genetics*, 6, e1000857.

Groothuis, T. G. G., Muller, W., Von Engelhardt, N., Carere, C. & Eising, C. (2005) Maternal hormones as a tool to adjust offspring phenotype in avian species. *Neuroscience and Biobehavioral Reviews*, 29, 329–352.

Gross, T. N. & Manzon, R. G. (2011) Sea lamprey (Petromyzon marinus) contain four developmentally regulated serum thyroid hormone distributor proteins. *General and Comparative Endocrinology*, 170, 640–649.

Grossman, A. (2000) Acclimation of *Chlamydomonas reinhardtii* to its nutrient environment. *Protist*, 151, 201–224.

Grumbach, M. M. & Styne, D. M. (1998) Puberty: ontogeny, neuroendocrinology, physiology and disorders. In Wilson, J. D., Foster, D. W., Kronenberg, H. M. & Larsen, P. R. (Eds.) *Williams Textbook of Endocrinology*, 9th edn. Philadelphia, W.B. Saunders.

Gruntenko, N. E. & Rauschenbach, I. Y. (2008) Interplay of JH, 20E and biogenic amines under normal and stress conditions and its effect on reproduction. *Journal of Insect Physiology*, 54, 902–908.

Guarente, L. (2000) Sir2 links chromatin silencing, metabolism, and aging. *Genes & Development*, 14, 1021–1026.

Guatelli-Steinberg, D., Reid, D. J., Bishop, T. A. & Larsen, C. S. (2005) Anterior tooth growth periods in Neandertals were comparable to those of modern humans. *Proceedings of the National Academy of Sciences of the United States of America*, 102, 14197–14202.

Gubernick, D. J. (1990) A maternal chemosignal maintains paternal behaviour in the biparental California mouse, *Peromyscus californicus*. *Animal Behaviour*, 39, 936–942.

Gudernatsch, J. F. (1912) Feeding Experiments on tadpoles. I. The influence of specific organs given as food on growth and differentiation. A contribution to the knowledge of organs with internal secretion. *Roux's Archives of Developmental Biology*, 35, 457–483.

Guidugli, K. R., Nascimento, A. M., Amdam, G. V., Barchuk, A. R., Omholt, S., Simoes, Z. L. & Hartfelder, K. (2005) Vitellogenin regulates hormonal dynamics in the worker caste of a eusocial insect. *FEBS Letters*, 579, 4961–4965.

Guidugli-Lazzarini, K. R., Do Nascimento, A. M., Tanaka, E. D., Piulachs, M. D., Hartfelder, K., Bitondi, M. G. & Simoes, Z. L. (2008) Expression analysis of putative vitellogenin and lipophorin receptors in honey bee (*Apis mellifera* L.) queens and workers. *Journal of Insect Physiology*, 54, 1138–1147.

Guillette, L. J. J. (1993) The evolution of vivparity in lizards. *BioScience*, 43, 742–751.

Guillette, L. J. J., Cox, M. C. & Crain, D. A. (1996) Plasma Insulin-like Growth Factor-I concentration during the reproductive cycle of the American alligator (*Alligator mississippiensis*). *General and Comparative Endocrinology*, 104, 116–122.

Guss, K. A. & Ettensohn, C. A. (1997) Skeletal morphogenesis in the sea urchin embryo: regulation of primary mesenchyme gene expression and skeletal rod growth by ectoderm-derived cues. *Development*, 124, 1899–1908.

Gustafsson, L. & Sutherland, W. J. (1988) The costs of reproduction in the collared flycatcher *Ficedula albicollis*. *Nature*, 335, 813–815.

Guzick, D. S., Overstreet, J. W., Factor-Litvak, P., Brazil, C. K., Nakajima, S. T., Coutifaris, C., Carson, S. A., Cisneros, P., Steinkampf, M. P., Hill, J. A., Xu, D. & Vogel, D. L. (2001) Sperm morphology, motility and concentration in fertile and infertile men. *New England Journal of Medicine*, 345, 1388–1393.

Gwadz, R. W. (1969) Regulation of blood meal size in the mosquito. *Journal of Insect Physiology*, 15, 2039–2044.

Haddad, L. S., Kelbert, L. & Hulbert, A. J. (2007) Extended longevity of queen honey bees compared to workers is associated with peroxidation-resistant membranes. *Experimental Gerontology*, 42, 601–609.

Hadfield, M. G. & Paul, J. V. (2001) Natural Chemical Cues for Settlement and Metamorphosis of Marine-Invertebrate Larvae. In McClintock, J. B. & Baker, B. J. (Eds.) *Marine Chemical Ecology*. Boca Raton, CRC Press.

Hadfield, M. G., Meleshkevitch, E. A. & Boudko, D. Y. (2000) The apical sensory organ of a gastropod veliger is a receptor for settlement cues. *Biological Bulletin*, 198, 67–76.

Hadfield, M. G., Carpizo-Ituarte, E. J., Del Carmen, K. & Nedved, B. T. (2001) Metamorphic competence, a major adaptive convergence in marine invertebrate larvae. *American Zoologist*, 41, 1123–1131.

Hahn, T. P., Boswell, T., Wingfield, J. C. & Ball, G. F. (1997) Temporal flexibility in avian reproduction. In Nolan JR., V., Ketterson, E. D. & Thompson, C. F. (Eds.) *Current Ornithology*. New York, Plenum Press.

Hahm, J. H., Kim, S. & Paik, Y. K. (2009) Endogenous cGMP regulates adult longevity via the insulin signaling pathway in *Caenorhabditis elegans*. *Aging Cell*, 8, 473–483.

Haig, D. (1996) Gestational drive and the green-bearded placenta. *Proceedings of the National Academy of Sciences of the United States of America*, 93, 6547–6551.

Haig, D. & Westoby, M. (1989) Parent-specific gene expression and the triploid endosperm. *The American Naturalist*, 134, 147–155.

Haigis, M. C. & Guarente, L. P. (2006) Mammalian sirtuins – emerging roles in physiology, aging, and calorie restriction. *Genes & Development*, 20, 2913–2921.

Halme, A., Cheng, M. & Hariharan, I. K. (2010) Retinoids regulate a developmental checkpoint for tissue regeneration in *Drosophila*. *Current Biology*, 20, 458–463.

Hamilton, W. D. (1964) The evolution of social behavior. *Journal of Theoretical Biology*, 7, 1–52.

Hamilton, W. D. (1966) The moulding of senescence by natural selection. *Journal of Theoretical Biology*, 12, 12–45.

Hamilton, W. D. (1967) Extraordinary sex ratios. *Science*, 156, 477–488.

Hamilton, W. D. (1980) Sex versus non-sex versus parasite. *Oikos*, 35, 282–290.

Hamilton, W. D., Axelrod, R. & Tanese, R. (1990) Sexual reproduction as an adaptation to resist parasites (a review). *Proceedings of the National Academy of Sciences of the United States of America*, 87, 3566–3573.

Hansen, T. F. (2003) Is modularity necessary for evolvability? Remarks on the relationship between pleiotropy and evolvability. *Biosystems*, 69, 83–94.

Hansen, T. F. & Houle, D. (2004) Evolvability, stabilizing selection, and the problem of stasis. In Pigliucci, M. & Preston, K. (Eds.) *The Evolutionary Biology of Complex Phenotypes*. Oxford, Oxford University Press.

Hansen, M., Hsu, A. L., Dillin, A. & Kenyon, C. (2005) New genes tied to endocrine, metabolic, and dietary regulation of lifespan from a *Caenorhabditis elegans* genomic RNAi screen. *PLoS Genetics*, 1, 119–128.

Hansen, M., Taubert, S., Crawford, D., Libina, N., Lee, S. J. & Kenyon, C. (2007) Lifespan extension by conditions that inhibit translation in *Caenorhabditis elegans*. *Aging Cell*, 6, 95–110.

Hansen, M., Chandra, A., Mitic, L. L., Onken, B., Driscoll, M. & Kenyon, C. (2008) A role for autophagy in the extension of lifespan by dietary restriction in *C. elegans. PLoS Genetics, 4*, e24.

Hard, J. J., Gross, M. R., Heino, M., Hilborn, R., Kope, R. G., Law, R. & Reynolds, J. D. (2008) Evolutionary consequences of fishing and their implications for salmon. *Evolutionary Applications*, 1, 388–408.

Hardin, J., Coffman, J. A., Black, S. D. & McClay, D. R. (1992) Commitment along the dorsoventral axis of the sea urchin embryo is latered in response to $NiCl_2$. *Development*, 116, 671–685.

Harman, D. (1956) Aging: a theory based on free radical and radiation chemistry. *Journal of Gerontology*, 11, 298–300.

Harman, S. M., Metter, E. J., Tobin, J. D., Pearson, J. D. & Blackman, M. R. (2001) Longitudinal effects of aging on serum total and free testosterone levels in healthy men, Baltimore Longitudinal Study of Aging. *Journal of Clinical Endocrinology and Metabolism*, 86, 724–731.

Harper, J. M., Leathers, C. W. & Austad, S. N. (2006) Does caloric restriction extend life in wild mice? *Aging Cell*, 5, 441–449.

Harrington, L. S., Findlay, G. M., Gray, A., Tolkacheva, T., Wigfield, S., Rebholz, H., Barnett, J., Leslie, N. R., Cheng, S., Shepherd, P. R., Gout, I., Downes, C. P. & Lamb, R. F. (2004) The TSC1-2 tumor suppressor controls insulin-PI3K signaling via regulation of IRS proteins. *Journal of Cell Biology*, 166, 213–223.

Harris, M. P., Fallon, J. F. & Prum, R. O. (2002) Shh-Bmp2 signaling module and the evolutionary origin and diversification of feathers. *Journal of Experimental Zoology*, 294, 160–176.

Harrison, J. M. (1986) Caste-specific changes in honeybee flight capacity. *Physiological Zoology*, 59, 175–187.

Harrison, J. F. & Fewell, J. H. (2002) Environmental and genetic influences on flight metabolic rate in the honey bee, *Apis mellifera*. *Comparative Biochemistry and Physiology A*, 133, 323–333.

Harrison, D. E., Strong, R., Sharp, Z. D., Nelson, J. F., Astle, C. M., Flurkey, K., Nadon, N. L., Wilkinson, J. E., Frenkel, K., Carter, C. S., Pahor, M., Javors, M. A., Fernandez, E.

& Miller, R. A. (2009) Rapamycin fed late in life extends lifespan in genetically heterogeneous mice. *Nature*, 460, 392–395.

Harshman, L. G. (1999) Investigation of the endocrine system in extended longevity lines of *Drosophila melanogaster*. *Experimental Gerontology*, 34, 997–1006.

Harshman, L. G. & Haberer, B. A. (2000) Oxidative stress resistance: a robust correlated response to selection in extended longevity lines of *Drosophila melanogaster*? *Journal of Gerontology A*, 55, B415–B417.

Harshman, L. G. & Zera, A. J. (2007) The cost of reproduction: the devil in the details. *Trends in Ecology & Evolution*, 22, 80–86.

Harshman, L. G., Ottea, J. A. & Hammock, B. D. (1991) Evolved environment-dependent expression of detoxification enzyme activity in *Drosophila melanogaster*. *Evolution*, 45, 791–795.

Harshman, L. G., Hoffmann, A. A. & Clark, A. G. (1999) Selection for starvation resistance in *Drosophila melanogaster*: physiological correlates, enzyme activities and multiple stress responses. *Journal of Evolutionary Biology*, 12, 370–379.

Hart, M. W. (1991) Particle captures and the method of suspension feeding by Echinoderm larvae. *Biological Bulletin*, 180, 12–27.

Hart, M. W. (1996) Evolutionary loss of larval feeding: Development, form and function in a facultatively feeding larva, *Brisaster latifrons*. *Evolution*, 50, 174–187.

Hart, M. W. & Strathmann, R. R. (1994) Functional consequences of phenotypic plasticity in echinoid larvae. *Biological Bulletin* 168, 291–299.

Hartfelder, K. & Engels, W. (1998) Social insect polymorphism: hormonal regulation of plasticity in development and reproduction in the honeybee. *Current Topics in Developmental Biology*, 40, 45–77.

Hartnoll, R. G. (2001) Growth in Crustacea – twenty years on. *Hydrobiologia*, 449, 111–122.

Harvell, C. D. (1990) The ecology and evolution of inducible defenses. *Quarterly Review of Biology*, 65, 323–340.

Harvey, W. (1651) *Excercitationes De Generatione Animalium* (Anatomical exercitations concerning the generation of living creatures). London, Pulleyn, 1651.

Harvey, P. H. & Clutton-Brock, T. H. (1985) Life history variation in primates. *Evolution*, 39, 559–581.

Harvie, P. D., Filippova, M. & Bryant, P. J. (1998) Genes expressed in the ring gland, the major endocrine organ of *Drosophila melanogaster*. *Genetics*, 149, 217–231.

Hashimoto, T. & Watanabe, S. (2005) Chronic food restriction enhances memory in mice - analysis with matched drive levels. *Neuroreport*, 16, 1129–1133.

Hasty, P., Campisi, J., Hoeijmakers, J., Van Steeg, H. & Vijg, J. (2003) Aging and genome maintenance: lessons from the mouse? *Science*, 299, 1355–1359.

Hasunuma, I., Yamamoto, K. & Kikuyama, S. (2004) Molecular cloning of bullfrog prolactin receptor cDNA: changes in prolactin receptor mRNA level during metamorphosis. *General and Comparative Endocrinology*, 138, 200–210.

Hatase, H., Sudo, R., Watanabe, K. K., Kasugai, T., Saito, T., Okamoto, H., Uchida, I. & Tsukamoto, K. (2008) Shorter telomere length with age in the loggerhead turtle: a new hope for live sea turtle age estimation. *Genes & Genetic Systems*, 83, 423–426.

Hau, M. (2007) Regulation of male traits by testosterone: implications for the evolution of vertebrate life histories. *BioEssays*, 29, 133–144.

Hau, M., Wikelski, M., Soma, K. K. & Wingfield, J. C. (2000) Testosterone and year-round territorial aggression in a tropical bird. *General and Comparative Endocrinology*, 117, 20–33.

Hau, M., Perfito, N. & Moore, I. T. (2008) Timing of breeding in tropical birds: mechanisms and evolutionary implications. *Ornitologia Neotropical*, 19(suppl), 39–59.

Hau, M., Ricklefs, R. E., Wikelski, M., Lee, K. A. & Brawn, J. D. (2010) Corticosterone, testosterone and life history strategies of birds. *Proceedings of the Royal Society London B*, 277, 3203–3212.

Haussmann, M. F., Winkler, D. W., Huntington, C. E., Nisbet, I. C. T. & Vleck, C. M. (2007) Telomerase activity is maintained throughout the lifespan of long-lived birds. *Experimental Gerontology*, 42, 610–618.

Havelock, J. C., Auchus, R. J. & Rainey, W. E. (2004) The rise in adrenal androgen biosynthesis: adrenarche. *Seminars in Reproductive Medicine*, 22, 337–347.

Havenhand, J. N. (1993) Egg to juvenile period, generation time, and the evolution of larval type in marine invertebrates. *Marine Ecology Progress Series*, 97, 247–260.

Hawdon, J. M. & Datu, B. (2003) The second messenger cyclic GMP mediates activation in *Ancylostoma caninum* infective larvae. *International Journal for Parasitology*, 33, 787–793.

Hawkes, K. (2003) Grandmothers and the evolution of human longevity. *American Journal of Human Biology*, 15, 380–400.

Hawkes, K., O'Connell, J. F. & Blurton Jones, N. G. (1989) Hardworking Hadza grandmothers. In Standen, V. & Foley, R. A. (Eds.) *Comparative Socioecology: The Behavioural Ecology of Humans and Other Mammals*. London, Basil Blackwell.

Hawkes, K., O'Connell, J. F., Blurton Jones, N. G., Alvarez, H. & Charnov, E. L. (1998) Grandmothering, menopause, and the evolution of human life histories. *Proceedings of the National Academy of Sciences of the United States of America*, 95, 1336–1339.

Hay, J. M., Subramanian, S., Millar, C. D., Mohandesan, E. & Lambert, D. M. (2008) Rapid molecular evolution in a living fossil. *Trends in Genetics*, 24, 106–109.

Hayashi, H., Yamaza, H., Komatsu, T., Park, S., Chiba, T., Higami, Y., Nagayasu, T. & Shimokawa, I. (2008) Calorie restriction minimizes activation of insulin signaling in response to glucose: potential involvement of the growth hormone-insulin-like growth factor 1 axis. *Experimental Gerontology*, 43, 827–32.

Hayes, T. B. (1995) Interdependence of corticosterone and thyroid hormones in larval toads (*Bufo boreas*). I. Thyroid hormone-dependent and independent effects of corticosterone on growth and development. *Journal of Experimental Zoology*, 271, 95–102.

Hayes, T. B. (1997) Steroids as potential modulators of thyroid hormone activity in anuran metamorphosis. *American Zoologist*, 37, 185–194.

Hazel, W. N. (2002) The environmental and genetic control of seasonal polyphenism in larval color and its adaptive significance in a swallowtail butterfly. *Evolution*, 56, 342–348.

Hedner, E., Sjogren, M., Frandberg, P. A., Johansson, T., Goransson, U., Dahlstrom, M., Jonsson, P., Nyberg, F. & Bohlin, L. (2006) Brominated cyclodipeptides from the marine sponge *Geodia barretti* as selective 5-HT ligands. *Journal of Natural Products*, 69, 1421–1424.

Hedrick, S. M. (2009) The cunning little vixen: Foxo and the cycle of life and death. *Nature Immunology*, 10, 1057–1063.

Heidel, A. J., Clarke, J. D., Antonovics, J. & Dong, X. N. (2004) Fitness costs of mutations affecting the systemic acquired resistance pathway in *Arabidopsis thaliana*. *Genetics*, 168, 2197–2206.

Heideman, P. D. (2004) Top-down approaches to the study of natural variation in complex physiological pathways using the white-footed mouse (*Peromyscus leucopus*) as a model. *ILAR Journal*, 45, 4–13.

Heideman, P. D. & Pittman, J. T. (2009) Microevolution of neuroendocrine mechanisms regulating reproductive timing in *Peromyscus leucopus*. *Integrative and Comparative Biology*, 49, 550–562.

Hekimi, S., Burgess, J., Bussiere, F., Meng, Y. & Benard, C. (2001) Genetics of lifespan in *C. elegans*: molecular diversity, physiological complexity, mechanistic simplicity. *Trends in Genetics*, 17, 712–718.

Held, J. M., White, M. P., Fisher, A. L., Gibson, B. W., Lithgow, G. J. & Gill, M. S. (2006) DAF-12-dependent rescue of dauer formation in *Caenorhabditis elegans* by (25S)-cholestenoic acid. *Aging Cell*, 5, 283–291.

Helle, S., Lummaa, V. & Jokela, J. (2002) Sons reduced maternal longevity in preindustrial humans. *Science*, 296, 1085.

Henderson, S. T. & Johnson, T. E. (2001) *daf-16* integrates developmental and environmental inputs to mediate aging in the nematode *C. elegans*. *Current Biology*, 11, 1975–1980.

Henderson, S. T., Bonafe, M. & Johnson, T. E. (2006) *daf-16* protects the nematode *Caenorhabditis elegans* during food deprivation. *Journal of Gerontology A*, 61, 444–460.

Hendler, G. (1978) Development of *Amphioplus abditus* (Verrill) (Echinodermata: Ophiuroidea). II. Description and discussion of ophiuroid skeletal ontogeny and homologies. *Biological Bulletin*, 154, 79–95.

Hendler, G. & Dojiri, M. (2009) The contrariwise life of a parasitic, pedomorphic copepod with a non-feeding adult: ontogenesis, ecology, and evolution. *Invertebrate Biology*, 128, 65–82.

Hennemann, G., Docter, R., Friesema, E. C., De Jong, M., Krenning, E. P. & Visser, T. J. (2001) Plasma membrane transport of thyroid hormones and its role in thyroid hormone metabolism and bioavailability. *Endocrine Reviews*, 22, 451–476.

Hentschel, B. T. & Emlet, R. B. (2000) Metamorphosis of barnacle nauplii: Effects of food variability and a comparison with amphibian models. *Ecology*, 81, 3495–3508.

Herlihy, J. T., Stacy, C. & Bertrand, H. A. (1992) Long-term calorie restriction enhances baroreflex responsiveness in Fischer 344 rats. *American Journal of Physiology. Heart and Circulatory Physiology*, 263, H1021–H1025.

Herman, W. S. & Tatar, M. (2001) Juvenile hormone regulation of longevity in the migratory monarch butterfly. *Proceedings of the Royal Society of London B*, 268, 2509–2514.

Herre, E. (1993) Population structure and the evolution of virulence in nematode parasites of fig wasps. *Science*, 259, 1442–1445.

Herron, M. D. & Michod, R. E. (2008) Evolution of complexity in the volvocine algae: Transitions in individuality through Darwin's eye. *Evolution*, 62, 436–451.

Herskind, A. M., McGue, M., Holm, N. V., Sorensen, T. I., Harvald, B. & Vaupel, J. W. (1996) The heritability of human longevity: a population-based study of 2872 Danish twin pairs born 1870–1900. *Human Genetics*, 97, 319–323.

Heuer, H. & Visser, T. J. (2009) Minireview: Pathophysiological importance of thyroid hormone transporters. *Endocrinology*, 150, 1078–1083.

Hewes, R. S. (2008) The buzz on fly neuronal remodeling. *Trends in Endocrinology & Metabolism*, 19, 317–323.

Hewlett, B. S. & Lamb, M. E. (2005) *Hunter-gatherer Childhoods: Evolutionary, developmental, and cultural perspectives*. New Brunswick, Aldine Transaction.

Heyland, A. & Hodin, J. (2004) Heterochronic developmental shift caused by thyroid hormone in larval sand dollars and its implications for phenotypic plasticity and the evolution of nonfeeding development. *Evolution*, 58, 524–538.

Heyland, A. & Moroz, L. L. (2005) Cross-kingdom hormonal signaling: An insight from thryoid hormone functions in marine larvae. *Journal of Experimental Biology*, 208, 4355–4361.

Heyland, A. & Moroz, L. L. (2006) Signaling mechanisms underlying metamorphic transitions in animals. *Integrative and Comparative Biology*, 46, 743–759.

Heyland, A., Reitzel, A. M. & Hodin, J. (2004) Thyroid hormones determine developmental mode in sand dollars (Echinodermata: Echinoidea). *Evolution & Development*, 6, 382–392.

Heyland, A., Hodin, J. & Reitzel, A. M. (2005) Hormone signaling in evolution and development: a non-model system approach. *BioEssays*, 27, 64–75.

Heyland, A., Price, D. A., Bodnarova-Buganova, M. & Moroz, L. L. (2006a) Thyroid hormone metabolism and peroxidase function in two non-chordate animals. *Journal of Experimental Zoology B*, 306, 551–566.

Heyland, A., Reitzel, A. M., Price, D. A. & Moroz, L. L. (2006b) Endogenous thyroid hormone synthesis in facultative planktotrophic larvae of the sand dollar *Clypeaster rosaceus*: implications for the evolutionary loss of larval feeding. *Evolution & Development*, 8, 568–579.

Heyland, A., Vue Z. Voolstra, C. A., Medina, M. & Moroz L. L., Developmental transcriptome of *Aplysia californica*. JEZ Part B (online article).

Hill, K. (1993) Life history theory and evolutionary anthropology. *Evolutionary Anthropology*, 2, 78–88.

Hill, K. & Hurtado, A. M. (1991) The evolution of reproductive senescence and menopause of human females. *Human Nature*, 2, 315–350.

Hill, K. & Hurtado, A. M. (1996) *Ache life history: the ecology and demography of a foraging people*. New York, Aldine de Gruyter.

Hill, R. C., De Carvalho, C. E., Salogiannis, J., Schlager, B., Pilgrim, D. & Haag, E. S. (2006) Genetic flexibility in the convergent evolution of hermaphroditism in *Caenorhabditis* nematodes. *Developmental Cell*, 10, 531–538.

Hillman, R. & Lesnik, L. H. (1970) Cuticle formation in the embryo of *Drosophila melanogaster*. *Journal of Morphology*, 131, 385–395.

Hirata, Y., Kurokura, H. & Kasahara, S. (1989) Effects of thyroxine and thiourea on the development of larval red sea bream *Pagrus major. Bulletin of the Japanese Society of Scientific Fisheries*, 55, 1189–1195.

Hirn, M., Hetru, C., Lagueux, M. & Hoffman, J. A. (1979) Prothoracic gland activity and blood titers of ecdysone and ecdysterone during the last larval instar of *Locusta migratoria*. *Journal of Insect Physiology*, 25, 255–262.

Hirokawa, T., Komatsu, M. & Nakajima, Y. (2008) Development of the nervous system in the brittle star *Amphipholis kochii*. *Development, Genes and Evolution*, 218, 15–21.

Hirschenhauser, K. & Oliveira, R. F. (2006) Social modulation of androgens in male vertebrates: meta-analyses of the challenge hypothesis. *Animal Behaviour*, 71, 265–277.

Hitchler, M. J., Wikainapakul, K., Yu, L., Powers, K., Attatippaholkun, W. & Domann, F. E. (2006) Epigenetic regulation of manganese superoxide dismutase expression in human breast cancer cells. *Epigenetics*, 1, 163–171.

Hittinger, C. T. & Carroll, S. B. (2007) Gene duplication and the adaptive evolution of a classic genetic switch. *Nature*, 449, 677–681.

Hittinger, C. T., Goncalves, P., Sampaio, J. P., Dover, J., Johnston, M. & Rokas, A. (2010) Remarkably ancient balanced polymorphisms in a multi-locus gene network. *Nature*, 464, 54–58.

Hjelmborg, J., Iachine, I., Skytthe, A., Vaupel, J. W., McGue, M., Koskenvuo, M., Kaprio, J., Pedersen, N. L. & Christensen, K. (2006) Genetic influence on human lifespan and longevity. *Human Genetics*, 119, 312–321.

Hoang, A. (2001) Immune response to parasitism reduces resistance of *Drosophila melanogaster* to desiccation and starvation. *Evolution*, 55, 2353–2358.

Hoar, W. S. (1976) Smoth transformation – evolution, behavior, and physiology. *Journal of the Fisheries Research Board of Canada*, 33, 1233–1252.

Hoar, W. S. & Randall, D. J. (1988) The physiology of smolting salmonids. *Fish Physiology: The Physiology of Developing Fish*. Toronto, Academic Press, Inc.

Hodek, I. (1983) Role of environmental factors and endogenous mechanisms in the seasonality of reproduction in insects diapausing as adults. In Brown, V. K., Hodek, I., & Brown, V. K. (Eds.) *Diapause and Life Cycle Strategies in Insects*. Berlin, Springer.

Hodin, J. (2006) Expanding networks: signaling components in and a hypothesis for the evolution of metamorphosis. *Integrative and Comparative Biology*, 46, 719–742.

Hodin, J. (2009) She shapes events as they come: Plasticity in insect reproduction. In Whitman, D. & Anathakrishnan, T. N. (Eds.) *Insects and Phenotypic Plasticity*. Enfield, Science Publishers.

Hodin, J. & Riddiford, L. M. (2000) Different mechanisms underlie phenotypic plasticity and interspecific variation for a reproductive character in drosophilids (Insecta: Diptera). *Evolution*, 54, 1638–1653.

Hodin, J., Hoffman, J., Miner, B. G. & Davidson, B. J. (2001) Thyroxine and the evolution of lecithotrophic development in echinoids. In Barker, M. (Ed.) *Echinoderms 2000*. Rotterdam, Swets and Zeitlinger.

Hodkova, M. (1976) Nervous inhibition of corpora allata by photoperiod in *Pyrrhocoris apterus*. *Nature*, 263, 521–523.

Hodkova, M. (1999) Regulation of diapause and reproduction in *Pyrrhocoris apterus (L.)* (Heteroptera)-neuroendocrine outputs (mini-review). *Entomological Science*, 2, 563–566.

Hodkova, M. (2008) Tissue signaling pathways in the regulation of life-span and reproduction in females of the linden bug, *Pyrrhocoris apterus*. *Journal of Insect Physiology*, 54, 508–517.

Hodkova, M., Okuda, T. & Wagner, R. M. (2001) Regulation of corpora allata in females of *Pyrrhocoris apterus* (Heteroptera) (a mini-review). *In Vitro Cellular & Developmental Biology.* 37, 560–563.

Hodkova, M., Berkova, P. & Zahradnickova, H. (2002) Photoperiodic regulation of the phospholipid molecular species composition in thoracic muscles and fat body of Pyrrhocoris apterus (Heteroptera) via an endocrine gland, corpus allatum. Journal of Insect Physiology, 48, 1009–1019.

Hoekstra, H. E. & Coyne, J. A. (2007) The locus of evolution: Evo devo and the genetics of adaptation. *Evolution*, 61, 995–1016.

Hoffmann, M. H. (2002) Biogeography of *Arabidopsis thaliana* (L.) Heynh. (Brassicaceae). *Journal of Biogeography*, 29, 125–134.

Hoffmann, A. A., Hallas, R., Sinclair, C. & Partridge, L. (2001) Rapid loss of stress resistance in *Drosophila melanogaster* under adaptation to laboratory culture. *Evolution*, 55, 436–438.

Hoffmann, M. H., Bremer, M., Schneider, K., Burger, F., Stolle, E. & Moritz, G. (2003) Flower visitors in a natural population of *Arabidopsis thaliana*. *Plant Biology*, 5, 491–494.

Hoheisel, G. & Sterba, G. (1963) Über die Wirkung von Kaliumperchlorat (KCIO4) auf Ammocyten von *Lampetra planeri* BLOCH. *Zeitschrift fur Mikroskopisch-Anatomische Forschung*, 70 490–516.

Holehan, A. M. & Merry, B. J. (1985) Lifetime breeding studies in fully fed and dietary restricted female CFY Sprague-Dawley rats. 1. Effect of age, housing conditions and diet on fecundity. *Mechanisms of Ageing and Development*, 33, 19–28.

Holland, B. & Rice, W. R. (1999) Experimental removal of sexual selection reverses intersexual antagonistic coevolution and removes a reproductive load. *Proceedings of the National Academy of Sciences of the United States of America*, 96, 5083–5088.

Holland, L. Z., Albalat, R., Azumi, K., Benito-Gutierrez, E., Blow, M. J., Bronner-Fraser, M., Brunet, F., Butts, T., Candiani, S., Dishaw, L. J., Ferrier, D. E. K., Garcia-Fernandez, J., Gibson-Brown, J. J., Gissi, C., Godzik, A., Hallbook, F., Hirose, D., Hosomichi, K., Ikuta, T., Inoko, H., Kasahara, M., Kasamatsu, J., Kawashima, T., Kimura, A., Kobayashi, M., Kozmik, Z., Kubokawa, K., Laudet, V., Litman, G. W., McHardy, A. C., Meulemans, D., Nonaka, M., Olinski, R. P., Pancer, Z., Pennacchio, L. A., Pestarino, M., Rast, J. P., Rigoutsos, I., Robinson-Rechavi, M., Roch, G., Saiga, H., Sasakura, Y., Satake, M., Satou, Y., Schubert, M., Sherwood, N., Shiina, T., Takatori, N., Tello, J., Vopalensky, P., Wada, S., Xu, A. L., Ye, Y. Z., Yoshida, K., Yoshizaki, F., Yu, J. K., Zhang, Q., Zmasek, C. M., De Jong, P. J., Osoegawa, K., Putnam, N. H., Rokhsar, D. S., Satoh, N. & Holland, P. W. H. (2008) The amphioxus genome illuminates vertebrate origins and cephalochordate biology. *Genome Research*, 18, 1100–1111.

Hölldobler, B. & Wilson, E. O. (2008) *The Superorganism: The Beauty, Elegance, and Strangeness of Insect Societies*. New York, W.W. Norton & Co.

Holliday, R. (1989) Food, reproduction and longevity: is the extended lifespan of calorie-restricted animals an evolutionary adaptation? *BioEssays*, 10, 125–127.

Holm, E. R., Nedved, B. T., Carpizo-Ituarte, E. & Hadfield, M. G. (1998) Metamorphic signal transduction in *Hydroides elegans* (Polychaeta: Serpulidae) is not mediated by a G protein. *Biological Bulletin*, 195, 21–29.

Holman, D. J. & Wood, J. W. (2001) Pregnancy loss and fecundability in women. In Ellison, P. T. (Ed.) *Reproductive Ecology and Human Evolution*. Hawthorne, Aldine de Gruyter.

Holmes, J. A., Chu, H., Khanam, S. A., Manzon, R. G. & Youson, J. H. (1999) Spontaneous and induced metamorphosis in the American brook lamprey, *Lampetra appendix*. *Canadian Journal of Zoology-Revue Canadienne de Zoologie*, 77, 959–971.

Holzenberger, M., Dupont, J., Ducos, B., Leneuve, P., Geloen, A., Even, P. C., Cervera, P. & Le Bouc, Y. (2003) IGF-1 receptor regulates lifespan and resistance to oxidative stress in mice. *Nature*, 421, 182–187.

Holzenberger, M., Kappeler, L. & De Magalhaes Filho, C. (2004) IGF-1 signaling and aging. *Experimental Gerontology*, 39, 1761–1764.

Hone, D. W. & Benton, M. J. (2005) The evolution of large size: how does Cope's Rule work? *Trends in Ecology & Evolution* 20, 4–6.

Honegger, B., Galic, M., Koehler, K., Wittwer, F., Brogiolo, W., Hafen, E. & Stocker, H. (2008) Imp-L2, a putative homolog of vertebrate IGF-binding protein 7, counteracts insulin signaling in *Drosophila* and is essential for starvation resistance. *Journal of Biology*, 7, 10.

Honek, A. (1993) Intraspecific variation in body size and fecundity in insects – a general relationship. *Oikos*, 66, 483–492.

Honjoh, S., Yamamoto, T., Uno, M. & Nishida, E. (2009) Signalling through RHEB-1 mediates intermittent fasting-induced longevity in *C. elegans*. *Nature*, 457, 726–730.

Hörstadius, S. (1939) The mechanics of sea urchin development, studied by operative methods. *Biological Reviews of the Cambridge Philosophical Society*, 14, 132–179.

Hörstadius, S. (1957) On the regulation of bilateral symmetry in plutei with exchanged meridional halves and in giant plutei. *Journal of Embryology and Experimental Morphology*, 5, 60–73.

Hörstadius, S. (1973) *Experimental Embryology of Echinoderms*. Oxford, Clarendon Press.

Hörstadius, S. (1975) Isolation and transplant experiments. In Czihak, G. (Ed.) *The Sea Urchin Embryo: Biochemistry and Morphogenesis*. Berlin, Springer.

Horton, G. E., Letcher, B. H., Bailey, M. M. & Kinnison, M. T. (2009) Atlantic salmon (*Salmo salar*) smolt production: the relative importance of survival and body growth. *Canadian Journal of Fisheries and Aquatic Sciences*, 66, 471–483.

Horwood, L. J., Darlow, B. A. & Mogridge, N. (2001) Breast milk feeding and cognitive ability at 7-8 years. *Archive of Disease in Childhood: Fetal and Neonatal Edition*, 84, F23–F27.

Hotchkiss, F. (1995) Loven's law and adult ray homologies in echinoids, ophiuroids, edrioasteroids, and an ophiocistioid (Echinodermata: Eleutherozoa). *Proceedings of the Biological Society of Washington*, 108, 401–435.

Houle, D. (1991) Genetic covariance of fitness correlates: what genetic correlations are made of and why it matters. *Evolution*, 45, 630–648.

Houle, D. (2001) Characters as the units of evolutionary change. In Wagner, G. P. (Ed.) *The Character Concept in Evolutionary Biology*. New York, Academic Press.

Houle, D. (2010) Numbering the hairs on our heads: the shared challenge and promise of phenomics. *Proceedings of the National Academy of Sciences of the United States of America*, 107 1691–1695.

Houston, A. I. & McNamara, J. M. (1999) *Models of adaptive behaviour. An approach based on state*. Cambridge, Cambridge University Press.

Houthoofd, K. & Vanfleteren, J. R. (2006) The longevity effect of dietary restriction in *Caenorhabditis elegans*. *Experimental Gerontology*, 41, 1026–1031.

Houthoofd, K., Braeckman, B. P., Lenaerts, I., Brys, K., De Vreese, A., Van Eygen, S. & Vanfleteren, J. R. (2002) Axenic growth up-regulates mass-specific metabolic rate, stress resistance, and extends lifespan in *Caenorhabditis elegans*. *Experimental Gerontology*, 37, 1371–1378.

Howell, N. (2000) *Demography of the Dobe !Kung*, 2nd edn. New York, Aldine de Gruyter.

Howie, P. W. & McNeilly, A. S. (1982) Effect of breast-feeding patterns on human birth intervals. *Journal of Reproduction and Fertility*, 65, 545–557.

Howitz, K. T., Bitterman, K. J., Cohen, H. Y., Lamming, D. W., Lavu, S., Wood, J. G., Zipkin, R. E., Chung, P., Kisielewski, A., Zhang, L. L., Scherer, B. & Sinclair, D. A. (2003) Small molecule activators of sirtuins extend *Saccharomyces cerevisiae* lifespan. *Nature*, 425, 191–196.

Hrdy, S. B. (2005) Evolutionary context of human development: The cooperative breeding model. In Carter, C. S. & Ahnert, L. (Eds.) *Attachment and Bonding: A New Synthesis*. Cambridge, MIT Press.

Hrdy, S. B. (2009) *Mothers and others: the evolutionary origins of mutual understanding*. Cambridge, Harvard University Press.

Hsin, H. & Kenyon, C. (1999) Signals from the reproductive system regulate the lifespan of *C. elegans*. *Nature*, 399, 362–366.

Hsu, A. L., Murphy, C. T. & Kenyon, C. (2003) Regulation of aging and age-related disease by DAF-16 and heat-shock factor. *Science*, 300, 1142–1145.

Hsu, H. J., LaFever, L. & Drummond-Barbose, D. (2008) Diet controls normal and tumorous germline stem cells via insulin-dependent and -independent mechanisms in *Drosophila*. *Developmental Biology*, 313, 700–712.

Huang, H. & Brown, D. D. (2000a) Overexpression of *Xenopus laevis* growth hormone stimulates growth of tadpoles and frogs. *Proceedings of the National Academy of Sciences of the United States of America*, 97, 190–194.

Huang, H. & Brown, D. D. (2000b) Prolactin is not a juvenile hormone in *Xenopus laevis* metamorphosis. *Proceedings of the National Academy of Sciences of the United States of America*, 97, 195–199.

Huang, L. Y., Miwa, S., Bengtson, D. A. & Specker, J. L. (1998a) Effect of triiodothyronine on stomach formation and pigmentation in larval striped bass (*Morone saxatilis*). *Journal of Experimental Zoology*, 280, 231–237.

Huang, L. Y., Schreiber, A. M., Soffientino, B., Bengtson, D. A. & Specker, J. L. (1998b) Metamorphosis of summer flounder (*Paralichthys dentatus*): Thyroid status and the timing of gastric gland formation. *The Journal of Experimental Zoology*, 280, 413–420.

Huang, H., Marsh-Armstrong, N. & Brown, D. D. (1999) Metamorphosis is inhibited in transgenic *Xenopus laevis* tadpoles that overexpress type III deiodinase. *Proceedings of the National Academy of Sciences of the United States of America*, 96, 962–967.

Huang, D. A. W., Sherman, B. T., Tan, Q., Kir, J., Liu, D., Bryant, D., Guo, Y., Stephens, R., Baseler, M. W., Lane, H. C. & Lempicki, R. A. (2007) DAVID Bioinformatics

Resources: expanded annotation database and novel algorithms to better extract biology from large gene lists. *Nucleic Acids Research*, 35, W169–W175.

Huang, D. A. W., Sherman, B. T. & Lempicki, R. A. (2009) Systematic and integrative analysis of large gene lists using DAVID bioinformatics resources. *Nature Protocols*, 4, 44–57.

Huey, R. B., Gilchrist, G. W., Carlson, M. L., Berrigan, D. & Serra, L. (2000) Rapid evolution of a geographic cline in size in an introduced fly. *Science*, 287, 308–309.

Hughes, R. N. (1989) *A Functional Biology of Clonal Animals*. New York, Chapman and Hall.

Hulbert, A. J. (2000) Thyroid hormones and their effects: a new perspective. *Biological Reviews of the Cambridge Philosophical Society*, 75, 519–631.

Hulbert, A. J. (2008) The links between membrane composition, metabolic rate and lifespan. *Comparative Biochemistry and Physiology A*, 150, 196–203.

Hulbert, A. J., Faulks, S. C. & Buffenstein, R. (2006) Oxidation-resistant membrane phospholipids can explain longevity differences among the longest-living rodents and similarly-sized mice. *Journal of Gerontology A*, 61, 1009–1018.

Hultmark, D. (1996) Insect lysozymes. *EXS*, 75, 87–102.

Hunt, J. H. & Amdam, G. V. (2005) Bivoltinism as an antecedent to eusociality in the paper wasp genus *Polistes*. *Science*, 308, 264–267.

Hunt, G. J., Amdam, G. V., Schlipalius, D., Emore, C., Sardesai, N., Williams, C. E., Rueppell, O., Guzman-Novoa, E., Arechavaleta-Valasco, M., Chandra, S., Fondrk, M. K., Beye, M. & Page, R. E. (2007) Behavioral genomics of honeybee foraging and nest defense. *Naturwissenschaften*, 94, 247–267.

Hunter, W. S., Croson, W. B., Bartke, A., Gentry, M. V. & Meliska, C. J. (1999) Low body temperature in long-lived Ames dwarf mice at rest and during stress. *Physiology & Behavior*, 67, 433–437.

Hurtado, A. M., Hill, K., Kaplan, H. & Hurtado, I. (1992) Trade-offs between female food acquisition and child care among Hiwi and Ache foragers. *Human Nature*, 3, 185–216.

Hutchings, J. A. & Myers, R. A. (1988) Mating success of alternative maturation phenotypes in male atlantic salmon, *Salmo salar*. *Oecologia*, 75, 169–174.

Hwangbo, D. S., Gersham, B., Tu, M. P., Palmer, M. & Tatar, M. (2004) *Drosophila* dFOXO controls lifespan and regulates insulin signalling in brain and fat body. *Nature*, 429, 562–566.

Hylemon, P. B., Zhou, H., Pandak, W. M., Ren, S., Gil, G. & Dent, P. (2009) Bile acids as regulatory molecules. *Journal of Lipid Research*, 50, 1509–1520.

Ibarguengoytia, N. R. & Casalins, L. M. (2007) Reproductive biology of the southernmost gecko *Homonota darwini*: Convergent life history patterns among southern hemisphere reptiles living in harsh environments. *Journal of Herpetology*, 41, 72–80.

Ikeya, T., Galic, M., Belawat, P., Nairz, K. & Hafen, E. (2002) Nutrient-dependent expression of insulin-like peptides from neuroendocrine cells in the CNS contributes to growth regulation in *Drosophila*. *Current Biology*, 12, 1293–1300.

Ikeya, T., Broughton, S., Alic, N., Grandison, R. & Partridge, L. (2009) The endosymbiont *Wolbachia* increases insulin/IGF-like signalling in *Drosophila*. *Proceedings of the Royal Society of London B*, 276, 3799–3807.

Ilmonen, P., Kotrschal, A. & Penn, D. J. (2008) Telomere attrition due to infection. *PLoS One*, 3, e2143.

Imler, J. L. & Eleftherianos, I. (2009) *Drosophila* as a model for studying antiviral defences. In Rolff, J. & Reynolds, S. E. (Eds.) *Infection and Immunity: Evolution, Ecology, and Mechanisms*. Oxford, Oxford University Press.

Inagaki, T., Dutchak, P., Zhao, G., Ding, X., Gautron, L., Parameswara, V., Li, Y., Goetz, R., Mohammadi, M., Esser, V., Elmquist, J. K., Gerard, R. D., Burgess, S. C., Hammer, R. E., Mangelsdorf, D. J. & Kliewer, S. A. (2007) Endocrine regulation of the fasting response by PPARalpha-mediated induction of fibroblast growth factor 21. *Cell Metabolism*, 5, 415–425.

Inagaki, T., Lin, V. Y., Goetz, R., Mohammadi, M., Mangelsdorf, D. J. & Kliewer, S. A. (2008) Inhibition of growth hormone signaling by the fasting-induced hormone FGF21. *Cell Metabolism*, 8, 77–83.

Ingram, D. K., Weindruch, R., Spangler, E. L., Freeman, J. R. & Walford, R. L. (1987) Dietary restriction benefits learning and motor performance of aged mice. *Journal of Gerontology*, 42, 78–81.

Ingram, D. K., Anson, R. M., De Cabo, R., Mamczarz, J., Zhu, M., Mattison, J., Lane, M. A. & Roth, G. S. (2004) Development of calorie restriction mimetics as a prolongevity strategy. *Annals of the New York Academy of Sciences*, 1019, 412–423.

Innocenti, P. & Morrow, E. H. (2009) Immunogenic males: a genome-wide analysis of reproduction and the cost of mating in *Drosophila melanogaster* females. *Journal of Evolutionary Biology*, 22, 964–973.

Insel, T. R. & Young, L. J. (2001) The neurobiology of attachment. *Nature Reviews Neuroscience*, 2, 129–136.

Inui, Y. & Miwa, S. (1985) Thyroid hormone induces metamorphosis of flounder larvae. *General and Comparative Endocrinology*, 60, 450–454.

Ishizaki, H. & Suzuki, A. (1994) The brain secretory peptides that control molting and metamorphosis of the

Silkmoth, *Bombyx mori*. *International Journal of Developmental Biology*, 38, 301–310.

Ishigaki, S., Abramovitz, M. & Listowsky, I. (1989) Glutathione-S-transferases are major cytosolic thyroid hormone binding proteins. *Archives of Biochemistry and Biophysics*, 273, 265–272.

Ishizuya-Oka, A. & Shimozawa, A. (1991) Induction of metamorphosis by thyroid hormone in anuran small intestine cultured organotypically *in vitro*. *In vitro Cellular & Developmental Biology*, 27A, 853–857.

Isorna, E., Obregon, M. J., Calvo, R. M., Vazquez, R., Pendon, C., Falcon, J. & Munoz-Cueto, J. A. (2009) Iodothyronine deiodinases and thyroid hormone receptors regulation during flatfish (*Solea senegalensis*) metamorphosis. *Journal of Experimental Zoology B*, 312B, 231–246.

Izawa, T., Takahashi, Y. & Yano, M. (2003) Comparative biology comes into bloom: genomic and genetic comparison of flowering pathways in rice and *Arabidopsis*. *Current Opinion in Plant Biology*, 6, 113–120.

Ja, W. W., Carvalho, G. B., Mak, E. M., De La Rosa, N. N., Fang, A. Y., Liong, J. C., Brummel, T. & Benzer, S. (2007) Prandiology of *Drosophila* and the CAFE assay. *Proceedings of the National Academy of Sciences of the United States of America*, 104, 8253–8256.

Jackson, J. B. C. & Coates, A. G. (1986) Life cycles and evolution of clonal (modular) animals. *Philosophical Transactions of the Royal Society of London B*, 313, 7–22.

Jacobs, M. W., Degnan, S. M., Woods, R., Williams, E., Roper, K., Green, K. & Degnan, B. M. (2006) The effect of larval age on morphology and gene expression during ascidian metamorphosis. *Integrative and Comparative Biology*, 46, 760–776.

Jaeckle, W. B. (1994) Multiple modes of asexual reproduction by tropical and subtropical sea star larvae: an unusual adaptation for genet dispersal and survival. *Biological Bulletin*, 186, 62–71.

Jaenike, J. (1978) An hypothesis to account for the maintenance of sex within populations. *Evolutionary Theory*, 3, 191–194.

Jaenisch, R. & Bird, A. (2003) Epigenetic regulation of gene expression: how the genome integrates intrinsic and environmental signals. *Nature Genetics*, 33 Suppl, 245–254.

Jakob, W. & Schierwater, B. (2007) Changing hydrozoan bauplans by silencing Hox-like genes. *PLoS One*, 2, e694.

James, A. C., Azevedo, R. B. R. & Partridge, L. (1997) Genetic and environmental responses to temperature of *Drosophila melanogaster* from a latitudinal cline. *Genetics*, 146, 881–890.

Jang, Y. C. & Remmen, V. H. (2009) The mitochondrial theory of aging: insight from transgenic and knockout mouse models. *Experimental Gerontology*, 44, 256–260.

Janke, A., Erpenbeck, D., Nilsson, M. & Arnason, U. (2001) The mitochondrial genomes of the iguana (*Iguana iguana*) and the caiman (*Caiman crocodylus*): implications for amniote phylogeny. *Proceedings of the Royal Society of London B*, 268, 623–631.

Jansen, J., Friesema, E. C., Kester, M. H., Schwartz, C. E. & Visser, T. J. (2008) Genotype-phenotype relationship in patients with mutations in thyroid hormone transporter MCT8. *Endocrinology*, 149, 2184–2190.

Janson, C. H. & van Schaik, C. P. (1993) Ecological risk aversion in juvenile primates: slow and steady wins the race. In Pereira, M. E. & Fairbanks, L. A. (Eds.) *Juvenile Primates: Life History, Development and Behavior*. Oxford, Oxford University Press.

Jasienska, G. (2001) Why energy expenditure causes reproductive suppression in women. An evolutionary and bioenergetic perspective. In Ellison, P. T. (Ed.) *Reproductive Ecology and Human Evolution*. New York, Aldine de Gruyter.

Jasienska, G. (2003) Energy metabolism and the evolution of reproductive suppression in the human female. *Acta Biotheoretica*, 51, 1–18.

Jasienska, G., Nenko, I. & Jasienska, M. (2006) Daughters increase longevity of fathers, but daughters and sons equally reduce longevity of mothers. *American Journal of Human Biology*, 18, 422–425.

Jawor, J. M., McGlothlin, J. W., Casto, J. M., Greives, T. J., Snajdr, E. A., Bentley, G. E. & Ketterson, E. D. (2006) Seasonal and individual variation in response to GnRH challenge in male dark-eyed juncos (*Junco hyemalis*). *General and Comparative Endocrinology*, 149, 182–189.

Jeffery, W. R. & Swalla, B. J. (1992) Evolution of alternate modes of development in Ascidians. *BioEssays*, 14, 219–226.

Jena, B. & Patnaik, B. (1992) Changes in catalase activity and its thermolability in liver and kidneys of aging male garden lizard. *Gerontology*, 38, 252–257.

Jena, B. S., Nayak, S. B. & Patnaik, B. K. (1998) Age-related changes in catalase activity and its inhibition by manganese (II) chloride in the brain of two species of poikilothermic vertebrates. *Archives of Gerontology and Geriatrics*, 26, 119–129.

Jenkins, T. M. J. (1969) Social structure, position choice and micro-distribution of two trout species (*Salmo trutta* and *Salmo gairdneri*) resident in mountain streams. *Animal Behavior Monographs*, 2, 56–123.

Jennings, D. H. & Hanken, J. (1998) Mechanistic basis of life history evolution in anuran amphibians: thyroid gland development in the direct-developing frog, *Eleutherodactylus coqui*. *General and Comparative Endocrinology*, 111, 225–232.

Jensen, A. R. (1998) *The g factor: the science of mental ability*. New York, Praeger.

Jensen, K. H., Little, T., Skorping, A. & Ebert, D. (2006) Empirical support for optimal virulence in a castrating parasite. *PLoS Biology*, 4, 1265–1269.

Jepson, J. H., Gardner, F. H., Gorshein, D. & Hait, W. M. (1973) Current concepts of the action of androgenic steroids on erythropoiesis. *Journal of Pediatrics*, 83, 703–708.

Jjepsen, K., Hermanson, O., Onami, T. M., Gleiberman, A. S., Lunyak, V., Jepson, J. H., Gardner, F. H., Gorshein, D. & Hait, W. M. (1973) Current concepts of the action of androgenic steroids on erythropoiesis. *Journal of Pediatrics*, 83, 703–708.

Jia, K., Chen, D. & Riddle, D. L. (2004) The TOR pathway interacts with the insulin signaling pathway to regulate *C. elegans* larval development, metabolism and life span. *Development*, 131, 3897–3906.

Jiang, J. C., Jaruga, E., Repnevskaya, M. V. & Jazwinski, S. M. (2000) An intervention resembling caloric restriction prolongs lifespan and retards aging in yeast. *FASEB Journal*, 14, 2135–2137.

Jiang, Z., Castoe, T., Austin, C., Burbrink, F., Herron, M., McGuire, J., Parkinson, C. & Pollock, D. (2007) Comparative mitochondrial genomics of snakes: extraordinary substitution rate dynamics and functionality of the duplicate control region. *BMC Evolutionary Biology* 7, 123.

Jiggins, C. D., Naisbit, R. E., Coe, R. L. & Mallet, J. (2001) Reproductive isolation caused by colour pattern mimicry. *Nature*, 411, 302–305.

Joffe, T. H. (1997) Social pressures have selected for an extended juvenile period in primates. *Journal of Human Evolution*, 32, 593–605.

Johanson, U., West, J., Lister, C., Michaels, S., Amasino, R. & Dean, C. (2000) Molecular analysis of *FRIGIDA*, a major determinant of natural variation in *Arabidopsis* flowering time. *Science*, 290, 344–347.

John-Alder, H. B. & Cox, R. M. (2007) Development of sexual size dimorphism in lizards: testosterone as a bipotential growth regulator. In Daphne, J. F., Blanckenhorn, W. U. & Szekely, T. (Eds.) *Sex, Size, and Gender Roles*. Oxford, Oxford University Press.

Johnsson, J. I. & Bjornsson, B. T. (1994) Growth hormone increases growth rate, appetite and dominance in juvenile rainbow trout, *Oncorhynchus mykiss Animal Behaviour*, 48, 177–186.

Joint, I. (2006) Bacterial conversations: talking, listening and eavesdropping. A NERC discussion meeting held at the Royal Society on 7 December 2005. *Journal of the Royal Society, Interface*, 3, 459–463.

Jolivet-Jaudet, G. & Leloup-Hatey, J. (1984) Variations in aldosterone and corticosterone plasma levels during metamorphosis in *Xenopus laevis* tadpoles. *General and Comparative Endocrinology*, 56, 59–65.

Jones, D. & Jones, G. (2007) Farnesoid secretions of dipteran ring glands: What we do know and what we can know. *Insect Biochemistry & Molecular Biology*, 37, 771–798.

Jones, E. I., Ferriere, R. & Bronstein, J. L. (2009) Eco-evolutionary dynamics of mutualists and exploiters. *The American Naturalist*, 174, 780–794.

Jonsson, K. I. (1997) Capital and income breeding as alternative tactics of resource use in reproduction. *Oikos*, 78, 57–66.

Joshi, A. & Thompson, J. N. (1995) Alternative routes to the evolution of competitive ability in 2 competing species of *Drosophila*. *Evolution*, 49, 616–625.

Just, J. J., Kraus-Just, J., Check, D. A. (1981) Survey of Chordate Metamorphosis. In Gilbert, L. I. & Frieden, E. (Eds.) *Metamorphosis: A Problem in Developmental Biology*. New York, Plenum Press.

Juul, A. (2001) The effects of oestrogens on linear bone growth. *Human Reproduction Update*, 7, 303–313.

Kaeberlein, M. & Powers III, R. W., (2007) Sir2 and calorie restriction in yeast: a skeptical perspective. *Aging Research Reviews*, 6, 128–140.

Kaeberlein, M. & Shamieh, L. S. (2010) *The Role of TOR Signaling in Aging*. New York, Springer.

Kaeberlein, M., McVey, M. & Guarente, L. (1999) The SIR2/3/4 complex and SIR2 alone promote longevity in *Saccharomyces cerevisiae* by two different mechanisms. *Genes & Development*, 13, 2570–2580.

Kaeberlein, T. L., Smith, E. D., Tsuchiya, M., Welton, K. L., Thomas, J. H., Fields, S., Kennedy, B. K. & Kaeberlein, M. (2006) Lifespan extension in *Caenorhabditis elegans* by complete removal of food. *Aging Cell*, 5, 487–494.

Kaltenbach, J. (1996) Endocrinology of Amphibian Metamorphosis. In Gilbert, L. I., Tata, J. R. & Atkinson, B. G. (Eds.) *Metamorphosis: Postembryonic Reprogramming of Gene Expression in Amphibian and Insect Cells*. San Diego, Academic Press.

Kalushkov, P., Hodkova, M., Nedved, O. & Hodek, I. (2001) Effect of thermoperiod on diapause intensity in *Pyrrhocoris apterus* (Heteroptera Pyrrhocoridae). *Journal of Insect Physiology*, 47, 55–61.

Kamleh, M. A., Hobani, Y., Dow, J. A. T. & Watson, D. G. (2007) Metabolomic profiling of *Drosophila* using liquid chromatography Fourier transform mass spectrometry. *FEBS Letters*, 582, 2916–2922.

Kamm, K., Schierwater, B., Jakob, W., Dellaporta, S. L. & Miller, D. J. (2006) Axial patterning and diversification in the *Cnidaria* predate the Hox system. *Current Biology*, 16, 920–926.

Kammenga, J. E., Doroszuk, A., Riksen, J. A., Hazendonk, E., Spiridon, L., Petrescu, A. J., Tijsterman, M., Plasterk, R. H. & Bakker, J. (2007) A *Caenorhabditis elegans* wild type defies the temperature-size rule owing to a single nucleotide polymorphism in tra-3. *PLoS Genetics*, 3, e34.

Kaneko, T. (2003) Aging and the accumulation of oxidative damage to DNA. *Journal of Clinical Biochemistry and Nutrition*, 34, 51–60.

Kapahi, P., Zid, B. M., Harper, T., Koslover, D., Sapin, V. & Benzer, S. (2004) Regulation of lifespan in *Drosophila* by modulation of genes in the TOR signaling pathway. *Current Biology*, 14, 885–890.

Kaplan, H. S. & Robson, A. J. (2002) The emergence of humans: the coevolution of intelligence and longevity with intergenerational transfers. *Proceedings of the National Academy of Sciences of the United States of America*, 99, 10221–10226.

Kaplan, H., Hill, K., Lancaster, J. & Hurtado, A. M. (2000) A theory of human life history evolution: diet, intelligence, and longevity. *Evolutionary Anthropology*, 9, 156–185.

Karaolis-Danckert, N., Buyken, A. E., Sonntag, A. & Kroke, A. (2009) Birth and early life influences on the timing of puberty onset: results from the DONALD (Dortmund Nutritional and Anthropometric Longitudinally Designed) study. *American Journal of Clinical Nutrition*, 90, 1559–1565.

Karim, F. D., Guild, G. M. and Thummel, C. S. (1993) The *Drosophila* Broad-Complex plays a role in controlling ecdysone-regulated gene expression at the onset of metamorphosis. *Development*, 118, 977–988.

Kato, H., Fukuda, T., Parkison, C., McPhie, P. & Cheng, S. Y. (1989) Cytosolic thyroid hormone-binding protein is a monomer of pyruvate kinase. *Proceedings of the National Academy of Sciences of the United States of America*, 86, 7861–7865.

Katona, P. & Katona-Apte, J. (2008) The interaction between nutrition and infection. *Clinical Infectious Diseases*, 46, 1582–1588.

Katz, S. H., Hediger, M. L., Zemel, B. S. & Parks, J. S. (1985) Adrenal androgens, body fat and advanced skeletal age in puberty: new evidence for the relations of adrenarche and gonadarche in males. *Human Biology*, 57, 401–413.

Kawakami, Y., Tanda, M., Adachi, S. & Yamauchi, K. (2003) Characterization of thyroid hormone receptor alpha and beta in the metamorphosing Japanese conger eel, *Conger myriaster*. *General and Comparative Endocrinology*, 132, 321–332.

Kawakami, Y., Yokoi, K., Kumai, H. & Ohta, H. (2008) The role of thyroid hormones during the development of eye pigmentation in the Pacific bluefin tuna (*Thunnus orientalis*). *Comparative Biochemistry and Physiology B, Biochemistry & Molecular Biology*, 150, 112–116.

Kawamura, K., Shibata, T., Saget, O., Peel, D. & Peter, J. (1999) A new family of growth factors produced by the fat body and active on *Drosophila* imaginal disc cells. *Development*, 126, 211–219.

Kawecki, T. J. & Mery, F. (2006) Genetically idiosyncratic responses of *Drosophila melanogaster* populations to selection for improved learning ability. *Journal of Evolutionary Biology*, 19, 1265–1274.

Kayukawa, T., Chen, B., Miyazaki, S., Itoyama, K., Shinoda, T. & Ishikawa, Y. (2005) Expression of mRNA for the t-complex polypeptide-1, a subunit of chaperonin CCT, is upregulated in association with increased cold hardiness in *Delia antiqua*. *Cell Stress Chaperones*, 10, 204–210.

Kealy, R. D., Lawler, D. F., Ballam, J. M., Mantz, S. L., Biery, D. N., Greeley, E. H., Lust, G., Segre, M., Smith, G. K. & Stowe, H. D. (2002) Effects of diet restriction on lifespan and age-related changes in dogs. *Journal of the American Veterinary Medical Association*, 220, 1315–1320.

Keefe, M. & Able, K. W. (1993) Patterns of metamorphosis in summer flounder, *Paralichthys dentatus Journal of Fish Biology*, 42, 713–728.

Kelic, V., Obradovic, T. & Pavkovic-Lucic, S. (2007) Growth temperature, mating latency, and duration of copulation in *Drosophila melanogaster*. *Drosophila Information Service*, 90, 111–113.

Keller, L. & Genoud, M. (1997) Extraordinary lifespans in ants: a test of evolutionary theories of aging. *Nature*, 389, 958–960.

Keller, L. & Gordon, E. (2009) *The lives of ants*. Oxford, Oxford University Press.

Keller, L. & Jemielity, S. (2006) Social insects as a model to study the molecular basis of aging. *Experimental Gerontology*, 41, 553–556.

Keller, L. & Surette, M. G. (2006) Communication in bacteria: an ecological and evolutionary perspective. *Nature Reviews Microbiology*, 4, 249.

Kempf, S. C. & Page, L. R. (2005) Anti-tubulin labeling reveals ampullary neuron ciliary bundles in opisthobranch larvae and a new putative neural structure associated with the apical ganglion. *Biological Bulletin*, 208, 169–182.

Kennedy, B. K., Austriaco, N. R., JR., Zhang, J. & Guarente, L. (1995) Mutation in the silencing gene SIR4 can delay aging in *S. cerevisiae*. *Cell*, 80, 485–496.

Kenyon, C. (2010) The genetics of ageing. *Nature*, 464, 504–512.

Kenyon, C., Chang, J., Gensch, E., Rudner, A. & Tabtiang, R. (1993) A *C. elegans* mutant that lives twice as long as wild type. *Nature*, 366, 461–464.

Kerr, B., Riley, M. A., Feldman, M. W. & Bohannan, B. J. M. (2002) Local dispersal promotes biodiversity in a real-life game of rock-paper-scissors. *Nature*, 418, 171–174.

Ketterson, E. D. & Nolan, V. (1992) Hormones and life histories: an integrative approach. *The American Naturalist*, 140, 33–62.

Ketterson, E. D. & Nolan JR., V. (1999) Adaptation, exaptation, and constraint: a hormonal perspective. *The American Naturalist*, 154 (Suppl.), S4–S25.

Ketterson, E. D., Atwell, J. W. & McGlothlin, J. W. (2009) Phenotypic integration and independence: hormones, performance, and response to environmental change. *Integrative and Comparative Biology*, 49, 365–379.

Khryanin, V. N. (2007) Evolution of the pathways of sex differentiation in plants. *Russian Journal of Plant Physiology*, 54, 845–852.

Kiguchi, K. & Riddiford, L. M. (1978) A role of juvenile hormone in pupal development of the tobacco hornworm, *Manduca sexta*. *Journal of Insect Physiology*, 24, 673–680.

Kikuyama, S., Niki, K., Mayumi, M. & Kawamura, K. (1982) Retardation of thyroxine-induced metamorphosis by Amphenone B in toad tadpoles. *Endocrinologia Japonica*, 29, 659–662.

Kikuyama, S., Kawamura, K., Tanaka, S. & Yamamoto, K. (1993) Aspects of amphibian metamorphosis: hormonal control. *International Review of Cytology*, 145, 105–148.

Killian, C. E. & Wilt, F. H. (2008) Molecular aspects of biomineralization of the Echinoderm skeleton. *Chemical Reviews*, 108, 4463–4474.

Kim, S., Benguria, A., Lai, C. Y. & Jazwinski, S. M. (1999) Modulation of life-span by histone deacetylase genes in *Saccharomyces cerevisiae*. *Molecular Biology of the Cell*, 10, 3125–3136.

Kim, T., Yoon, J., Cho, H., Lee, W. B., Kim, J., Song, Y. H., Kim, S. N., Yoon, J. H., Kim-Ha, J. & Kim, Y. J. (2005) Downregulation of lipopolysaccharide response in *Drosophila* by negative crosstalk between the AP1 and NF-kappaB signaling modules. *Nature Immunology*, 6, 211–218.

Kim, L. K., Choi, U. Y., Cho, H. S., Lee, J. S., Lee, W. B., Kim, J., Jeong, K., Shim, J., Kim-Ha, J. & Kim, Y. J. (2007) Down-regulation of NF-kappaB target genes by the AP-1 and STAT complex during the innate immune response in *Drosophila*. *PLoS Biology*, 5, e238.

Kimura, M. T. (1988) Interspecific and geographic variation of diapause intensity and seasonal adaptation in the *Drosophila auraria* species complex (Diptera: Drosophilidae). *Functional Ecology*, 2, 177–183.

Kimura, K. D., Tissenbaum, H. A., Liu, Y. & Ruvkun, G. (1997) daf-2, an insulin receptor-like gene that regulates longevity and diapause in *Caenorhabditis elegans*. *Science*, 277, 942–946.

Kingsley, R. J., Afif, E., Cox, B. C., Kothari, S., Kriechbaum, K., Kuchinsky, K., Neill, A. T., Puri, A. F. & Kish, V. M. (2003) Expression of heat shock and cold shock proteins in the gorgonian *Leptogorgia virgulata*. *Journal of Experimental Zoology A*, 296A, 98–107.

Kingsolver, J. G. (1987) Evolution and coadaptation of thermoregulatory behavior and wing pigmentation pattern in Pierid butterflies. *Evolution*, 41, 472–490.

Kingsolver, J. G. (1995a) Fitness consequences of seasonal polyphenism in western white butterflies. *Evolution*, 49, 942–954.

Kingsolver, J. G. (1995b) Viability selection on seasonally polyphenic traits - wing melanin pattern in western white butterflies. *Evolution*, 49, 932–941.

Kingsolver, J. G. (1996) Experimental manipulation of wing pigment pattern and survival in western white butterflies. *The American Naturalist*, 147, 296–306.

Kingsolver, J. G. & Pfennig, D. W. (2004) Individual-level selection as a cause of Cope's rule of phyletic size increase. *Evolution*, 58, 1608–1612.

Kington, R., Lillard, L. & Rogowski, J. (1997) Reproductive history, socioeconomic status, and self-reported health status of women aged 50 years or older. *American Journal of Public Health*, 87, 33–37.

Kinjoh, T., Kaneko, Y., Itoyama, K., Mita, K., Hiruma, K. & Shinoda, T. (2007) Control of juvenile hormone biosynthesis in *Bombyx mori*: cloning of the enzymes in the mevalonate pathway and assessment of their developmental expression in the corpora allata. *Insect Biochemistry & Molecular Biology*, 37(8), 808–818.

Kirk, D. L. (1995) Asymmetric division, cell size and germsoma specification in *Volvox Seminars in Developmental Biology*, 6, 369–379.

Kirk, D. L. (1998) *Volvox. Molecular genetic origins of multicellularity and cellular differentiation*. New York, Cambridge University Press.

Kirk, D. L., Baran, G. J., Harper, J. F., Huskey, R. J., Huson, K. S. & Zagris, N. (1987) Stage-specific hypermutability of the reg A locus of *Volvox*, a gene regulating the germsoma dichotomy. *Cell*, 18, 11–24.

Kirk, M., Ransick, A., McRae, S. E. & Kirk, D. L. (1993) The relationship between cell size and cell fate in *Volvox carteri*. *Journal of Cell Biology*, 123, 191–208.

Kirk, M., Stark, K., Miller, S., Muller, W., Taillon, B., Gruber, H., Schmitt, R. & Kirk, D. L. (1999) regA, a *Volvox* gene that plays a central role in germ soma differentiation, encodes a novel regulatory protein. *Development*, 126, 639–647.

Kirkwood, T. B. (1977) Evolution of aging. *Nature*, 270, 301–304.

Kirkwood, T. B. & Holliday, R. (1979) The evolution of aging and longevity. *Proceedings of the Royal Society of London B*, 205, 531–546.

Kiss, I. (1976) Prepupal larval mosaics in *Drosophila melanogaster*. *Nature*, 262, 136–138.

Kiss, I., Beaton, A. H., Tardiff, J., Fristrom, D. & Firstrom, J. W. (1988) Interactions and developmental effects of mutations in the *Broad-Complex* of *Drosophila melanogaster*. *Genetics*, 118, 247–259.

Kitajima, C., Sato, T. & Kawanishi, M. (1967) On the effect of thyroxine to promote the metamorphosis of a conger eel. *Bulletin of the Japanese Society of Scientific Fisheries*, 33, 919–922.

Kitamoto, N., Ueno, S., Takenaka, A., Tsumura, Y., Washitani, I. & Ohsawa, R. (2006) Effect of flowering phenology on pollen flow distance and the consequences for spatial genetic structure within a population of *Primula sieboldii* (Primulaceae). *American Journal of Botany*, 93, 226–233.

Klapper, W., Heidorn, K., Kuhne, K., Parwaresch, R. & Krupp, G. (1998) Telomerase activity in 'immortal' fish. *FEBS Letters*, 434, 409–412.

Klass, M. R. (1977) Aging in the nematode *Caenorhabditis elegans*: major biological and environmental factors influencing life span. *Mechanisms of Ageing and Development*, 6, 413–429.

Klass, M. R. (1983) A method for the isolation of longevity mutants in the nematode *Caenorhabditis elegans* and initial results. *Mechanisms of Ageing and Development*, 22, 279–286.

Kleemann, G. A. & Murphy, C. T. (2009) The endocrine regulation of aging in *Caenorhabditis elegans*. *Molecular and Cellular Endocrinology*, 299, 51–57.

Klein, R. G. (1984) *The human career: human biological and cultural origins*. Chicago, Chicago University Press.

Klinzing, M. S. E. & Pechenik, J. A. (2000) Evaluating whether velar lobe size indicates food limitation among larvae of the marine gastropod *Crepidula fornicata*. *Journal of Experimental Marine Biology and Ecology*, 252, 255–279.

Klok, M. D., Jakobsdottir, S. & Drent, M. L. (2007) The role of leptin and ghrelin in the regulation of food intake and body weight in humans: a review. *Obesity Reviews*, 8, 21–34.

Knauf, F., Rogina, B., Jiang, Z., Aronson, P. S. & Helfand, S. L. (2002) Functional characterization and immunolocalization of the transporter encoded by the life-extending gene Indy. *Proceedings of the National Academy of Sciences of the United States of America*, 99, 14315–14319.

Knight, T. M., Steets, J. A., Vamosi, J. C., Mazer, S. J., Burd, M., Campbell, D. R., Dudash, M. R., Johnston, M. O., Mitchell, R. J. & Ashman, T.-L. (2005) Pollen limitation of plant reproduction: pattern and process. *Annual Review of Ecology, Evolution, and Systematics*, 36, 467–497.

Knight, C. G., Zitzmann, N., Prabhakar, S., Antrobus, R., Dwek, R., Hebestreit, H. & Rainey, P. B. (2006) Unraveling adaptive evolution: how a single point mutation affects the protein coregulation network. *Nature Genetics*, 38, 1015–1022.

Knobil, E. & Neill, J. D. (1988) *The Physiology of Reproduction*. New York, Raven.

Kobuke, L., Specker, J. L. & Bern, H. A. (1987) Thyroxine content of eggs and larvae of coho salmon, *Oncorhynchus kisutch. Journal of Experimental Zoology*, 242, 89–94.

Koch, P. B. (1992) Seasonal polyphenism in butterflies - a hormonally controlled phenomenon of pattern-formation. *Zoologische Jahrbücher – Abteilung fur Allgemeine Zoologie und Physiologie der Tiere* 96, 227–240.

Koch, P. B., Brakefield, P. M. & Kesbeke, F. (1996) Ecdysteroids control eyespot size and wing color pattern in the polyphenic butterfly *Bicyclus anynana* (Lepidoptera: Satyridae). *Journal of Insect Physiology*, 42, 223–230.

Koch, M., Bishop, J. & Mitchell-Olds, T. (1999) Molecular systematics and evolution of *Arabidopsis* and *Arabis*. *Plant Biology*, 1, 529–537.

Kojima, S., Takahashi, Y., Kobayashi, Y., Monna, L., Sasaki, T., Araki, T. & Yano, M. (2002) *Hd3a*, a rice ortholog of the *Arabidopsis FT* gene, promotes transition to flowering downstream of *Hd1* under short-day conditions. *Plant & Cell Physiology*, 43, 1096–1105.

Kokko, H. & Rankin, D. J. (2006) Lonely hearts or sex in the city? Density-dependent effects in mating systems. *Philosophical Transactions of the Royal Society of London B*, 361, 319–334.

Kole, C., Quijada, P., Michaels, S. D., Amasino, R. M. & Osborn, T. C. (2001) Evidence for homology of flowering-time genes *VFR2* from *Brassica rapa* and *FLC* from *Arabidopsis thaliana*. *Theoretical and Applied Genetics*, 102, 425–430.

Komeda, Y. (2004) Genetic regulation of time to flower in *Arabidopsis thaliana*. *Annual Review of Plant Biology*, 55, 521–535.

Kondrashov, A. S. (1993) Classification of hypotheses on the advantage of amphimixis. *Journal of Heredity*, 84, 372–387.

Konopova, B. & Jindra, M. (2008) Broad Complex acts downstream of Met in juvenile hormone signaling to coordinate primitive holometabolan metamorphosis. *Development* 135, 559–568.

Konopova, B. & Jindra, M. (2007) Juvenile hormone resistance gene *Methoprene-tolerant* controls entry into metamorphosis in the beetle *Tribolium castaneum*. *Proceedings of the National Academy of Sciences of the United States of America*, 104, 10488–10493.

Konopova, B. & Jindra, M. (2009) Juvenile hormone regulates metamorphosis of holometabolous and hemimetabolous insects through Met and Kr-h1 genes. *Mechanisms of Development*, 126, S68–S69.

Konopova, B. & Zrzavy, J. (2005) Ultrastructure, development, and homology of insect embryonic cuticles. *Journal of Morphology*, 264, 339–362.

Kooi, R. E. & Brakefield, P. M. (1999) The critical period for wing pattern induction in the polyphenic tropical butterfly *Bicyclus anynana* (Satyrinae). *Journal of Insect Physiology*, 45, 201–212.

Koornneef, M., Hanhart, C. J. & Vanderveen, J. H. (1991) A genetic and physiological analysis of late flowering mutants in *Arabidopsis thaliana*. *Molecular & General Genetics*, 229, 57–66.

Koornneef, M., Alonso-Blanco, C. & Vreugdenhil, D. (2004) Naturally occurring genetic variation in *Arabidopsis thaliana*. *Annual Review of Plant Biology*, 55, 141–172.

Korte, M. S., Koolhaas, J. M., Wingfield, J. C. & McEwen, B. S. (2005) The Darwinian concept of stress: benefits of allostasis and costs of allostatic load and the trade-offs in health and disease. *Neuroscience Biobehavior Reviews*, 29, 3–38.

Kortschak, R. D., Samuel, G., Saint, R. & Miller, D. J. (2003) EST analysis of the cnidarian *Acropora millepora* reveals extensive gene loss and rapid sequence divergence in the model invertebrates. *Current Biology*, 13, 2190–2195.

Korves, T. M., K. J. Schmid, A. L. Caicedo, C. Mays, J. R. Stinchcombe, M. D. Purugganan, and J. Schmitt (2007) Fitness effects associated with the major flowering time gene FRIGIDA in *Arabidopsis thaliana* in the field. *The American Naturalist*, 169, E141–E157.

Kostál, V. (2006) Eco-physiological phases of insect diapause. *Journal of Insect Physiology*, 52, 113–127.

Kostál, V., Tollarova, M. & Dolezel, D. (2008) Dynamism in physiology and gene diapause in a heteropteran transcription during reproductive bug, *Pyrrhocoris apterus*. *Journal of Insect Physiology*, 54, 77–88.

Koufopanou, V. (1994) The evolution of soma in the Volvocales. *The American Naturalist*, 143, 907–931.

Koufopanou, V. & Bell, G. (1993) Soma and germ - an experimental approach using Volvox. *Proceedings of the Royal Society of London B*, 254, 107–113.

Kowalski, S. P., Lan, T. H., Feldmann, K. A. & Paterson, A. H. (1994) QTL mapping of naturally-occurring variation in flowering time of *Arabidopsis thaliana*. *Molecular & General Genetics*, 245, 548–555.

Kraaijeveld, A. R. & Godfray, H. C. J. (1997) Trade-off between parasitoid resistance and larval competitive ability in *Drosophila melanogaster*. *Nature*, 389, 278–280.

Kraaijeveld, A. R., Limentani, E. C. & Godfray, H. C. J. (2001) Basis of the trade-off between parasitoid resistance and larval competitive ability in *Drosophila melanogaster*. *Proceedings of the Royal Society of London B*, 268, 259–261.

Kraaijeveld, A. R., Ferrari, J. & Godfray, H. C. J. (2002) Costs of resistance in insect-parasite and insect-parasitoid interactions. *Parasitology*, 125, S71–S82.

Krain, L. P. & Denver, R. J. (2004) Developmental expression and hormonal regulation of glucocorticoid and thyroid hormone receptors during metamorphosis in *Xenopus laevis*. *Journal of Endocrinology*, 181, 91–104.

Kralj-Fiser, S., Scheiber, I. B. R., Blejec, A., Moestl, E. & Kotrschal, K. (2007) Individualities in a flock of free-roaming greylag geese: behavioral and physiological consistency over time and across situations. *Hormones and Behavior*, 51, 239–248.

Kristensen, N. P. (1999) Phylogeny of endopterygote insects, the most successful lineage of living organisms. *European Journal of Entomology* 96, 237–253.

Krug, P. J. (2009) Not my "type": larval dispersal dimorphisms and bet-hedging in Opisthobranch life histories. *Biological Bulletin*, 216, 355–372.

Krug, E. C., Honn, K. V., Battista, J. & Nicoll, C. S. (1983) Corticosteroids in serum of *Rana catesbeiana* during development and metamorphosis. *General and Comparative Endocrinology*, 52, 232–241.

Kubli, E. (2003) Sex-peptides: seminal peptides of the *Drosophila* male. *Cellular and Molecular Life Sciences*, 60, 1689–1704.

Kucharski, R., Maleszka, J., Foret, S. & Maleszka, R. (2008) Nutritional control of reproductive status in honeybees via DNA methylation. *Science*, 319, 1827–1830.

Kuiper, G. G., Klootwijk, W., Morvan-Dubois, G., Destree, O., Darras, V. M., Van Der Geyten, S., Demeneix, B. & Visser, T. J. (2006) Characterization of recombinant *Xenopus laevis* type I iodothyronine deiodinase: substitution of a proline residue in the catalytic center by serine (Pro132Ser) restores sensitivity to 6-propyl-2-thiouracil. *Endocrinology*, 147, 3519–3529.

Kuittinen, H., Niittyvuopio, A., Rinne, P. & Savolainen, O. (2008) Natural variation in *Arabidopsis lyrata* vernalization requirement conferred by a *FRIGIDA* indel polymorphism. *Molecular Biology and Evolution*, 25, 319–329.

Kulkarni, S. A., Singamasetty, S., Buchholz, D. R. (2010) Corticotropin-releasing factor regulates the development in the direct developing frog, Eleutherodactylus coqui. Gen. Comp. Endocrinol. 169: 225–230.

Kuningas, M., Magi, R., Westendorp, R. G., Slagboom, P. E., Remm, M. & Van Heemst, D. (2007a) Haplotypes in the human Foxo1a and Foxo3a genes; impact on disease and mortality at old age. *European Journal of Human Genetics* 15, 294–301.

Kuningas, M., Putters, M., Westendorp, R. G., Slagboom, P. E. & Van Heemst, D. (2007b) SIRT1 gene, age-related diseases, and mortality: the Leiden 85-plus study. *Journal of Gerontology A*, 62, 960–965.

Kuningas, M., Mooijaart, S. P., Van Heemst, D., Zwaan, B. J., Slagboom, P. E. & Westendorp, R. G. (2008) Genes encoding longevity: from model organisms to humans. *Aging Cell*, 7, 270–280.

Kusserow, A., Pang, K., Sturm, C., Hrouda, M., Lentfer, J., Schmidt, H. A., Technau, U., Von Haeseler, A., Hobmayer, B., Martindale, M. Q. & Holstein, T. W. (2005) Unexpected complexity of the Wnt gene family in a sea anemone. *Nature*, 433, 156–160.

Kyriazakis, I., Tolkamp, B. J. & Hutchings, M. R. (1998) Towards a functional explanation for the occurrence of anorexia during parasitic infections. *Animal Behaviour*, 56, 265–274.

Lack, D. (1947) The significance of clutch size. *Ibis*, 89, 302–352.

Lack, D. (1966). Population Studies of Birds. Clarendon Press, Oxford, England.

LaFever, L. & Drummond-Barbosa, D. (2005) Direct control of germline stem cell division and cyst growth by neural insulin in *Drosophila*. *Science*, 309, 1071–1073.

Lager, C. & Ellison, P. T. (1990) Effect of moderate weight loss on ovarian function assessed by salivary progesterone measurements. *American Journal of Human Biology*, 2, 303–312.

Lagios, M. D. (1982) Latimeria and the Chondrichthyes as sister taxa: A rebuttal to recent attempts at refutation. *Copeia*, 4, 942–948.

Lagueux, M., Hetru, C., Goltzene, F., Kappler, C. & Hoffmann, J. A. (1979) Ecdysone titre and metabolism in relation to cuticulogenesis in embryos of *Locusta migratoria*. *Journal of Insect Physiology*, 25, 709–723.

Lai, C. Q., Parnell, L. D., Lyman, R. F., Ordovas, J. A. & Mackay, T. F. C. (2007) Candidate genes affecting *Drosophila* lifespan identified by integrating microarray gene expression analysis and QTL mapping. *Mechanisms of Ageing and Development*, 128, 237–249.

Lakkis, F. G., Dellaporta, S. L. & Buss, L. W. (2008) Allorecognition and chimerism in an invertebrate model organism. *Organogenesis*, 4, 236–240.

Lakowski, B. & Hekimi, S. (1996) Determination of lifespan in *Caenorhabditis elegans* by four clock genes. *Science*, 272, 1010–1013.

Lakowski, B. & Hekimi, S. (1998) The genetics of caloric restriction in *Caenorhabditis elegans*. *Proceedings of the National Academy of Sciences of the United States of America*, 95, 13091–13096.

Laland, K. N., Odling-Smee, J. & Feldman, M. W. (2000) Niche construction, biological evolution, and cultural change. *Behavioral and Brain Sciences*, 23, 131–175.

Lam, T. J. (1980) Thyroxine enhances larval development and survival in *Sarotherodon* (Tilapia) *Mossambicus ruppell*. *Aquaculture*, 21, 287–291.

Lambert, A., Buckingham, J. A., Boysen, H. M. & Brand, M. D. (2010) Low complex I content explains the low hydrogen peroxide production rate of heart mitochondria from the long-lived pigeon, *Columa livia*. *Aging Cell*, 9, 78–91.

Lambrechts, L., Fellous, S. & Koella, J. C. (2006) Coevolutionary interactions between host and parasite genotypes. *Trends in Parasitology*, 22, 12–16.

Lancaster, L. T., McAdam, A. G., Wingfield, J. C. & Sinervo, B. (2007) Adaptive social and maternal induction of antipredator dorsal patterns in a lizard with alternative social strategies. *Ecology Letters*, 10, 798–808.

Lancaster, L. T., Hazard, L. C., Clobert, J. & Sinervo, B. R. (2008) Corticosterone manipulation reveals differences in hierarchical organization of multidimensional reproductive trade-offs in r-strategist and K-strategist females. *Journal of Evolutionary Biology*, 21, 556–565.

Lancaster, L. T., McAdam, A. G. & Sinervo, B. (2010) Maternal adjustment of egg size organizes alternative escape behaviors, promoting adaptive phenotypic integration. *Evolution*, 64, 1607–1621.

Lande, R. (1982) A quantitative genetic theory of life history evolution. *Ecology*, 63, 607–615.

Landry, C. R., Wittkopp, P. J., Taubes, C. H., Ranz, J. M., Clark, A. G. & Hartl, D. L. (2005) Compensatory cis-trans evolution and the dysregulation of gene expression in interspecific hybrids of *Drosophila*. *Genetics*, 171, 1813–1822.

Lane, M. A. (2000) Nonhuman primate models in biogerontology. *Experimental Gerontology*, 35, 533–541.

Lane, M. A., Mattison, J., Ingram, D. K. & Roth, G. S. (2002) Caloric restriction and aging in primates: Relevance to humans and possible CR mimetics. *Microscopy Research and Technique*, 59, 335–338.

Langley, E., Pearson, M., Faretta, M., Bauer, U. M., Frye, R. A., Minucci, S., Pelicci, P. G. & Kouzarides, T. (2002) Human SIR2 deacetylates p53 and antagonizes PML/p53-induced cellular senescence. *EMBO Journal*, 21, 2383–2396.

Lanzrein, B., Gentinetta, V., Abegglen, H., Baker, F. C., Miller, C. A. & Schooley, D. A. (1985) Titers of ecdysone, 20-hydroxy-ecdysone and juvenile hormone III throughout the life cycle of a hemimetabolous insect, the ovoviviparous cockroach *Nauphoeta cinerea*. *Experientia* 41, 913–917.

Larsen, P. L. (2001) Asking the age-old questions. *Nature Genetics*, 28, 102–104.

Larson, A., Kirk, M. & Kirk, D. L. (1992) Molecular phylogeny of the volvocine flagellates. *Molecular Biology and Evolution*, 9, 85–105.

Larsen, D. A., Swanson, P., Dickey, J. T., Rivier, J. & Dickhoff, W. W. (1998) In vitro thyrotropin-releasing activity of corticotropin-releasing hormone-family peptides in coho salmon, *Oncorhynchus kisutch*. *General and Comparative Endocrinology*, 109, 276–285.

Lawniczak, M. K. & Begun, D. J. (2004) A genome-wide analysis of courting and mating responses in *Drosophila melanogaster* females. *Genome*, 47, 900–910.

Lawniczak, M. K. N., Barnes, A. I., Linklater, J. R., Boone, J. M., Wigby, S. & Chapman, T. (2007) Mating and immunity in invertebrates. *Trends in Ecology & Evolution*, 22, 48–55.

Layalle, S., Arquier, N. & Leopold, P. (2008) The TOR pathway couples nutrition and developmental timing in *Drosophila*. *Developmental Cell*, 15, 568–577.

Lazar, M. A. (1993) Thyroid hormone receptors: Multiple forms, multiple possibilities. *Endocrine Reviews*, 14, 184–193.

Lazar, M. A. (2003) Thyroid hormone action: a binding contract. *Journal of Clinical Investigation*, 112, 497–499.

Lazzaro, B. P. (2008) Natural selection on the *Drosophila* antimicrobial immune system. *Current Opinion in Microbiology*, 11, 284–289.

Lazzaro, B. P. & Little, T. J. (2009) Immunity in a variable world. *Philosophical Transactions of the Royal Society of London B*, 364, 15–26.

Lazzaro, B. P., Sackton, T. B. & Clark, A. G. (2006) Genetic variation in *Drosophila melanogaster* resistance to infection: a comparison across bacteria. *Genetics*, 174, 1539–1554.

Leaf, D. S., Anstrom, J. A., Chin, J. E., Harkey, M. A., Showman, R. M. & Raff, R. A. (1987) Antibodies to a fusion protein identify a cDNA clone encoding msp 130, a primary mesenchyme-specific cell surface protein of the sea urchin. *Developmental Biology*, 121, 29–40.

Leatherland, J. F. (1994) Reflections on the thyroidology of fishes: from molecules to humankind. *Guelph Ichthyology Reviews*, 2 1–67.

Leatherland, J. F., Hilliard, R. W., Macey, D. J. & Potter, I. C. (1990) Changes in serum thyroxine and triiodothyronine concentrations during metamorphosis of the southern hemisphere lamprey *Geotria australis*, and the effect of propylthiouracil, triiodothyronine and environmental temperature on serum thyroid hormone concentrations of ammocoetes. *Fish Physiology and Biochemistry*, 8, 167–177.

LeBlanc, S. A. (2003) *Constant Battles: The Myth of the Peaceful, Noble Savage*. New York, St. Martin's Press.

Le Corre, V., Roux, F. & Reboud, X. (2002) DNA polymorphism at the *FRIGIDA* gene in *Arabidopsis thaliana*: Extensive nonsynonymous variation is consistent with local selection for flowering time. *Molecular Biology and Evolution*, 19, 1261–1271.

Lee, R. D. (2003) Rethinking the evolutionary theory of aging: transfers, not births, shape senescence in social species. *Proceedings of the National Academy of Sciences of the United States of America*, 100, 9637–9642.

Lee, R. C. & Ambros, V. (2001) An extensive class of small RNAs in *Caenorhabditis elegans*. *Science*, 294, 862–864.

Lee, S. J. & Kenyon, C. (2009) Regulation of the longevity response to temperature by thermosensory neurons in *Caenorhabditis elegans*. *Current Biology*, 19, 715–722.

Lee, S. S., Kennedy, S., Tolonen, A. C. & Ruvkun, G. (2003) DAF-16 target genes that control *C. elegans* life-span and metabolism. *Science*, 300, 644–647.

Lee, K. S., You, K. H., Choo, J. K., Han, Y. M. & Yu, K. (2004) *Drosophila* short neuropeptide F regulates food intake and body size. *Journal of Biological Chemistry*, 279, 50781–50789.

Lee, G. D., Wilson, M. A., Zhu, M., Wolkow, C. A., De Cabo, R., Ingram, D. K. & Zou, S. (2006a) Dietary deprivation extends lifespan in *Caenorhabditis elegans*. *Aging Cell*, 5, 515–524.

Lee, P. N., Pang, K., Matus, D. Q. & Martindale, M. Q. (2006b) A WNT of things to come: Evolution of Wnt signaling and polarity in Cnidarians. *Seminars in Cell & Developmental Biology*, 17, 157–167.

Lee, E. J., Oh, B., Lee, J. Y., Kimm, K., Lee, S. H. & Baek, K. H. (2008a) A novel single nucleotide polymorphism of INSR gene for polycystic ovary syndrome. *Fertility and Sterility*, 89, 1213–1220.

Lee, K. P., Simpson, S. J., Clissold, F. J., Brooks, R., Ballard, J. W. O., Taylor, P. W., Soran, N. & Raubenheimer, D. (2008b) Lifespan and reproduction in *Drosophila*: New insights from nutritional geometry. *Proceedings of the National Academy of Sciences of the United States of America*, 105, 2498–2503.

Lee, K. S., Kwon, O. Y., Lee, J. H., Kwon, K., Min, K. J., Jung, S. A., Kim, A. K., You, K. H., Tatar, M. & Yu, K. (2008c) *Drosophila* short neuropeptide F signalling regulates growth by ERK-mediated insulin signalling. *Nature Cell Biology*, 10, 468–475.

Lee, K. A., Wikelski, M., Robinson, W. D., Robinson, T. R. & Klasing, K. C. (2008d) Constitutive immune defences correlate with life history variables in tropical birds. *Journal of Animal Ecology*, 77, 356–363.

Lee, J. M., Kaciroti, N., Appugliese, D., Corwyn, R. F., Bradley, R. H. & Lumeng, J. C. (2010) Body mass index and pubertal initiation in boys. *Archives of Pediatrics & Adolescent Medicine*, 164, 139–144.

Lefranc, A. & Bundgaard, J. (2000) The influence of male and female body size on copulation duration and fecundity in *Drosophila melanogaster*. *Hereditas*, 132, 243–247.

Legan, S. K., Rebrin, I., Mockett, R. J., Radyuk, S. N., Klichko, V. I., Sohal, R. S. & Orr, W. C. (2008) Overexpression of glucose-6-phosphate dehydrogenase extends the lifespan of *Drosophila melanogaster*. *Journal of Biological Chemistry*, 283, 32492–32499.

Le Goff, G., Boundy, S., Daborn, P. J., Yen, J. L., Sofer, L., Lind, R., Sabourault, C., Madi-Ravazzi, L. & Ffrench-Constant, R. H. (2003) Microarray analysis of cytochrome P450 mediated insecticide resistance in *Drosophila*. *Insect Biochemistry & Molecular Biology*, 33, 701–708.

Lehtinen, M. K., Yuan, Z., Boag, P. R., Yang, Y., Villen, J., Becker, E. B., Dibacco, S., De La Iglesia, N., Gygi, S., Blackwell, T. K. & Bonni, A. (2006) A conserved MST-FOXO signaling pathway mediates oxidative-stress responses and extends life span. *Cell*, 125, 987–1001.

Leidy, L. E. (1994) Biological aspects of menopause: across the lifespan. *Annual Review of Anthropology*, 23, 231–253.

Leigh, S. R. (2004) Brain growth, cognition, and life history in primate and human evolution. *American Journal of Primatology*, 62, 139–164.

Leips, J. & Mackay, T. F. C. (2000) Quantitative trait loci for lifespan in *Drosophila melanogaster*: Interactions with genetic background and larval density. *Genetics*, 155, 1773–1788.

Leloup-Hatey, J., Buscaglia, M., Jolivet-Jaudet, G. & Leloup, J. (1990) Interrenal function during the metamorphosis in anuran amphibia. *Fortschritte der Zoologie*, 38, 139–154.

Lemaitre, B. & Hoffmann, J. (2007) The host defense of *Drosophila melanogaster*. *Annual Review of Immunology*, 25, 697–743.

Lengfeld, T., Watanabe, H., Simakov, O., Lindgens, D., Gee, L., Law, L., Schmidt, H. A., Özbek, S., Bode, H. & Holstein, T. W. (2009) Multiple Wnts are involved in Hydra organizer formation and regeneration. *Developmental Biology*, 330, 186–199.

Leone, D. V., Quinlan, R. J., Hayden, R., Stewart, J. & Flinn, M. V. (2004) Long-term implications for growth of prenatal and early postnatal environment. *American Journal of Human Biology*, 16, 212–213.

Leonelli, S. (2007) *Arabidopsis*, the botannical *Drosophila*: from mouse cress to model organism. *Endeavour*, 31, 34–38.

Leroi, A. M. (2001) Molecular signals versus the Loi de Balancement. *Trends in Ecology & Evolution*, 16, 24–29.

Lescai, F., Blanche, H., Nebel, A., Beekman, M., Sahbatou, M., Flachsbart, F., Slagboom, E., Schreiber, S., Sorbi, S., Passarino, G. & Franceschi, C. (2009) Human longevity and 11p15.5: a study in 1321 centenarians. *European Journal of Human Genetics* 17, 1515–1519.

Lessells, C. M. (2008) Neuroendocrine control of life histories: what do we need to know to understand the evolution of phenotypic plasticity? *Philosophical Transactions of the Royal Society of London B*, 363, 1589–1598.

Levin, L. A. & Bridges, T. S. (1995) Pattern and Diversity in Reproduction and Development. In McEdward, L. (Ed.) *Ecology of Marine Invertebrate Larvae*. Boca Raton, CRC Press.

Levine, M. & Davidson, E. H. (2005) Gene regulatory networks for development. *Proceedings of the National Academy of Sciences of the United States of America*, 102, 4936–4942.

Levitan, D. R. (2000) Optimal egg size in marine invertebrates: theory and phylogenetic analysis of the critical relationship between egg size and development time in echinoids. *The American Naturalist*, 156, 175–192.

Levy, O., Appelbaum, L., Leggat, W., Gothlif, Y., Hayward, D. C., Miller, D. J. & Hoegh-Guldberg, O. (2007) Light-responsive cryptochromes from a simple multicellular animal, the coral *Acropora millepora*. *Science*, 318, 467–470.

Levy, Y. Y. & Dean, C. (1998) The transition to flowering. *Plant Cell*, 10, 1973–1989.

Lewontin, R. (1974) *The Genetic Basis of Evolutionary Change*. New York, Columbia University Press.

Liang, V. C., Sedgwick, T. & Shi, Y. B. (1997) Characterization of the *Xenopus* homolog of an immediate early gene associated with cell activation: sequence analysis and regulation of its expression by thyroid hormone during amphibian metamorphosis. *Cell Research*, 7, 179–193.

Liang, B., Moussaif, M., Kuan, C. J., Gargus, J. J. & Sze, J. Y. (2006) Serotonin targets the DAF-16/FOXO signaling pathway to modulate stress responses. *Cell Metabolism*, 4, 429–440.

Libert, S., Zwiener, J., Chu, X., Vanvoorhies, W., Roman, G. & Pletcher, S. D. (2007) Regulation of *Drosophila* lifespan by olfaction and food-derived odors. *Science*, 315, 1133–1137.

Libert, S., Chao, Y., Zwiener, J. & Pletcher, S. D. (2008) Realized immune response is enhanced in long-lived puc and chico mutants but is unaffected by dietary restriction. *Molecular Immunology*, 45, 810–817.

Licht, P., Papkoff, H., Farmer, S. W., Muller, C. H., Tsui, H. W. & Crews, D. (1977) Evolution of gonadotropin structure and function. *Recent Progress in Hormone Research*, 33, 169–248.

Lieps, J. & Travis, J. (1994) Metamorphic responses to changing food levels in two species of hylid frogs. *Ecology*, 75, 1345–1356.

Lim, M. M., Wang, Z., Olazabal, D. E., Ren, X., Terwilliger, E. F. & Young, L. J. (2004) Enhanced partner preference in a promiscuous species by manipulating the expression of a single gene. *Nature*, 429, 754–757.

Lin, K., Dorman, J. B., Rodan, A. & Kenyon, C. (1997) daf-16: An HNF-3/forkhead family member that can function to double the life-span of *Caenorhabditis elegans*. *Science*, 278, 1319–1322.

Lin, Y. J., Seroude, L. & Benzer, S. (1998) Extended life-span and stress resistance in the *Drosophila* mutant methuselah. *Science*, 282, 943–946.

Lin, K., Hsin, H., Libina, N. & Kenyon, C. (2001) Regulation of the *C. elegans* longevity protein DAF-16 by insulin/IGF-1 and germline signaling. *Nature Genetics*, 28, 139–145.

Linklater, J. R., Wertheim, B., Wigby, S. & Chapman, T. (2007) Ejaculate depletion patterns evolve in response to experimental manipulation of sex ratio in *Drosophila melanogaster*. *Evolution*, 61, 2027–2034.

Linnen, C., Tatar, M. & Promislow, D. E. L. (2001) Cultural artifacts: A comparison of senescence in natural, lab-adapted and artificially selected lines of *Drosophila melanogaster*. *Evolutionary Ecology Research*, 3, 877–888.

Lintlop, S. P. & Youson, J. H. (1983) Concentration of triiodothyronine in the sera of the sea lamprey, *Petromyzon marinus*, and the brook lamprey, *Lampetra lamottenii*, at various phases of the life cycle. *General and Comparative Endocrinology*, 49, 187–194.

Lipson, S. F. & Ellison, P. T. (1996) Comparison of salivary steroid profiles in naturally occurring conception and non-conception cycles. *Human Reproduction*, 11, 2090–2096.

Lirman, D. (2000) Fragmentation in the branching coral *Acropora palmata* (Lamarck): growth, survivorship, and reproduction of colonies and fragments. *Journal of Experimental Marine Biology and Ecology*, 251, 41–57.

Little, T. J., Colegrave, N., Sadd, B. M. & Schmid-Hempel, P. (2008) Studying immunity at the whole organism level. *BioEssays*, 30, 404–405.

Liu, Y. W., Lo, L. J. & Chan, W. K. (2000) Temporal expression and T3 induction of thyroid hormone receptors alpha 1 and beta 1 during early embryonic and larval development in zebrafish, *Danio rerio*. *Molecular and Cellular Endocrinology*, 159, 187–195.

Liu, X., Jiang, N., Hughes, B., Bigras, E., Shoubridge, E. & Hekimi, S. (2005) Evolutionary conservation of the *clk-1*-dependent mechanism of longevity: loss of *mclk1* increases cellular fitness and lifespan in mice. *Genes & Development*, 19, 2424–2434.

Liu, W.-C., Lo, W.-T., Purcell, J. & Chang, H.-H. (2009) Effects of temperature and light intensity on asexual reproduction of the scyphozoan, *Aurelia aurita* (L.) in Taiwan. *Hydrobiologia*, 616, 247–258.

Lively, C. M. & Dybdahl, M. F. (2000) Parasite adaptation to locally common host genotypes. *Nature*, 405, 679–681.

Lively, C. M., Dybdahl, M. F., Jokela, J., Osnas, E. E. & Delph, L. F. (2004) Host sex and local adaptation by parasites in a snail-trematode interaction. *The American Naturalist*, 164 Suppl 5, S6–S18.

Lochmiller, R. L. & Dabbert, C. B. (1993) Immunocompetence, environmental stress, and the regulation of animal populations. *Trends in Comparative Biochemistry & Physiology*, 1, 823–855.

Lochmiller, R. L. & Deerenberg, C. (2000) Trade-offs in evolutionary immunology: just what is the cost of immunity? *Oikos*, 88, 87–98.

Lopez, S. & Dominguez, C. A. (2003) Sex choice in plants: facultative adjustment of the sex ratio in the perennial herb *Begonia gracilis*. *Journal of Evolutionary Biology*, 16, 1177–1185.

Loudet, O., Chaillou, S., Krapp, A. & Daniel-Vedele, F. (2003) Quantitative trait loci analysis of water and anion contents in interaction with nitrogen availability in *Arabidopsis thaliana*. *Genetics*, 163, 711–722.

Lounibos, L. P., Van Dover, C. & O'Meara, G. F. (1982) Fecundity, autogeny and the larval environment of the pitcher-plant mosquito, *Wyeomyia smithii*. *Oecologia*, 55, 160–164.

Love, A. C., Andrews, M. E. & Raff, R. A. (2007) Gene expression patterns in novel animal appendage: the sea urchin pluteus arm. *Evolution & Development*, 9, 51–68.

Lovejoy, A. O. (1981) The origin of man. *Science*, 211, 341–350.

Lowe, C. J., Issel-Tarver, L. & Wray, G. A. (2002) Gene expression and larval evolution: changing roles of distal-less and orthodenticle in echinoderm larvae. *Evolution & Development*, 4, 111–123.

Luckinbill, L. S., Arking, R. A., Clare, M. J., Cirocco, W. C. & Buck, S. A. (1984) Selection for delayed senescence in *Drosophila melanogaster*. *Evolution*, 38, 996–1004.

Luckinbill, L. S., Riha, V., Rhine, S. & Gurdzein, T. A. (2001) The role of glucose-6-phosphate dehydrogenase in the evolution of longevity of *Drosophila melanogaster*. *Heredity*, 65, 29–38.

Lukhtanov, V. A., Kandul, N. P., Plotkin, J. B., Dantchenko, A. V., Haig, D. & Al, E. (2005) Reinforcement of pre-zygotic isolation and karyotype evolution in Agrodiaetus butterflies. *Nature*, 436, 385–389.

Lumme, J. (1981) Localization of the genetic unit controlling the photoperiodic adult diapause in *Drosophila littoralis*. *Hereditas*, 94, 241–244.

Lumme, J. & Keranen, L. (1978) Photoperiodic diapause in *Drosophila lummei* Hackman is controlled by an X-chromosomal factor. *Hereditas*, 89, 261–262.

Lumme, J. & Lakovaara, S. (1983) Seasonality and diapause in Drosophilids. In Ashburner, M., Carson, H. L. & Thompson, J. N. J. (Eds.) *Genetics and Biology of Drosophila*. London, Academic Press.

Lundholm, J. T. & Aarssen, L. W. (1994) Neighbor effects on gender variation in *Ambrosia artemisiifolia*. *Canadian Journal of Botany*, 72, 794–800.

Luo, J., Nikolaev, A. Y., Imai, S., Chen, D., Su, F., Shiloh, A., Guarente, L. & Gu, W. (2001) Negative control of p53 by Sir2alpha promotes cell survival under stress. *Cell*, 107, 137–148.

Lutz, P. L., Prentice, H. M. & Milton, S. L. (2003) Is turtle longevity linked to enhanced mechanisms for surviving brain anoxia and reoxygenation? *Experimental Gerontology*, 38, 797–800.

Lynn, S. E., Walker, B. G. & Wingfield, J. C. (2005) A phylogenetically controlled test of hypotheses for behavioral insensitivity to testosterone in birds. *Hormones and Behavior*, 47, 170–177.

Lyytinen, A., Brakefield, P. M., Lindstrom, L. & Mappes, J. (2004) Does predation maintain eyespot plasticity in *Bicyclus anynana*? *Proceedings of the Royal Society of London B*, 271, 279–283.

Mabee, P. M., Olmstead, K. L. & Cubbage, C. C. (2000) An experimental study of intraspecific variation, developmental timing, and heterochrony in fishes. *Evolution*, 54, 2091–2106.

Mabee, P. M., Crotwell, P. L., Bird, N. C. & Burke, A. C. (2002) Evolution of median fin modules in the axial skeleton of fishes. *Journal of Experimental Zoology*, 294, 77–90.

MacDonald, K. & Hershberger, S. L. (2005) Theoretical issues in the study of evolution and development. In Burgess, R. L. & MacDonald, K. (Eds.) *Evolutionary Perspectives on Human Development*. Thousand Oaks, Sage Press.

Mace, R. (2000) Evolutionary ecology of human life history. *Animal Behaviour*, 59, 1–10.

Mack, P. D., Kapelnikov, A., Heifetz, Y. & Bender, M. (2006) Mating-responsive genes in reproductive tissues of female *Drosophila melanogaster*. *Proceedings of the National Academy of Sciences of the United States of America*, 103, 10358–10363.

Mackay, T. F. C., Roshina, N. V., Leips, J. W. & Pasyukova, E. G. (2006) Complex genetic architecture of *Drosophila* longevity. In Masaro, E. J. & Austad, S. N. (Eds.) *Handbook of the Biology of Aging*. Burlington, Elsevier Press.

Mackay, T. F. C., Stone, E. A. & Ayroles, J. F. (2009) The genetics of quantitative traits: challenges and prospects. *Nature Reviews Genetics*, 10, 565–577.

MacKenzie, D. S., Jones, R. A. & Miller, T. C. (2009) Thyrotropin in teleost fish. *General and Comparative Endocrinology*, 161, 83–89.

Madhavan, M. M. & Schneiderman, H. A. (1977) Histological ananlysis of the dynamics of growth of imaginal discs and histoblast nests during larval development of *Drosophila melanogaster*. *Roux's Archives of Developmental Biology*, 183, 269–305.

Magie, C. R. & Martindale, M. Q. (2008) Cell-cell adhesion in the Cnidaria: insights into the evolution of tissue morphogenesis. *Biological Bulletin*, 214, 218–232.

Mair, W. & Dillin, A. (2008) Aging and survival: the genetics of lifespan extension by dietary restriction. *Annual Review of Biochemistry*, 77, 727–754.

Mair, W., Goymer, P., Pletcher, S. D. & Partridge, L. (2003) Demography of dietary restriction and death in *Drosophila*. *Science*, 301, 1731–1733.

Mair, W., Sgro, C. M., Johnson, A. P., Chapman, T. & Partridge, L. (2004) Lifespan extension by dietary restriction in female *Drosophila melanogaster* is not caused by a reduction in vitellogenesis or ovarian activity. *Experimental Gerontology*, 39, 1011–1019.

Mair, W., Piper, M. D. & Partridge, L. (2005) Calories do not explain extension of lifespan by dietary restriction in *Drosophila*. *PLoS Biology*, 3, e223.

Majhi, S., Jena, B. S. & Patnaik, B. K. (2000) Effect of age on lipid peroxides, lipofuscin and ascorbic acid contents of the lungs of male garden lizard. *Comparative Biochemistry and Physiology C*, 126, 293–298.

Maklakov, A. A., Simpson, S. J., Zajitschek, F., Hall, M. D., Dessmann, J., Clissold, F., Raubenheimer, D., Bonduriansky, R. & Brooks, R. C. (2008) Sex-specific fitness effects of nutrient intake on reproduction and lifespan. *Current Biology*, 18, 1062–1066.

Malamuth, N. M. (1996) Sexually explicit media, gender differences, and evolutionary theory. *Journal of Communication*, 46, 8–31.

Mangel, M. & Clark, C. (1988) *Dynamic modeling in behavioral ecology*. Princeton, Princeton University Press.

Manier, M. K., Seyler, C. M. & Arnold, S. J. (2007) Adaptive divergence within and between ecotypes of the terrestrial garter snake, *Thamnophis elegans*, assessed with F-St-Q(ST) comparisons. *Journal of Evolutionary Biology*, 20, 1705–1719.

Manzon, L. A. (2006) Cloning and developmental expression of sea lamprey (Petromyzon marinus) thyroid hormone and retinoid X receptors. Unpublished Ph.D. *Dissertation*, University of Toronto.

Manzon, R. G. & Denver, R. J. (2004) Regulation of pituitary thyrotropin gene expression during *Xenopus* metamorphosis: negative feedback is functional throughout metamorphosis. *Journal of Endocrinology*, 182, 273–285.

Manzon, R. G. & Youson, J. H. (1997) The effects of exogenous thyroxine (T4) or triiodothyronine (T3), in the presence and absence of potassium perchlorate, on the incidence of metamorphosis and on serum T4 and T3 concentrations in larval sea lamprey (*Petromyzon marinus*). *General and Comparative Endocrinology*, 106, 211–220.

Manzon, R. G., Eales, J. G. & Youson, J. H. (1998) Blocking of KClO4-induced metamorphosis in premetamorphic sea lampreys by exogenous thyroid hormones (TH): Effects of KClO4 and TH on serum TH concentrations and intestinal thyroxine outer-ring deiodination. *General and Comparative Endocrinology*, 112, 54–62.

Manzon, R. G., Holmes, J. A. & Youson, J. H. (2001) Variable effects of goitrogens in inducing precocious metamorphosis in sea lampreys (*Petromyzon marinus*). *Journal of Experimental Zoology*, 289, 290–303.

Mappes, T., Koivula, M., Koskela, E., Oksanen, T. A., Savolainen, T. & Sinervo, B. (2008) Frequency and density-dependent selection on life history strategies – A field experiment. *PLoS One*, 3, e1687.

Marden, J. H., Rogina, B., Montooth, K. L. & Helfand, S. L. (2003) Conditional trade-offs between aging and organismal performance of Indy long-lived mutant flies. *Proceedings of the National Academy of Sciences of the United States of America*, 100, 3369–3373.

Margulis, L. (1981) *Symbiosis in cell evolution*, Freeman, San Francisco.

Markow, T. A. & O'Grady, P. (2008) Reproductive ecology of *Drosophila*. *Functional Ecology*, 22, 747–759.

Markow, T. A. & O'Grady, P. M. (2005) Evolutionary genetics of reproductive behavior in *Drosophila*: Connecting the dots. *Annual Review of Genetics*, 39, 263–291.

Marlowe, F. W. (2003) A critical period for provisioning by Hadza men: Implications for pair bonding. *Evolution and Human Behavior*, 24, 217–229.

Marnett, L. J. & Plastaras, J. P. (2001) Endogenous DNA damage and mutation. *Trends in Genetics*, 17, 214–221.

Maróy, P., Kaufmann, G. & Dübendorfer, A. (1988) Embryonic ecdysteroids of *Drosophila melanogaster*. *Journal of Insect Physiology*, 34, 633–637.

Marshall, D. J. & Keough, M. J. (2003) Variation in the dispersal potential of non-feeding invertebrate larvae: the desperate larva hypothesis and larval size. *Marine Ecology Progress Series*, 255, 145–153.

Marshall, W. A. & Tanner, J. M. (1986) Puberty. In Falkner, F. & Tanner, J. M. (Eds.) *Human Growth*. New York, Plenum.

Marsh-Armstrong, N., Huang, H., Berry, D. L. & Brown, D. D. (1999) Germ-line transmission of transgenes in *Xenopus laevis*. *Proceedings of the National Academy of Sciences of the United States of America*, 96, 14389–14393.

Marsh-Armstrong, N., Cai, L. & Brown, D. D. (2004) Thyroid hormone controls the development of connections between the spinal cord and limbs during *Xenopus laevis* metamorphosis. *Proceedings of the National Academy of Sciences of the United States of America*, 101, 165–170.

Martin, I. & Grotewiel, M. S. (2006) Oxidative damage and age-related functional declines. *Mechanisms of Ageing and Development*, 127, 411–423.

Martin, L. B., Weil, Z. M. & Nelson, R. J. (2008) Seasonal changes in vertebrate immune activity: mediation by physiological trade-offs. *Philosophical Transactions of the Royal Society of London B*, 363, 321–339.

Martin-Smith, K. M., Armstrong, J. D., Johnsson, J. I. & Bjornsson, B. T. (2004) Growth hormone increases growth and dominance of wild juvenile Atlantic salmon without affecting space use. *Journal of Fish Biology*, 65, 156–172.

Masuda-Nakagawa, L. M., Gröer, H., Aerne, B. L. & Schmid, V. (2000) The Hox-like gene Cnox2-Pc is expressed at the anterior region in all life cycle stages of the jellyfish *Podocoryne carnea*. *Development, Genes and Evolution*, 210, 151–156.

Mathias, D. M., Jacky, L., Bradshaw, W. E. & Holzapfel, C. M. (2007) Quantitative trait loci associated with photoperiodic response and stage of diapause in the pitcher-plant mosquito, *Wyeomyia smithii*. *Genetics*, 176, 391–402.

Matkovic, V., Ilich, J. Z., Skugor, M., Badenhop, N. E., Goel, P., Clairmont, A., Klisovic, D., Nahhas, R. W. & Landoll, J. D. (1997) Leptin is inversely related to age at menarche in human females. *Journal of Clinical Endocrinology and Metabolism*, 82, 3239–3245.

Matsuda, H., Paul, B. D., Choi, C. Y., Hasebe, T. & Shi, Y. B. (2009) Novel functions of protein arginine methyltransferase 1 in thyroid hormone receptor-mediated transcription and in the regulation of metamorphic rate in *Xenopus laevis*. *Molecular and Cellular Biology*, 29, 745–757.

Matteo, S. & Rissman, E. F. (1984) Increased sexual activity during the midcycle portion of the human menstrual cycle. *Hormones and Behavior*, 18, 249–255.

Mattison, J. A., Lane, M. A., Roth, G. S. & Ingram, D. K. (2003) Calorie restriction in rhesus monkeys. *Experimental Gerontology*, 38, 35–46.

Matus, D. Q., Thomsen, G. H. & Martindale, M. Q. (2006) Dorso/ventral genes are asymmetrically expressed and involved in germ-layer demarcation during cnidarian gastrulation. *Current Biology*, 16, 499–505.

May, R. M. & Anderson, R. M. (1990) Parasite-host coevolution. *Parasitology*, 100 Suppl, S89–S101.

Maynard Smith, J. (1958) The effects of temperature and of egg-laying on the longevity of *Drosophila subobscura*. *Journal of Experimental Biology*, 35, 832–842.

Maynard Smith, J. (1982) *Evolution and the Theory of Games*. Cambridge, Cambridge University Press.

Maynard Smith, J., Burian, R., Kauffman, S., Alberch, P., Campbell, J., Goodwin, B., Lande, R., Raup, D. & Wolpert, L. (1985) Developmental constraints and evolution. *Quarterly Review of Biology*, 60, 265–287.

Mazur, A. (1992) Testosterone and chess competition. *Social Psychology Quarterly*, 55, 70–77.

McAlister, J. S. (2007) Egg size and the evolution of phenotypic plasticity in larvae of the echinoid genus *Strongylocentrotus*. *Journal of Experimental Marine Biology and Ecology*, 352, 306–316.

McAlister, J. S. (2008) Evolutionary responses to environmental heterogeneity in central american echinoid larvae: plasticity versus constant phenotypes. *Evolution*, 62, 1358–1372.

McBrayer, Z., Ono, H., Shimell, M., Parvy, J., Beckstead, R., Warren, J., Thummel, C., Dauphinvillemant, C., Gilbert, L. & Oconnor, M. (2007) Prothoracicotropic hormone regulates developmental timing and body size in *Drosophila*. *Developmental Cell*, 13, 857–871.

McCarroll, S. A., Murphy, C. T., Zou, S., Pletcher, S. D., Chin, C. S., Jan, Y. N., Kenyon, C., Bargmann, C. I. & Li, H. (2004) Comparing genomic expression patterns across species identifies shared transcriptional profile in aging. *Nature Genetics*, 36, 197–204.

McCart, C., Buckling, A. & Ffrench-Constant, R. H. (2005) DDT resistance in flies carries no cost. *Current Biology*, 15, R587–R589.

McCart, C. & Ffrench-Constant, R. H. (2008) Dissecting the insecticide-resistance-associated cytochrome P450 gene Cyp6g1. *Pest Management Science*, 64, 639–645.

McCauley, D. W. (1997) Serotonin plays an early role in the metamorphosis of the hydrozoan *Phialidium gregarium*. *Developmental Biology*, 190, 229–240.

McCay, C. M., Dilly, W. E. & Crowell, M. F. (1929) Growth rates of brook trout reared uopn purified rations, upon skim milk diets, and upon combinations of cereal grains. *Journal of Nutrition*, 1, 233–246.

McCay, C. M., Crowell, M. F. & Maynard, L. A. (1935) The effect of retarded growth upon the length of lifespan and upon the ultimate body size. *Nutrition*, 5, 63–79.

McClain, C. R. & Rex, M. A. (2001) The relationship between dissolved oxygen concentration and maximum size in deep-sea turrid gastropods: an application of quantile regression. *Marine Biology*, 139, 681–685.

McCormick, S. D. (1996) Effects of growth hormone and insulin-like growth factor I on salinity tolerance and gill Na+, K+-ATPase in Atlantic salmon (*Salmo salar*): Interaction with cortisol. *General and Comparative Endocrinology*, 101, 3–11.

McCormick, S. D. (2001) Endocrine control of osmoregulation in teleost fish. *American Zoologist*, 41, 781–794.

McCormick, S. D., Sakamoto, T., Hasegawa, S. & Hirano, T. (1991) Osmoregulatory actions of insulin-like growth factor-I in rainbow trout (*Oncorhynchus mykiss*). *Journal of Endocrinology*, 130, 87–92.

McCormick, S. D., Hansen, L. P., Quinn, T. P. & Saunders, R. L. (1998) Movement, migration, and smolting of Atlantic salmon (*Salmo salar*). *Canadian Journal of Fisheries and Aquatic Sciences*, 55, 77–92.

McCue, M. D. (2008) Fatty acid analyses may provide insight into the progression of starvation among squamate reptiles. *Comparative Biochemistry and Physiology A*, 151, 239–246.

McDiarmid, R. W. & Altig, R. (1999) *Tadpoles: The biology of anuran larvae*. Chicago and London, University of Chicago Press.

McDowell, J. M. & Simon, S. A. (2006) Recent insights into R gene evolution. *Molecular Plant Pathology*, 7, 437–448.

McEdward, L. R. (1996) Experimental manipulation of parental investment in Echinoid Echinoderms. *American Zoologist*, 36, 169–179.

McEdward, L. R. (1997) Reproductive strategies of marine benthic invertebrates revisited: facultative feeding by planktotrophic larvae. *The American Naturalist*, 150, 48–72.

McEdward, L. R. & Herrera, J. C. (1999) Body form and skeletal morphometrics during larval development of the sea urchin *Lytechinus variegatus* Lamarck. *Journal of Experimental Marine Biology and Ecology*, 232, 151–176.

McEdward, L. R. & Miner, B. G. (2001) Larval and life-cycle patterns in Echinoderms. *Canadian Journal of Zoology-Revue Canadienne de Zoologie*, 79, 1125–1170.

McElwee, J. J., Schuster, E., Blanc, E., Thomas, J. H. & Gems, D. (2004) Shared transcriptional signature in *Caenorhabditis elegans* dauer larvae and long-lived *daf-2* mutants implicates detoxification system in longevity assurance. *Journal of Biological Chemistry*, 279, 44533–44543.

McElwee, J. J., Schuster, E., Blanc, E., Piper, M. D., Thomas, J. H., Patel, D. S., Selman, C., Withers, D. J., Thornton, J. M., Partridge, L. & Gems, D. (2007) Evolutionary conservation of regulated longevity assurance mechanisms. *Genome Biology*, 8, R132.

McGarrigle, D. & Huang, X. Y. (2007) Methuselah antagonist extends life span. *Nature Chemical Biology*, 3, 371–372.

McGlothlin, J. W. & Ketterson, E. D. (2008) Hormone-mediated suites as adaptations and evolutionary constraints. *Philosophical Transactions of the Royal Society of London B*, 363, 1611–1620.

McGlothlin, J. W., Jawor, J. M. & Ketterson, E. D. (2007) Natural variation in a testosterone-mediated trade-off between mating effort and parental effort. *The American Naturalist*, 170, 864–875.

McGlothlin, J. W., Jawor, J. M., Greives, T. J., Casto, J. M., Phillips, J. L. & Ketterson, E. D. (2008) Hormones and honest signals: males with larger ornaments elevate testosterone more when challenged. *Journal of Evolutionary Biology*, 21, 39–48.

McGraw, L. A., Gibson, G., Clark, A. G. & Wolfner, M. F. (2004) Genes regulated by mating, sperm, or seminal proteins in mated female *Drosophila melanogaster*. *Current Biology*, 14, 1509–1514.

McGuire, M. & Gruter, M. (2003) Prostitution: An evolutionary perspective. In Somit, A. & Peterson, S. (Eds.) *Human Nature and Public Policy: An Evolutionary Approach*. New York, Palgrave McMillan.

McKay, J. K., Richards, J. H. & Mitchell-Olds, T. (2003) Genetics of drought adaptation in *Arabidopsis thaliana*: I. Pleiotropy contributes to genetic correlations among ecological traits. *Molecular Ecology*, 12, 1137–1151.

McKay, J. K., Richards, J. H., Nemali, K. S., Sen, S., Mitchell-Olds, T., Boles, S., Stahl, E. A., Wayne, T., Juenger, T. E. & Rausher, M. (2008) Genetics of drought adaptation in *Arabidopsis thaliana* II. QTL analysis of a new mapping population, Kas-1 x Tsu-1. *Evolution*, 62, 3014–3026.

McKean, K. A. & Nunney, L. (2001) Increased sexual activity reduces male immune function in *Drosophila melanogaster*. *Proceedings of the National Academy of Sciences of the United States of America*, 98, 7904–7909.

McKean, K. A. & Nunney, L. (2005) Bateman's principle and immunity: Phenotypically plastic reproductive strategies predict changes in immunological sex differences. *Evolution*, 59, 1510–1517.

McKean, K. A. & Nunney, L. (2008) Sexual selection and immune function in *Drosophila melanogaster*. *Evolution*, 62, 386–400.

McKean, K. A., Yourth, C. P., Lazzaro, B. P. & Clark, A. (2008) The evolutionary costs of immunological maintenance and deployment. *BMC Evolutionary Biology*, 8, 76.

McKenzie, J. A. (2001) Pesticide resistance. In Fox, C. W., Roff, D. A. & Daphne, J. F. (Eds.) *Evolutionary Ecology*. Oxford, Oxford University Press.

McLachlan, A. J. & Allen, D. F. (1987) Male mating success in Diptera – advantages of small size. *Oikos*, 48, 11–14.

McNabb, F. M. A. (2007) The hypothalamic-pituitary-thyroid (HPT) axis in birds and its role in bird development and reproduction. *Critical Reviews in Toxicology*, 37, 163–193.

McNeilly, A. S., Glasier, A., Jonassen, J. & Howie, P. W. (1982) Evidence for direct inhibition of ovarian function by prolactin. *Journal of Reproduction and Fertility*, 65, 559–569.

Medawar, P. B. (1952) *An Unsolved Problem in Biology*. London, Lewis.

Meddle, S. L., Maney, D. L. & Wingfield, J. C. (1999) Effects of N-methyl-D-aspartate on luteinizing hormone release and fos-like immunoreactivity in the male white-crowned sparrow (*Zonotrichia leucophrys gambelii*). *Endocrinology*, 140, 5922–5928.

Meeuwis, R., Michielsen, R., Decuypere, E. & Kuhn, E. R. (1989) Thyrotropic activity of the ovine corticotropin releasing factor in the chick embryo. *General and Comparative Endocrinology*, 76, 357–363.

Meinhardt, H. (2009) Models for the generation and interpretation of gradients. *Cold Spring Harbor Perspectives in Biology*, 1, a001362.

Meissner, M., Stark, K., Cresnar, B., Kirk, D. L. & Schmitt, R. (1999) *Volvox* germline-specific genes that are putative targets of RegA repression encode chloroplast proteins. *Current Genetics*, 36, 363–370.

Melendez, A., Talloczy, Z., Seaman, M., Eskelinen, E. L., Hall, D. H. & Levine, B. (2003) Autophagy genes are essential for dauer development and life-span extension in *C. elegans*. *Science*, 301, 1387–1391.

Melzer, D., Frayling, T. M., Murray, A., Hurst, A. J., Harries, L. W., Song, H., Khaw, K., Luben, R., Surtees, P. G., Bandinelli, S. S., Corsi, A. M., Ferrucci, L., Guralnik, J. M., Wallace, R. B., Hattersley, A. T. & Pharoah, P. D. (2007) A common variant of the p16(INK4a) genetic region is associated with physical function in older people. *Mechanisms of Ageing and Development*, 128, 370–377.

Mendel, C. M., Weisiger, R. A., Jones, A. L. & Cavalieri, R. R. (1987) Thyroid hormone binding proteins in plasma facilitate uniform distribution of thyroxine within tissues: A perfused rat liver study. *Endocrinology*, 120, 1742–1749.

Merchant, S. S., Prochnik, S. E., Vallon, O., Harris, E. H., Karpowicz, S. J., Witman, G. B., Terry, A., Salamov, A., Fritz-Laylin, L. K., Marechal-Drouard, L., Marshall, W. F., Qu, L. H., Nelson, D. R., Sanderfoot, A. A., Spalding, M. H., Kapitonov, V. V., Ren, Q. H., Ferris, P., Lindquist, E., Shapiro, H., Lucas, S. M., Grimwood, J., Schmutz, J., Cardol, P., Cerutti, H., Chanfreau, G., Chen, C. L., Cognat, V., Croft, M. T., Dent, R., Dutcher, S., Fernandez, E., Fukuzawa, H., Gonzalez-Balle, D., Gonzalez-Halphen, D., Hallmann, A., Hanikenne, M., Hippler, M., Inwood, W., Jabbari, K., Kalanon, M., Kuras, R., Lefebvre, P. A., Lemaire, S. D., Lobanov, A. V., Lohr, M., Manuell, A., Meir, I., Mets, L., Mittag, M., Mittelmeier, T., Moroney, J. V., Moseley, J., Napoli, C., Nedelcu, A. M., Niyogi, K., Novoselov, S. V., Paulsen, I. T., Pazour, G., Purton, S., Ral, J. P., Riano-Pachon, D. M., Riekhof, W., Rymarquis, L., Schroda, M., Stern, D., Umen, J., Willows, R., Wilson, N., Zimmer, S. L., Allmer, J., Balk, J., Bisova, K., Chen, C. J., Elias, M., Gendler, K., Hauser, C., Lamb, M. R., Ledford, H., Long, J. C., Minagawa, J., Page, M. D., Pan, J. M., Pootakham, W., Roje, S., Rose, A., Stahlberg, E., Terauchi, A. M., Yang, P. F., Ball, S., Bowler, C., Dieckmann, C. L., Gladyshev, V. N., Green, P., Jorgensen, R., Mayfield, S., Mueller-Roeber, B., Rajamani, S., Sayre, R. T., Brokstein, P., et al. (2007) The *Chlamydomonas* genome reveals the evolution of key animal and plant functions. *Science*, 318, 245–251.

Merritt, T. J. S., Sezgin, E., Zhu, C.-T. & Eanes, W. F. (2006) Triglyceride pools, flight and activity variation at the *Gpdh* locus in *Drosophila melanogaster*. *Genetics*, 172, 293–304.

Metcalfe, N. B., Huntingford, F. A., Graham, W. D. & Thorpe, J. E. (1989) Early social-status and the development of life history strategies in Atlantic Salmon. *Proceedings of the Royal Society of London B*, 236, 7–19.

Metcalfe, N. B., F. A. Huntingford, J. E. Thorpe, and C. E. Adams. 1990. The effects of social status on life-history variation in juvenile salmon. *Canadian Journal of Zoology - Revue Canadienne de la. Zoologie*, 68, 2630–2636.

Metcalfe, N. B., and J. E. Thorpe. 1990. Determinants of geographical variation in the age of seaward migrating salmon, *Salmo salar*. *Journal of Animal Ecology*, 59, 135–145.

Metcalf, C. J. E. & Pavard, S. (2007) Why evolutionary biologists should be demographers. *Trends in Ecology & Evolution*, 22, 205–212.

Metcalf, V. J., George, P. M. & Brennan, S. O. (2007) Lungfish albumin is more similar to tetrapod than to teleost albumins: Purification and characterisation of albumin from the Australian lungfish, *Neoceratodus forsteri*. *Comparative Biochemistry and Physiology B*, 147, 428–437.

Metcalf, C. J. E., Rose, K. E., Childs, D. Z., Sheppard, A. W., Grubb, P. J. & Rees, M. (2008) Evolution of flowering decisions in a stochastic, density-dependent environment. *Proceedings of the National Academy of Sciences of the United States of America*, 105, 10466–10470.

Meunier, N., Belgacem, Y. H. & Martin, J. R. (2007) Regulation of feeding behaviour and locomotor activity by takeout in *Drosophila*. *Journal of Experimental Biology*, 210, 1424–1434.

Meyer, E., Davies, S., Wang, S., Willis, B. L., Abrego, D., Juenger, T. E. & Matz, M. V. (2009) Genetic variation in responses to a settlement cue and elevated temperature in the reef-building coral *Acropora millepora*. *Marine Ecology Progress Series*, 392, 81–92.

Mezentseva, N., Kumaratilake, J. & Newman, S. (2008) The brown adipocyte differentiation pathway in birds: An evolutionary road not taken. *BMC Biology*, 6, 17.

Michaels, S. D. & Amasino, R. M. (1999) *FLOWERING LOCUS C* encodes a novel MADS domain protein that acts as a repressor of flowering. *Plant Cell*, 11, 949–956.

Michaels, S. D., He, Y. H., Scortecci, K. C. & Amasino, R. M. (2003) Attenuation of *FLOWERING LOCUS C* activity as a mechanism for the evolution of summer-annual flowering behavior in *Arabidopsis*. *Proceedings of the National Academy of Sciences of the United States of America*, 100, 10102–10107.

Michaels, S. D., Bezerra, I. C. & Amasino, R. M. (2004) *FRIGIDA*-related genes are required for the winter-annual habit in *Arabidopsis*. *Proceedings of the National Academy of Sciences of the United States of America*, 101, 3281–3285.

Michod, R. E. (2006) The group covariance effect and fitness trade-offs during evolutionary transitions in individuality. *Proceedings of the National Academy of Sciences of the United States of America*, 103, 9113–9117.

Michod, R. E. & Nedelcu, A. M. (2003) On the reorganization of fitness during evolutionary transitions in individuality. *Integrative and Comparative Biology*, 43, 64–73.

Michod, R. E., Viossat, Y., Solari, C. A., Hurand, M. & Nedelcu, A. M. (2006) Life history evolution and the origin of multicellularity. *Journal of Theoretical Biology*, 239, 257–272.

Middleton, C. A., Nongthomba, U., Parry, K., Sweeney, S. T., Sparrow, J. C. & Elliott, C. J. H. (2006) Neuromuscular organization and aminergic modulation of contractions in the *Drosophila* ovary. *BMC Biology*, 4, 1–14.

Millar, J. G., Chaney, J. D. & Mulla, M. S. (1992) Identification of oviposition attractants for *Culex quinquefasciatus* from fermented bermuda grass infusions. *Journal of the American Mosquito Control Association*, 8, 11–17.

Miller, G. E. (2000) *The mating mind: how sexual choice shaped the evolution of human nature*. New York, Doubleday.

Miller, S. E. & Hadfield, M. G. (1990) Developmental arrest during larval life and life-span extension in a marine Mollusc. *Science*, 248, 356–358.

Miller, A. E. & Heyland, A. (2010) Endocrine interactions between plants and animals: Implications of exogenous hormone sources for the evolution of hormone signaling. *General and Comparative Endocrinology*, 166, 455–461.

Miller, R. A., Buehner, G., Chang, Y., Harper, J. M., Sigler, R. & Smith-Wheelock, M. (2005) Methionine-deficient diet extends mouse lifespan, slows immune and lens aging, alters glucose, T4, IGF-I and insulin levels, and increases hepatocyte MIF levels and stress resistance. *Aging Cell*, 4, 119–125.

Mills, S. M., Hazard, L., Lancaster, L., Mappes, J., Miles, D. B., Oksanen, T. A. & Sinervo, B. (2008) Gonadotropin hormone modulation of testosterone, immune function, performance and behavioral trade-offs among male morphs of the lizard, *Uta stansburiana*. *The American Naturalist*, 171, 339–357.

Milo, R., Shen-Orr, S., Itzkovitz, S., Kashtan, N., Chklovskii, D. & Alon, U. (2002) Network motifs: simple building blocks of complex networks. *Science*, 298, 824–829.

Min, K. J. & Tatar, M. (2006) Restriction of amino acids extends lifespan in *Drosophila melanogaster*. *Mechanisms of Ageing and Development*, 127, 643–646.

Min, K. J., Hogan, M. F., Tatar, M. & O'Brien, D. M. (2006) Resource allocation to reproduction and soma in *Drosophila*: A stable isotope analysis of carbon from dietary sugar. *Journal of Insect Physiology*, 52, 763–770.

Min, K. J., Flatt, T., Kulaots, I. & Tatar, M. (2007) Counting calories in *Drosophila* diet restriction. *Experimental Gerontology*, 42, 247–251.

Min, K. J., Yamamoto, R., Buch, S., Pankratz, M. & Tatar, M. (2008) *Drosophila* lifespan control by dietary restriction independent of insulin-like signaling. *Aging Cell*, 7, 199–206.

Minakuchi, C., Zhou, X. & Riddiford, L. M. (2008) Krüppel homolog 1 (Kr-h1) mediates juvenile hormone action during metamorphosis of *Drosophila melanogaster*. *Mechanisms of Development*, 124, 91–105.

Minakuchi, C., Namiki, T. & Shinoda, T. (2009) Krüppel homolog 1, an early juvenile hormone-response gene downstream of Methoprene-tolerant, mediates its anti-metamorphic action in the red flour beetle *Tribolium castaneum*. *Developmental Biology*, 325, 341–350.

Minasian, L. L. J. & Mariscal, R. N. (1979) Characteristics and regulation of fission activity in clonal cultures of the cosmopolitan sea anemone, *Haliplanella luciae* (Verrill) *Biological Bulletin*, 157, 478–493.

Miner, B. G. (2005) Evolution of feeding structure plasticity in marine invertebrate larvae: a possible trade-off between arm length and stomach size. *Journal of Experimental Marine Biology and Ecology*, 315, 117–125.

Miner, B. (2007) Larval feeding structure plasticity during pre-feeding stages of echinoids: not all species respond to the same cues. *Journal of Experimental Marine Biology and Ecology*, 343, 158–165.

Miner, B. G. & Vonesh, J. R. (2004) Effects of fine grain environmental variability on morphological plasticity. *Ecology Letters*, 7, 794–801.

Miron, M., Lasko, P. & Sonenberg, N. (2003) Signaling from Akt to FRAP/TOR targets both 4E-BP and S6K in *Drosophila melanogaster*. *Molecular and Cellular Biology*, 23, 9117–9126.

Mirth, C. (2005) Ecdysteroid control of metamorphosis in the differentiating adult leg structures of *Drosophila melanogaster*. *Developmental Biology*, 278, 163–174.

Mirth, C. K. & Riddiford, L. M. (2007) Size assessment and growth control: how adult size is determined in insects. *BioEssays*, 29, 344–355.

Mirth, C., Truman, J. W. & Riddiford, L. M. (2005) The role of the prothoracic gland in determining critical weight for metamorphosis in *Drosophila melanogaster*. *Current Biology*, 15, 1796–1807.

Misra, R. K. & Reeve, C. R. (1964) Clines in body dimensions in populations of *Drosophilia subobscura*. *Genetical Research*, 5, 240–256.

Mitchell, B. D., Hsueh, W. C., King, T. M., Pollin, T. I., Sorkin, J., Agarwala, R., Schaffer, A. A. & Shuldiner, A. R. (2001) Heritability of lifespan in the Old Order Amish. *American Journal of Medical Genetics*, 102, 346–352.

Mitchell-Olds, T. & Schmitt, J. (2006) Genetic mechanisms and evolutionary significance of natural variation in *Arabidopsis*. *Nature*, 441, 947–952.

Mitchell-Olds, T., Willis, J. H. & Goldstein, D. B. (2007) Which evolutionary processes influence natural genetic variation for phenotypic traits? *Nature Reviews Genetics*, 8, 845–856.

Mittler, R. (2002) Oxidative stress, antioxidants and stress tolerance. *Trends in Plant Science*, 7, 405–410.

Miura, K., Oda, M., Makita, S. & Chinzei, Y. (2005) Characterization of the *Drosophila* Methoprene-tolerant gene product. *FEBS Journal*, 272, 1169–1178.

Miwa, S. & Inui, Y. (1987) Effects of various doses of thyroxine and triiodothyronine on the metamorphosis of flounder (*Paralichthys olivaceus*). *General and Comparative Endocrinology*, 67, 356–363.

Miwa, S. & Inui, Y. (1991) Thyroid hormone stimulates the shift of erythrocyte populations during metamorphosis of the flounder. *Journal of Experimental Zoology*, 259, 222–228.

Miwa, S., Tagawa, M., Inui, Y. & Hirano, T. (1988) Thyroxine surge in metamorphosing flounder larvae. *General and Comparative Endocrinology*, 70, 158–163.

Miwa, S., Yamano, K. & Inui, Y. (1992) Thyroid hormone stimulates gastric development in flounder larvae during metamorphosis. *Journal of Experimental Zoology*, 261, 424–430.

Miyata, S., Begun, J., Troemel, E. R. & Ausubel, F. M. (2008) DAF-16-dependent suppression of immunity during reproduction in *Caenorhabditis elegans*. *Genetics*, 178, 903–918.

Moberg, F. & Folke, C. (1999) Ecological goods and services of coral reef ecosystems. *Ecological Economics*, 29, 215–233.

Mockett, R. J., Cooper, T. M., Orr, W. C. & Sohal, R. S. (2006) Effects of caloric restriction are species-specific. *Biogerontology*, 7, 157–160.

Moczek, A. P. (2009) Developmental plasticity and the origins of diversity: a case study on horned beetles. In Ananthakrishnan, T. N. & Whitman, D. W. (Eds.) *Phenotypic Plasticity in Insects*. Plymouth, Science Publishers Inc. pp. 81–134.

Mohamed, S. A., Rottmann, O. & Pirchner, F. (2001) Components of heterosis for growth traits and litter size in line crosses of mice after long-term selection. *Journal of Animal Breeding and Genetics*, 118, 263–270.

Mok, F. S. Y., Thiyagarajan, V. & Qian, P. Y. (2009) Proteomic analysis during larval development and metamorphosis of the spionid polychaete *Pseudopolydora vexillosa*. *Proteome Science*, 7, 44.

Moll, J., Zahn, R., De Oliveira-Souza, R., Krueger, F. & Grafman, J. (2005) The neural basis of human moral cognition. *Nature Reviews Neuroscience*, 6, 799–809.

Moller, H. (1984) Reduction of a larval herring population by jellyfish predator. *Science*, 224, 621–622.

Momose, T., Derelle, R. & Houliston, E. (2008) A maternally localised Wnt ligand required for axial patterning in the cnidarian *Clytia hemisphaerica*. *Development*, 135, 2105–2113.

Monaghan, P. (2008) Early growth conditions, phenotypic development and environmental change. *Philosophical Transactions of the Royal Society of London B*, 363, 1635–1645.

Monaghan, P. & Haussmann, M. F. (2006) Do telomere dynamics link lifestyle and lifespan? *Trends in Ecology & Evolution*, 21, 47–53.

Monaghan, P., Metcalfe, N. B. & Torres, R. (2009) Oxidative stress as a mediator of life history trade-offs: mechanisms, measurements and interpretation. *Ecology Letters*, 12, 75–92.

Monastirioti, M. (2003) Distinct octopamine cell population residing in the CNS abdominal ganglion controls ovulation in *Drosophila melanogaster*. *Developmental Biology*, 264, 38–49.

Mongold, J. A. & Lenski, R. E. (1996) Experimental rejection of a nonadaptive explanation for increased cell size in *Escherichia coli*. *Journal of Bacteriology*, 178, 5333–5334.

Monte, E., Alonso, J. M., Ecker, J. R., Zhang, Y., Li, X., Young, J., Austin-Phillips, S. & Quail, P. H. (2003) Isolation and characterization of *PHYC* mutants in *Arabidopsis* reveals complex crosstalk between phytochrome signaling pathways. *Plant Cell*, 15, 1962–1980.

Monteiro, A. & Podlaha, O. (2009) Wings, horns, and butterfly eyespots: how do complex traits evolve? *PLoS Biology*, 7, 209–215.

Mooijaart, S. P., Kuningas, M., Westendorp, R. G., Houwing-Duistermaat, J. J., Slagboom, P. E., Rensen, P. C. & Van Heemst, D. (2007) Liver X receptor alpha associates with human life span. *Journal of Gerontology A*, 62, 343–349.

Moore, T., Beltran, L., Carbajal, S., Strom, S., Traag, J., Hursting, S. D. & Digiovanni, J. (2008) Dietary energy balance modulates signaling through the Akt/mammalian target of rapamycin pathways in multiple epithelial tissues. *Cancer Prevention Research*, 1, 65–76.

Moran, N. A. (1994) Adaptation and constraint in the complex life cycles of animals. *Annual Review of Ecology and Systematics*, 25, 573–600.

Moret, Y. & Schmid-Hempel, P. (2001) Immune defence in bumble-bee offspring. *Nature*, 414, 506.

Morgan, S. G. (1995) Life and death in the plankton: larval mortality and adaptation. In McEdward, L. (Ed.) *Ecology of Marine Invertebrate Larvae*. Boca Raton, CRC Press.

Morgan, A. D. (2008) The effect of food availability on phenotypic plasticity in larvae of the temperate sea cucumber *Australostichopus mollis*. *Journal of Experimental Marine Biology and Ecology*, 363, 89–95.

Morgan, M. B. & Snell, T. W. (2002) Characterizing stress gene expression in reef-building corals exposed to the mosquitoside dibrom. *Marine Pollution Bulletin*, 44, 1206–1218.

Morgan, N. C., Le Cren, E. D. & Lowe-McConell, R. H. (1980) Secondary production. *The Functioning of Freshwater Ecosystems*. Cambridge, Cambridge University Press.

Mori, J., Suzuki, S., Kobayashi, M., Inagaki, T., Komatsu, A., Takeda, T., Miyamoto, T., Ichikawa, K. & Hashizume, K. (2002) Nicotinamide adenine dinucleotide phosphate-dependent cytosolic T(3) binding protein as a regulator for T(3)-mediated transactivation. *Endocrinology*, 143, 1538–1544.

Mori, A., Romero-Severson, J., Black, W. C. & Severson, D. W. (2008) Quantitative trait loci determining autogeny and body size in the Asian tiger mosquito (*Aedes albopictus*). *Heredity*, 101, 75–82.

Morin, P. P., Hara, T. J. & Eales, J. G. (1997) Thyroid function and olfactory responses to L-alanine during induced smoltification in Atlantic salmon, *Salmo salar*. *Canadian Journal of Fisheries and Aquatic Sciences*, 54, 596–602.

Morvan-Dubois, G., Demeneix, B. A. & Sachs, L. M. (2008) *Xenopus laevis* as a model for studying thyroid hormone signalling: From development to metamorphosis. *Molecular and Cellular Endocrinology*, 293, 71–79.

Moseley, J. L., Chang, C. W. & Grossman, A. R. (2006) Genome-based approaches to understanding phosphorus deprivation responses and PSR1 control in *Chlamydomonas reinhardtii*. *Eukaryotic Cell*, 5, 26–44.

Moshitzky, P., Fleischmann, I., Chaimov, N., Saudan, P., Klauser, S., Kubli, E. & Applebaum, S. W. (1996) Sex-peptide activates juvenile hormone biosynthesis in the *Drosophila melanogaster* corpus allatum. *Archives of Insect Biochemistry and Physiology*, 32, 363–374.

Moss, E. G. (2007) Heterochronic genes and the nature of developmental time. *Current Biology*, 17, R425–R434.

Moss, C., Burke, R. D. & Thorndyke, M. C. (1994) Immunocytochemical localization of the neuropeptide-

S1 and serotonin in larvae of the starfish *Pisaster ochraceus* and *Asterias rubens*. *Journal of the Marine Biological Association of the United Kingdom*, 74, 61–71.

Motola, D. L., Cummins, C. L., Rottiers, V., Sharma, K., Sunino, K., Xu, E., Auchus, R., Antebi, A. & Mangelsdorf, M. (2006) Identification of DAF-12 ligands that govern dauer formation and reproduction in *C. elegans*. *Cell*, 124, 1209–1223.

Mougi, A. & Nishimura, K. (2006) Evolution of the maturation rate collapses competitive coexistence. *Journal of Theoretical Biology*, 241, 467–476.

Mousseau, T. A. (1997) Ectotherms follow converse to Bergann's Rule. *Evolution*, 51, 630–632.

Mousseau, T. A. & Fox, C. W. (1998) *Maternal Effects as Adaptations*. Oxford, Oxford University Press.

Moynihan, K. A., Grimm, A. A., Plueger, M. M., Bernal-Mizrachi, E., Ford, E., Cras-Meneur, C., Permutt, M. A. & Imai, S. (2005) Increased dosage of mammalian Sir2 in pancreatic beta cells enhances glucose-stimulated insulin secretion in mice. *Cell Metabolism*, 2, 105–117.

Muehlenbein, M. P. (2008) Adaptive variation in testosterone levels in response to immune activation: empirical and theoretical perspectives. *Social Biology*, 53, 13–23.

Muehlenbein, M. P. & Bribiescas, R. G. (2005) Testosterone-mediated immune functions and male life histories. *American Journal of Human Biology*, 17, 527–558.

Muehlenbein, M. P., Campbell, B. C., Phillippi, K. M., Murchison, M. A., Richards, R. J., Svec, F. & Myers, L. (2001) Reproductive maturation in a sample of captive male baboons. *Journal of Medical Primatology*, 30, 273–282.

Muehlenbein, M. P., Algier, J., Cogswell, F., James, M. & Krogstad, D. (2005) The reproductive endocrine response to *Plasmodium vivax* infection in Hondurans. *American Journal of Tropical Medicine and Hygiene*, 73, 178–187.

Muehlenbein, M. P., Jordan, J. L., Bonner, J. Z. & Swartz, A. M. (2010) Towards quantifying the usage costs of human immunity: altered metabolic rates and hormone levels during acute immune activation in men. American Journal of Human Biology, 22, 546–556.

Mueller, J. L., Page, J. L. & Wolfner, M. F. (2007) An ectopic expression screen reveals the protective and toxic effects of *Drosophila* seminal fluid proteins. *Genetics*, 175, 777–783.

Mugat, B., Brodu, V., Kejzlarova-Lepesant, J., Antoniewski, C., Bayer, C., Fristrom, J. & Lepesant, J. (2000) Dynamic expression of broad-complex isoforms mediates temporal control of an ecdysteroid target gene at the onset of *Drosophila* metamorphosis. *Developmental Biology*, 227, 104–117.

Muller, M., Den Tonkelaar, I., Thijssen, J. H. H., Grobbee, D. E. & Van Der Schouw, Y. T. (2003) Endogenous sex hormones in men aged 40–80 years. *European Journal of Endocrinology*, 149, 583–589.

Mullen, L. M., Lightfoot, M. E. & Goldsworthy, G. J. (2004) Induced hyperlipaemia and immune challenge in locusts. *Journal of Insect Physiology*, 50, 409–417.

Munch, D., Amdam, G. V. & Wolschin, F. (2008) Aging in a eusocial insect: molecular and physiological characteristics of lifespan plasticity in the honey bee. *Functional Ecology*, 22, 407–421.

Munroe, R. L. & Munroe, R. H. (1997) A comparative anthropological perspective. In Berry, J. W., Poortinga, Y. H. & Pandey, J. (Eds.) *Handbook of Cross Cultural Psychology*, 2nd edn. Boston, Allyn and Bacon.

Murakami, H. & Murakami, S. (2007) Serotonin receptors antagonistically modulate *Caenorhabditis elegans* longevity. *Aging Cell*, 6, 483–488.

Murdock, G. P. (1967) *Ethnographic Atlas*. Pittsburgh, University of Pittsburgh Press.

Murphy, C. T., McCarroll, S. A., Bargmann, C. I., Fraser, A., Kamath, R. S., Ahringer, J., Li, H. & Kenyon, C. (2003) Genes that act downstream of DAF-16 to influence the lifespan of *Caenorhabditis elegans*. *Nature*, 424, 277–283.

Musset, L., Le Bras, J. & Clain, J. (2007) Parallel evolution of adaptive mutations in plasmodium falciparum mitochondrial DNA during atovaquone-proguanil treatment. *Molecular Biology and Evolution*, 24, 1582–1585.

Mutti, N. S., Wolschin, F., Dolezal, A. G., Mutti, J. S., Gill, K. S. & Amdam, G. V. (submitted, under review) IIS and TOR nutrient-signaling pathways act via juvenile hormone to influence honey bee caste fate.

Myers, R. A. (1984) Demographic consequences of precocious maturation of Atlantic salmon (*Salmo salar*). *Canadian Journal of Fisheries and Aquatic Sciences*, 41, 1349–1353.

Nahmad, M., Glass, L. & Abouheif, E. (2008) The dynamics of developmental system drift in the gene network underlying wing polyphenism in ants: a mathematical model. *Evolution & Development*, 10, 360–374.

Nakajima, Y. (1986) Development of the nervous system of sea urchin embryos: formation of ciliary bands and the appearance of two types of ectoneural cells in the pluteus. *Development, Growth & Differentiation*, 28, 243–249.

Nakajima, Y., Kaneko, H., Murray, G. & Burke, R. D. (2004) Divergent patterns of neural development in larval echinoids and asteroids. *Evolution & Development*, 6, 95–104.

Nakano, H., Hibino, T., Oji, T., Hara, Y. & Amemiya, S. (2003) Larval stages of the living sea lily (stalked crinoid Echinoderm). *Nature*, 421, 158–160.

Nakano, H., Murabe, N., Amemiya, S. & Nakajima, Y. (2006) Nervous system development of the sea cucumber *Stichopus japonicus*. *Developmental Biology*, 292, 205–212.

Nanji, M., Hopper, N. A. & Gems, D. (2005) LET-60 RAS modulates effects of insulin/IGF-1 signaling on development and aging in *Caenorhabditis elegans*. *Aging Cell*, 4, 235–245.

Nappi, A. J. & Ottaviani, E. (2000) Cytotoxicity and cytotoxic molecules in invertebrates. *BioEssays*, 22, 469–480.

Napp-Zinn, K. (1985) *Arabidopsis thaliana*. In Halevy, A. (Ed.) *CRC Handbook of Flowering*. Boca Raton, FL, CRC.

Nedelcu, A. M. (2009) Environmentally induced responses co-opted for reproductive altruism. *Biology Letters*, 5, 805–808.

Nedelcu, A.M. and Michod, R.E. (2004) Evolvability, modularity, and individuality during the transition to multicellularity in volvocalean green algae. In Schlosser, G. & Wagner, G. (Eds.) *Modularity in Development and Evolution*. Chicago, University of Chicago Press.

Nedelcu, A. M. & Michod, R. E. (2006) The evolutionary origin of an altruistic gene. *Molecular Biology and Evolution*, 23, 1460–1464.

Nelson, R. J. (2005) *An Introduction to Behavioral Endocrinology*. Sunderland, Sinauer.

Nelson, J. S. (2006) *Fishes of the World*. New Jersy, John Wiley and Sons, Inc.

Nelson, E. R. & Habibi, H. R. (2009) Thyroid receptor subtypes: Structure and function in fish. *General and Comparative Endocrinology*, 161, 90–96.

Nelson, C. M., Ihle, K. E., Fondrk, M. K., Page, R. E. & Amdam, G. V. (2007) The gene vitellogenin has multiple coordinating effects on social organization. *PLoS Biology*, 5, e62.

Nemoto, S., Fergusson, M. M. & Finkel, T. (2005) SIRT1 functionally interacts with the metabolic regulator and transcriptional coactivator PGC-1α. *Journal of Biological Chemistry*, 280, 16456–16460.

Nepomnaschy, P. A., Welch, K. B., McConnel, D. S., Strassmann, B. I. & England, B. G. (2004) Stress and female reproductive function: a study of daily variations in cortisol, gonadotropins, and gonadal steroids in a rural Mayan population. *American Journal of Human Biology*, 16, 523–532.

Nepomnaschy, P. A., Welch, K. B., McConnell, D. S., Low, B. S., Strassmann, B. I. & England, B. G. (2006) Cortisol levels and very early pregnancy loss in humans. *Proceedings of the National Academy of Sciences of the United States of America*, 103, 3938–3942.

Neretti, N., Wang, P. Y., Brodsky, A. S., Nyguyen, H. H., White, K. P., Rogina, B. & Helfand, S. L. (2009) Long-lived Indy induces reduced mitochondrial reactive oxygen species production and oxidative damage. *Proceedings of the National Academy of Sciences of the United States of America*, 106, 2277–2282.

Ness, R. B., Harris, T., Cobb, J., Flegal, K. M., Kelsey, J. L., Balanger, A., Stunkard, A. J. & Dagostino, R. B. (1993) Number of pregnancies and the subsequent risk of cardiovascular disease. *New England Journal of Medicine*, 328, 1528–1533.

Nesse, R. M. & Williams, G. C. (1996) *Why We Get Sick: The New Science of Darwinian Medicine*. New York, Vintage Books.

Neukirch, A. (1982) Dependence of the life-span of the Honeybee (*Apis mellifica*) upon flight performance and energy-consumption. *Journal of Comparative Physiology B*, 146, 35–40.

Niehrs, C. (2004) Synexpression groups: genetic modules and embryonic development. In Schlosser, G. & Wagner, G. P. (Eds.) *Modularity in Development and Evolution*. Chicago, University of Chicago Press.

Nielsen, C. (1998) Origin and evolution of animal life cycles. *Biological Reviews of the Cambridge Philosophical Society*, 73, 125–155.

Nielsen, R., Bustamante, C., Clark, A. G., Glanowski, S., Sackton, T. B., Hubisz, M. J., Fledel-Alon, A., Tanenbaum, D. M., Civello, D., White, T. J., J Sninsky, J., Adams, M. D. & Cargill, M. (2005) A scan for positively selected genes in the genomes of humans and chimpanzees. *PLoS Biology*, 3, e170.

Nieman, D. C. (1999) Nutrition, exercise and immune system function. *Clinics in Sports Medicine*, 18, 537–548.

Nieman, D. C. (2008) Immunonutrition support for atheletes. *Nutrition Reviews*, 66, 310–320.

Niinuma, K., Yamamoto, K. & Kikuyama, S. (1991) Changes in plasma and pituitary prolactin levels in toad (*Bufo japonicus*) larvae during metamorphosis. *Zoological Science*, 8, 97–101.

Nijhout, H. F. (1979) Stretch-induced molting in *Oncopeltus fasciatus*. *Journal of Insect Physiology*, 25, 277–281.

Nijhout, H. F. (1994) *Insect Hormones*. Princeton, Princeton University Press.

Nijhout, H. F. (1999) Control mechanisms of polyphenic development in insects. *Bioscience*, 49, 181–192.

Nijhout, H. F. (2003) Development and evolution of adaptive polyphenisms. *Evolution & Development*, 5, 9–18.

Nijhout, H. F., Davidowitz, G. & Roff, D. A. (2006) A quantitative analysis of the mechanism that controls body size in *Manduca sexta*. *Journal of Biology*, 5(5) 16.

Nijhout, H. F. & Williams, C. F. (1974a) Control of moulting and metamorphosis in the tobacco hornworm, *Manduca sexta* (L.): cessation of juvenile hormone secretion as a trigger for pupation. *Journal of Experimental Biology*, 61, 493–501.

Nijhout, H. F. & Williams, D. W. (1974b) Control of moulting and metamorphosis in the tobacco hornworm, *Manduca sexta* (L.): growth of the las instar larva and the decision to pupate. *Journal of Experimental Biology*, 61, 481–491.

Nilsen, K.-A., Frederick, M., Fondrk, K. M., Smedal, B. & Hartfelder, G. V. (submitted) Dual role of fat body insulin/insulin-like growth factor signaling in honey bee behavioral physiology.

Nishiwaki, K., Kubota, Y., Chigira, Y., Roy, S. K., Suzuki, M., Schvarzstein, M., Jigami, Y., Hisamoto, N. & Matsumoto, K. (2004) An NDPase links ADAM protease glycosylation with organ morphogenesis in *C. elegans*. *Nature Cell Biology*, 6, 31–37.

Nordborg, M. & Bergelson, J. (1999) The effect of seed and rosette cold treatment on germination and flowering time in some *Arabidopsis thaliana* (Brassicaceae) ecotypes. *American Journal of Botany*, 86, 470–475.

Norris, D. O. (2007) *Vertebrate Endocrinology*. 4th edition New York, Academic Press.

Novak, V. J. A. (1966) *Insect Hormones*. London, Methuen and Co Ltd.

Nowak, M. A., Kamarova, N. L. & Niyogi, P. (2001) Evolution of universal grammar. *Science*, 291, 114–118.

Nugegoda, D., Walfor, J. & Lam, T. H. (1994) Thyroid hormones in early development of seabass (*Lates calcarifer*) larvae. *Journal of Aquaculture in the Tropics*, 9 279–290.

Nunez, J., Celi, F. S., Ng, L. & Forrest, D. (2008) Multigenic control of thyroid hormone functions in the nervous system. *Molecular and Cellular Endocrinology*, 287, 1–12.

Nunney, L. (2007) Pupal period and adult size in *Drosophila melanogaster*: a cautionary tale of contrasting correlations between two sexually dimorphic traits. *Journal of Evolutionary Biology*, 20, 141–151.

Nussey, D. H., Wilson, A. J. & Brommer, J. E. (2007) The evolutionary ecology of individual phenotypic plasticity in wild populations. *Journal of Evolutionary Biology*, 20, 831–844.

Nylin, S. (1992) Seasonal plasticity in life history traits – growth and development in *Polygonia c-album* (Lepidoptera, Nymphalidae). *Biological Journal of the Linnean Society*, 47, 301–323.

Nylin, S. & Gotthard, K. (1998) Plasticity in life history traits. *Annual Review of Entomology*, 43, 63–83.

Nylin, S. & Wahlberg, N. (2008) Does plasticity drive speciation? Host-plant shifts and diversification in nymphaline butterflies (Lepidoptera : Nymphalidae) during the tertiary. *Biological Journal of the Linnean Society*, 94, 115–130.

Nylin, S., Wickman, P. O. & Wiklund, C. (1989) Seasonal plasticity in growth and development of the speckled wood butterfly, *Pararge aegeria* (Satyrinae). *Biological Journal of the Linnean Society*, 38, 155–171.

Oberdoerffer, P., Michan, S., McVay, M., Mostoslavsky, R., Vann, J., Park, S. K., Hartlerode, A., Stegmuller, J., Hafner, A., Loerch, P., Wright, S. M., Mills, K. D., Bonni, A., Yankner, B. A., Scully, R., Prolla, T. A., Alt, F. W. & Sinclair, D. A. (2008) SIRT1 redistribution on chromatin promotes genomic stability but alters gene expression during aging. *Cell*, 135, 907–918.

O'Brien, D. M., Fogel, M. L. & Boggs, C. L. (2002) Renewable and nonrenewable resources: Amino acid turnover and allocation to reproduction in Lepidoptera. *Proceedings of the National Academy of Sciences of the United States of America*, 99, 4413–4418.

O'Brien, D. M., Min, K. J., Larsen, T. & Tatar, M. (2008) Use of stable isotopes to examine how dietary restriction extends *Drosophila* lifespan. *Current Biology*, 18, R155–R156.

O'Connell, J. F., Hawkes, K. & Blurton Jones, N. G. (1999) Grandmothering and the evolution of Homo erectus. *Journal of Human Evolution*, 36, 461–485.

Odell, W. D. & Parker, L. N. (1985) Control of adrenal androgen production. *Endocrine Research*, 10, 617–630.

Oeppen, J. & Vaupel, J. W. (2002) Broken limits to life expectancy. *Science*, 296, 1029–1031.

Oetting, A. & Yen, P. M. (2007) New insights into thyroid hormone action. *Best Practice & Research. Clinical Endocrinology & Metabolism*, 21, 193–208.

Oftedal, O. T. & Iverson, S. J. (1995) Comparative analysis of nonhuman milks: phylogenetic variation in the gross composition of milks. In Jensen, R. G. (Ed.) *Handbook of Milk Composition*. San Diego, Academic Press.

Ogawa, A., Streit, A., Antebi, A. & Sommer, R. J. (2009) A conserved endocrine mechanism controls the formation of dauer and infective larvae in nematodes. *Current Biology*, 19, 67–71.

Oh, S. W., Mukhopadhyay, A., Dixit, B. L., Raha, T., Green, M. R. & Tissenbaum, H. A. (2006) Identification of direct DAF-16 targets controlling longevity, metabolism and diapause by chromatin immunoprecipitation. *Nature Genetics*, 38, 251–257.

Ohtsu, T., Kimura, M. T. & Hori, S. H. (1992) Energy storage during reproductive diapause in the *Drosophila melanogaster* species group. *Journal of Comparative Physiology B*, 162, 203–208.

Oikarinen, A. & Lumme, J. (1979) Selection against photoperiodic reproductive diapause in *Drosophila littoralis*. *Hereditas*, 90, 119–125.

Ojeda, S. R. (2004) The anterior pituitary and hypothalamus. In Griffin, J. E. & Ojeda, S. R. (Eds.) *Textbook of Endocrine Physiology*, 5th edn. New York, Oxford University Press.

Oksanen, T. A., Koskela, E. & Mappes, T. (2002) Hormonal manipulation of offspring number: maternal effort and reproductive costs. *Evolution*, 56, 1530–1537.

Oldham, S. & Hafen, E. (2003) Insulin/IGF and target of rapamycin signaling: a TOR de force in growth control. *Trends in Cell Biology*, 13, 79–85.

Oldham, S., Bohni, R., Stocker, H., Brogiolo, W. & Hafen, E. (2000) Genetic control of size in *Drosophila*. *Philosophical Transactions of the Royal Society of London B*, 355, 945–952.

Oliver, B., Perrimon, N. & Mahowald, A. P. (1987) The ovo locus is required for sex-specific germ line maintenance in *Drosophila*. *Genes & Development*, 1, 913–923.

Oliver, K. M., Russell, J. A., Moran, N. A. & Hunter, M. S. (2003) Facultative bacterial symbionts in aphids confer resistance to parasitic wasps. *Proceedings of the National Academy of Sciences of the United States of America*, 100, 1803–1807.

Oliver, K. M., Moran, N. A. & Hunter, M. S. (2005) Variation in resistance to parasitism in aphids is due to symbionts not host genotype. *Proceedings of the National Academy of Sciences of the United States of America*, 102, 12795–12800.

Olsen, K. M., Womack, A., Garrett, A. R., Suddith, J. I. & Purugganan, M. D. (2002) Contrasting evolutionary forces in the *Arabidopsis thaliana* floral developmental pathway. *Genetics*, 160, 1641–1650.

Olsen, K. M., Halldorsdottir, S. S., Stinchcombe, J. R., Weinig, C., Schmitt, J. & Purugganan, M. D. (2004) Linkage disequilibrium mapping of *Arabidopsis CRY2* flowering time alleles. *Genetics*, 167, 1361–1369.

Olsson, M. & Shine, R. (2002) Growth to death in lizards. *Evolution*, 56, 1867–1870.

Olsson, M., Wilson, M., Isaksson, C., Uller, T. & Mott, B. (2008a) Carotenoid intake does not mediate a relationship between reactive oxygen species and bright colouration: experimental test in a lizard. *Journal of Experimental Biology*, 211, 1257–1261.

Olsson, M., Wilson, M., Uller, T., Mott, B., Isaksson, C., Healey, M. & Wanger, T. (2008b) Free radicals run in lizard families. *Biology Letters*, 4, 186–188.

Olsson, M., Wilson, M., Uller, T., Mott, B. & Isaksson, C. (2009) Variation in levels of reactive oxygen species is explained by maternal identity, sex and body-size-corrected clutch size in a lizard. *Naturwissenschaften*, 96, 25–29.

Oostra, V., de Jong, M. A., Invergo, B. M., Kesbeke, F. H. N., Wende, F., Brakefield, P. M., and Zwaan, B. J. (2010). Translating environmental gradients into discontinuous reaction norms via hormone signaling in a polyphenic butterfly. Proceedings of the Royal Society of London B print September 8, 2010, doi: 10.1098/rspb.2010.1560.

Optim, O., Amore, G., Minokawa, T., McClay, D. R. & Davidson, E. H. (2004) SpHnf6, a transcription factor that executes multiple function in sea urchin embryogensis. *Developmental Biology*, 273, 226–243.

Orentreich, N., Matias, J. R., Defelice, A. & Zimmerman, J. A. (1993) Low methionine ingestion by rats extends life span. *Journal of Nutrition*, 123, 269–274.

Orgogozo, V., Broman, K. W. & Stern, D. L. (2006) High-resolution quantitative trait locus mapping reveals sign epistasis controlling ovariole number between two *Drosophila* species. *Genetics*, 173, 197–205.

O'Rourke, E. J., Soukas, A. A., Carr, C. E. & Ruvkun, G. (2009) *C. elegans* major fats are stored in vesicles distinct from lysosome-related organelles. *Cell Metabolism*, 10, 430–435.

Orozco, A. & Valverde, R. (2005) Thyroid hormone deiodination in fish. *Thyroid*, 15, 799–813.

Orr, H. A. & Coyne, J. A. (1992) The genetics of adaptation: a reassessment. *The American Naturalist*, 140, 725–742.

Ostrowski, E. A., Woods, R. J. & Lenski, R. E. (2008) The genetic basis of parallel and divergent phenotypic responses in evolving populations of *Escherichia coli*. *Proceedings of the Royal Society of London B*, 275, 277–284.

Ouellet, J., Li, S. & Roy, R. (2008) Notch signalling is required for both dauer maintenance and recovery in *C. elegans*. *Development*, 135, 2583–2592.

Overgaard, J., Malmendal, A., J.G., S., Bundy, J. G., Loeschcke, V., Nielsen, N. C. & Holmstrup, M. (2007) Metabolomic profiling of rapid cold hardening and cold shock in *Drosophila melanogaster*. *Journal of Insect Physiology*, 53, 1218–1232.

Ozaki, Y., Okumura, H., Kazeto, Y., Ikeuchi, T., Ijiri, S., Nagae, M., Adachi, S. & Yamauchi, K. (2000) Developmental changes in pituitary-thyroid axis, and formation of gonads in leptocephali and glass eels of Anguilla spp. *Fisheries Science*, 66, 1115–1122.

Ozsolak, F., Platt, A. R., Jones, D. R., Reifenberger, J. G., Sass, L. E., McInerney, P., Thompson, J. F., Bowers, J., Jarosz, M., & Milos, P. M. (2009). Direct RNA sequencing. *Nature*, 461, 814–818.

Paaby, A. B. & Schmidt, P. S. (2008) Functional significance of allelic variation at *methuselah*, an aging gene in *Drosophila*. *PLoS One*, 3, e1987.

Paaby, A., Blacket, M. J., Hoffmann, A. A. & Schmidt, P. S. (2010) Identification of a candidate adaptive polymorphism for *Drosophila* life history by parallel independent clines on two continents. *Molecular Ecology*, 19, 760–774.

Packer, C., Tatar, M. & Collin, A. (1998) Reproductive cessation in female mammals. *Nature*, 392, 807–810.

Padmanabhan, S., Mukhopadhyay, A., Narasimhan, S. D., Tesz, G., Czech, M. P. & Tissenbaum, H. A. (2009) A PP2A regulatory subunit regulates *C. elegans* insulin/IGF-1 signaling by modulating AKT-1 phosphorylation. *Cell*, 136, 939–951.

Page, L. R. (2002) Comparative structure of the larval apical sensory organ in Gastropods and hypotheses about function and developmental evolution. *Invertebrate Reproduction & Development*, 41, 193–200.

Page, R. E. J., & Amdam, G. V. (2007) The making of a social insect: developmental architectures of social design. *BioEssays*, 29, 334–343.

Page, R. E. J. & Fondrk, M. K. (1995) The effects of colony level selection o the social organization of honey-bee (*Apis mellifera*) colonies – colony level components of pollen hoarding. *Behavioral Ecology and Sociobiology*, 36, 135–144.

Page, R. E. J., Scheiner, R., Erber, J. & Amdam, G. V. (2006) The development and evolution of division of labor and foraging specialization in a social insect (*Apis mellifera* L.). *Current Topics in Developmental Biology*, 74, 253–286.

Paitz, R. T., Haussmann, M. F., Boden, R. M., Janzen, F. J. & Vleck, C. (2004) Long telomeres may minimize the effect of aging in the Painted Turtle. *Integrative and Comparative Biology*, 44, 617.

Palopoli, M. F., Rockman, M. V., Tinmaung, A., Ramsay, C., Curwen, S., Aduna, A., Laurita, J. & Kruglyak, L. (2008) Molecular basis of the copulatory plug polymorphism in *Caenorhabditis elegans*. *Nature*, 454, 1019–1022.

Pamplona, R. & Barja, G. (2007) Highly resistant macromolecular components and low rate of generation of endogenous damage: Two key traits of longevity. *Aging Research Reviews*, 6, 189–210.

Pan, K. Z., Palter, J. E., Rogers, A. N., Olsen, A., Chen, D., Lithgow, G. J. & Kapahi, P. (2007) Inhibition of mRNA translation extends lifespan in *Caenorhabditis elegans*. *Aging Cell*, 6, 111–119.

Panowski, S. H., Wolff, S., Aguilaniu, H., Durieux, J. & Dillin, A. (2007) PHA-4/Foxa mediates diet-restriction-induced longevity of *C. elegans*. *Nature*, 447, 550–555.

Panter-Brick, C., Lotstein, D. S. & Ellison, P. T. (1993) Seasonality of reproductive function and weight loss in rural Nepali women. *Human Reproduction*, 8, 684–690.

Panza, F., D'Introno, A., Capurso, C., Colacicco, A. M., Seripa, D., Pilotto, A., Santamato, A., Capurso, A. & Solfrizzi, V. (2007) Lipoproteins, vascular-related genetic factors, and human longevity. *Rejuvenation Research*, 10, 441–458.

Papaceit, M., Sanantonio, J. & Prevosti, A. (1991) Genetic-analysis of extra sex combs in the hybrids between *Drosophila subobscura* and *D madeirensis*. *Genetica*, 84, 107–114.

Papadopoulou, E. & Grumet, R. (2005) Brassinosteriod-induced femaleness in cucumber and relationship to ethylene production. *HortScience*, 40, 1763–1767.

Papadopoulou, E., Little, H. A., Hammar, S. A. & Grumet, R. (2005) Effect of modified endogenous ethylene production on sex expression, bisexual flower development and fruit production in melon (*Cucumis melo* L.). *Sexual Plant Reproduction*, 18, 131–142.

Paris, M. & Laudet, V. (2008) The history of a developmental stage: Metamorphosis in chordates. *Genesis*, 46, 657–672.

Paris, M., Escriva, H., Schubert, M., Brunet, F., Brtko, J., Ciesielski, F., Roecklin, D., Vivat-Hannah, V., Jamin, E. L., Cravedi, J. P., Scanlan, T. S., Renaud, J. P., Holland, N. D. & Laudet, V. (2008) Amphioxus postembryonic development reveals the homology of chordate metamorphosis. *Current Biology*, 18, 825–830.

Parthasarathy, R., Tan, A., Bai, H. & Palli, S. R. (2008) Transcription factor broad suppresses precocious development of adult structures during larval-pupal metamorphosis in the red flour beetle, *Tribolium castaneum*. *Mechanisms of Development*, 125, 299–313.

Partridge, L. & Fowler, K. (1992) Direct and correlated responses to selection on age at reproduction in *Drosophila melanogaster*. *Evolution*, 46, 76–91.

Partridge, L. & Gems, D. (2006) Beyond the evolutionary theory of aging, from functional genomics to evo-gero. *Trends in Ecology & Evolution*, 21, 334–340.

Partridge, L. & Harvey, P. H. (1988) The ecological context of life history evolution. *Science*, 241, 1449–1455.

Partridge, L., Barrie, B., Fowler, K. & French, V. (1994) Evolution and development of body-size and cell-size in *Drosophila melanogaster* in response to temperature. *Evolution*, 48, 1269–1276.

Partridge, L., Barrie, B., Barton, N. H., Fowler, K. & French, V. (1995) Rapid laboratory evolution of adult life history traits in *Drosophila melanogaster* in response to temperature. *Evolution*, 49, 538–544.

Partridge, L., Langelan, R., Fowler, K., Zwaan, B. & French, V. (1999) Correlated responses to selection on body size in *Drosophila melanogaster*. *Genetical Research*, 74, 43–54.

Partridge, L., Green, A., & Fowler, K. (1989) Effects of egg-production and of exposure to males on female survival in *Drosophila melanogaster. Journal of Insect Physiology*, 33, 745–749.

Partridge, L., Gems, D. & Withers, D. J. (2005a) Sex and death: What is the connection? *Cell*, 120, 461–472.

Partridge, L., Piper, M. D. & Mair, W. (2005b) Dietary restriction in *Drosophila*. *Mechanisms of Ageing and Development*, 126, 938–950.

Patel, A., Fondrk, M. K., Kaftanoglu, O., Emore, C., Hunt, G., Frederick, K. & Amdam, G. V. (2007) The making of a queen: TOR pathway is a key player in diphenic caste development. *PLoS One*, 2, e509.

Patel, D. S., Fang, L. L., Svy, D. K., Ruvkun, G. & Li, W. (2008) Genetic identification of HSD-1, a conserved steroidogenic enzyme that directs larval development in *Caenorhabditis elegans*. *Development*, 135, 2239–2249.

Paul, V. J. & Ritson-Williams, R. (2008) Marine chemical ecology. *Natural Product Reports*, 25, 662–695.

Paul, B. D., Fu, L., Buchholz, D. R. & Shi, Y. B. (2005a) Coactivator recruitment is essential for liganded thyroid hormone receptor to initiate amphibian metamorphosis. *Molecular and Cellular Biology*, 25, 5712–5724.

Paul, M. J., Freeman, D. A., Park, J. H. & Dark, J. (2005b) Neuropeptide Y induces torpor-like hypothermia in Siberian hamsters. *Brain Research*, 1055, 83–92.

Paul, B. D., Buchholz, D. R., Fu, L. & Shi, Y. B. (2007) Src-p300 coactivator complex is required for thyroid hormone-induced amphibian metamorphosis. *Journal of Biological Chemistry*, 282, 7472–7481.

Pearse, V. B. (2002) Prodigies of propagation: the many modes of clonal replication in boloceroidid sea anemones (Cnidaria, Anthozoa, Actiniaria). *Invertebrate Reproduction & Development*, 41, 201–213.

Pearse, J. S., Pearse, V. B. & Newberry, A. T. (1989) Telling sex from growth: dissolving Maynard Smith's paradox. *Bulletin of Marine Science*, 45, 433–446.

Pearson, K. J., Baur, J. A., Lewis, K. N., Peshkin, L., Price, N. L., Labinskyy, N., Swindell, W. R., Kamara, D., Minor, R. K., Perez, E., Jamieson, H. A., Zhang, Y., Dunn, S. R., Sharma, K., Pleshko, N., Woollett, L. A., Csiszar, A., Ikeno, Y., Le Couteur, D., Elliott, P. J., Becker, K. G., Navas, P., Ingram, D. K., Wolf, N. S., Ungvari, Z., Sinclair, D. A. & De Cabo, R. (2008) Resveratrol delays age-related deterioration and mimics transcriptional aspects of dietary restriction without extending life span. *Cell Metabolism*, 8, 157–168.

Pecasse, F., Beck, Y., Ruiz, C. & Richards, G. (2000) Kruppel-homolog, a stage-specific modulator of the prepupal ecdysone response, is essential for *Drosophila* metamorphosis. *Developmental Biology*, 221, 53–67.

Pechenik, J. A., Estrella, M. S. & Hammer, K. (1996) Food limitation stimulates metamorphosis of competent larvae and alters postmetamorphic growth rate in the marine gastropod *Crepidula fornicata*. *Marine Biology*, 127, 267–275.

Peck, L. S. & Maddrell, S. H. (2005) Limitation of size by hypoxia in the fruit fly *Drosophila melanogaster*. *Journal of Experimental Zoology A*, 303, 968–975.

Pedra, J. H., Festucci-Buselli, R. A., Sun, W. L., Muir, W. M., Scharf, M. E. & Pittendrigh, B. R. (2005) Profiling of abundant proteins associated with dichlorodiphenyl-trichloroethane resistance in *Drosophila melanogaster*. *Proteomics*, 5, 258–269.

Peel, D. J. & Milner, M. J. (1992) The response of *Drosophila* imaginal disk cell-lines to ecdysteroids. *Roux's Archives of Developmental Biology*, 202, 23–35.

Peeters, A. V., Beckers, S., Verrijken, A., Mertens, I., Roevens, P., Peeters, P. J., Van Hul, W. & Van Gaal, L. F. (2008) Association of SIRT1 gene variation with visceral obesity. *Human Genetics*, 124, 431–436.

Peled-Kramar, M., Hamilton, P. & Wilt, F. H. (2002) Spicule matrix protein LSM34 is essential for biomineralization of the sea urchin spicule. *Experimental Cell Research*, 272, 56–61.

Pelosi, L., Kuhn, L., Guetta, D., Garin, J., Geiselmann, J., Lenski, R. E. & Schneider, D. (2006) Parallel changes in global protein profiles during long-term experimental evolution in *Escherichia coli*. *Genetics*, 173, 1851–1869.

Pelz, H.-J., Rost, S., Hunerberg, M., Fregin, A., Heiberg, A.-C., Baert, K., MacNicoll, A. D., Prescott, C. V., Walker, A.-S., Oldenburg, J. & Muller, C. R. (2005) The genetic basis of resistance to anticoagulants in rodents. *Genetics*, 170, 1839–1847.

Penaz, M. (2001) A general framework of fish ontogeny: a review of the ongoing debate. *Folia Zoologica*, 50, 241–256.

Pener, M. P. (1972) The corpus allatum in adult acridids: the interrelation of its functions and possible correlations with the life cycle. In Hemming, C. F. & Taylor, T. H. C. (Eds.) *Proceedings of the International Study Conference on the Current and Future Problems of Acridology*. London: Centre for Overseas Pest Research.

Pener, M. P. (1992) Environmental cues, endocrine factors, and reproductive diapause in male insects. *Chronobiology International*, 9, 102–113.

Peng, J., Zipperlen, P. & Kubli, E. (2005) *Drosophila* sex-peptide stimulates female innate immune system after mating via the Toll and Imd pathways. *Current Biology*, 15, 1690–1694.

Perez, V. I., Bokov, A., Van Remmen, H., Mele, J., Ran, Q., Ikeno, Y. & Richardson, A. (2009) Is the oxidative stress theory of aging dead? *Biochimica et Biophysica Acta*, 1790, 1005–1014.

Perls, T. T., Wilmoth, J., Levenson, R., Drinkwater, M., Cohen, M., Bogan, H., Joyce, E., Brewster, S., Kunkel, L. & Puca, A. (2002) Life-long sustained mortality advantage of siblings of centenarians. *Proceedings of the National Academy of Sciences of the United States of America*, 99, 8442–8447.

Perron, F. E. (1986) Life history consequences of differences in developmental mode among gastropods in the genus Conus *Bulletin of Marine Science*, 39, 485–497.

Peter, R. E., Yu, K. L., Marchant, T. A. & Rosenblum, P. M. (1990) Direct neural regulation of the teleost adenohypophysis. *Journal of Experimental Zoology*, 4, 84–89.

Peterson, C. C., Walton, B. M. & Bennett, A. F. (1999) Metabolic costs of growth in free-living garter snakes and the energy budgets of ectotherms. *Functional Ecology*, 13, 500–507.

Pfannschmidt, T., Brautigam, K., Wagner, R., Dietzel, L., Schroter, Y., Steiner, S. & Nykytenko, A. (2009) Potential regulation of gene expression in photosynthetic cells by redox and energy state: approaches towards better understanding. *Annals of Botany*, 103, 599–607.

Pfennig, D. (1990) The adaptive significance of an environmentally-cued developmental switch in an anuran tadpole. *Oecologia*, 85, 101–107.

Pfennig, D. W. (1992a) Polyphenism in spadefoot toad tadpoles as a locally adjusted evolutionarily stable strategy. *Evolution*, 46, 1408–1420.

Pfennig, D. W. (1992b) Proximate and functional causes of polyphenism in an anuran tadpole. *Functional Ecology*, 6, 167–174.

Pfennig, D. W., Reeve, H. K. & Sherman, P. W. (1993) Kin recognition and cannibalism in spadefoot toad tadpoles. *Animal Behaviour*, 46, 67–84.

Philipp, I., Aufschnaiter, R., Ozbek, S., Pontasch, S., Jenewein, M., Watanabe, H., Rentzsch, F., Holstein, T. W. & Hobmayer, B. (2009) Wnt/beta-Catenin and noncanonical Wnt signaling interact in tissue evagination in the simple eumetazoan *Hydra*. *Proceedings of the National Academy of Sciences of the United States of America*, 106, 4290–4295.

Phillips, P. C. & Arnold, S. J. (1989) Visualizing multivariate selection. *Evolution*, 43, 1209–1222.

Phillips, J. P., Frye, F., Berkovitz, A., Calle, P., Millar, R., Rivier, J. & Lasley, B. E. (1987) Exogenous GnRH overrides the endogenous annual reproductive rhythm in green iguanas, *Iguana iguana*. *Journal of Experimental Zoology A*, 241, 227–236.

Phillips, J. P., Campbell, S. D., Michaud, D., Charbonneau, M. & Hilliker, A. J. (1989) Null mutation of copper/zinc superoxide dismutase in *Drosophila* confers hypersensitivity to paraquat and reduced longevity. *Proceedings of the National Academy of Sciences of the United States of America*, 86, 2761–2765.

Picard, F., Kurtev, M., Chung, N., Topark-Ngarm, A., Senawong, T., Machado De Oliveira, R., Leid, M., McBurney, M. W. & Guarente, L. (2004) Sirt1 promotes fat mobilization in white adipocytes by repressing PPAR-γ. *Nature*, 429, 771–776.

Pickering, A. D., Griffiths, R. & Pottinger, T. G. (1987) A comparison of the effects of overhead cover on the growth, survival and hematology of juvenile Atlantic Salmon, *Salmo salar* L., Brown Trout, *Salmo trutta* L., and Rainbow Trout, *Salmo Gairdneri. Aquaculture*, 66, 109–124.

Pierce, S. B., Costa, M., Wisotzkey, R., Devadhar, S., Homburger, S. A., Buchman, A. R., Ferguson, K. C., Heller, J., Platt, D. M., Pasquinelli, A. A., Liu, L. X., Doberstein, S. K. & Ruvkun, G. (2001) Regulation of DAF-2 receptor signaling by human insulin and ins-1, a member of the unusually large and diverse *C. elegans* insulin gene family. *Genes & Development*, 15, 672–686.

Pigliucci, M. (2001) *Phenotypic Plasticity: Beyond Nature and Nurture*. Baltimore, Johns Hopkins Press.

Pigliucci, M. (2005) Evolution of phenotypic plasticity: where are we going now? *Trends in Ecology & Evolution*, 20, 481–486.

Pigliucci, M. (2010) Genotype–phenotype mapping and the end of the 'genes as blueprint' metaphor. *Philosophical Transactions of the Royal Society B*, 365, 557–566.

Pijpe, J., Fischer, K., Brakefield, P. & Zwaan, B. (2006) Consequences of artificial selection on pre-adult development for adult lifespan under benign conditions in the butterfly *Bicyclus anynana*. *Mechanisms of Ageing and Development*, 127, 802–807.

Pijpe, J., Brakefield, P. M. & Zwaan, B. J. (2007) Phenotypic plasticity of starvation resistance in the butterfly *Bicyclus anynana*. *Evolutionary Ecology*, 21, 589–600.

Pijpe, J., Brakefield, P. M. & Zwaan, B. J. (2008) Increased lifespan in a polyphenic butterfly artificially selected for starvation resistance. *The American Naturalist*, 171, 81–90.

Pike, I. L. (1999) Age, reproductive history, seasonality, and maternal body composition during pregnancy for nomadic Turkana of Kenya. *American Journal of Human Biology*, 11, 658–672.

Pike, I. L. (2000) Pregnancy outcome for nomadic Turkana pastoralists of Kenya. *American Journal of Physical Anthropology*, 113, 31–45.

Pinker, S. (1994) *The Language Instinct*. New York, William Morrow.

Pinto, L. Z., Bitondi, M. M. & Simoes, Z. L. (2000) Inhibition of vitellogenin synthesis in *Apis mellifera* workers by a juvenile hormone analogue, pyriproxyfen. *Journal of Insect Physiology*, 46, 153–160.

Piper, M. D. W., Selman, C., McElwee, J. J. & Partridge, L. (2005) Models of insulin signalling and longevity. *Drug Discovery Today: Disease Models*, 2, 249–256.

Piper, M. D. W., Selman, C., McElwee, J. J. & Partridge, L. (2008) Separating cause from effect: how does insulin/IGF signalling control lifespan in worms, flies and mice? *Journal of Internal Medicine*, 263, 179–191.

Pirke, K. M., Schweiger, V., Lemmel, W., Krieg, J. C. & Berger, M. (1985) The influence of dieting on the menstrual cycle of healthy young women. *Journal of Clinical Endocrinology and Metabolism*, 70, 1174–1179.

Pishcedda, A. & Chippindale, A. K. (2006) Intralocus conflict diminishes the benefits of sexual selection. *PLoS Biology*, 4, e394.

Pitnick, S. (1991) Male size influences mate fecundity and remating interval in *Drosophila melanogaster*. *Animal Behaviour*, 41, 735–745.

Pitnick, S. & Garcia-Gonzalez, F. (2002) Harm to females increases with male body size in *Drosophila melanogaster*. *Proceedings of the Royal Society of London*, 269, 1821–1828.

Plas, E., Berger, P., Hermann, M. & Pflüger, H. (2000) Effects of aging on male fertility? *Experimental Gerontology*, 35, 543–551.

Pletcher, S. D., MacDonald, S. J., Marguerie, S. R., Certa, U., Stearns, S. C. & Partridge, L. (2002) Genome-wide transcript profiles in aging and calorically restricted *Drosophila melanogaster*. *Current Biology*, 12, 712–723.

Plickert, G., Jacoby, V., Frank, U., Müller, W. A. & Mokady, O. (2006) Wnt signaling in hydroid development: Formation of the primary body axis in embryogenesis and its subsequent patterning. *Developmental Biology*, 298, 368–378.

Podolsky, R. D. & McAlister, J. S. (2005) Developmental plasticity in *Macrophiothrix* brittlestars: Are morphologically convergent larvae also convergently plastic? *Biological Bulletin*, 209, 127–138.

Poe, S. (2004) A test for patterns of modularity in sequences of developmental events. *Evolution*, 58, 1852–1855.

Poodry, C. A. & Woods, D. F. (1990) Control of the developmental timer for *Drosophila* pupariation. *Roux's Archives of Developmental Biology*, 199, 219–227.

Portmann, A. (1941) Die Tragzeiten der Primaten und die Dauer der Schwangerschaft beim Menschen: Ein Problem der vergleichenden Biologie. *Revue Suisse de Zoologie* 48, 511–518.

Postlethwait, J. H. & Shirk, P. D. (1981) Genetic and endocrine regulation of vitellogenesis in *Drosophila*. *American Zoologist*, 21, 687–700.

Potthoff, M. J., Inagaki, T., Satapati, S., Ding, X., He, T., Goetz, R., Mohammadi, M., Finck, B. N., Mangelsdorf, D. J., Kliewer, S. A. & Burgess, S. C. (2009) FGF21 induces PGC-1α and regulates carbohydrate and fatty acid metabolism during the adaptive starvation response. *Proceedings of the National Academy of Sciences of the United States of America*, 106, 10853–10858.

Powanda, M. C. & Beisel, W. R. (2003) Metabolic effects of infection on protein and energy status. *Journal of Nutrition*, 133, 322–327.

Power, D. M., Llewellyn, L., Faustino, M., Nowell, M. A., Bjornsson, B. T., Einarsdottir, I. E., Canario, A. V. M. & Sweeney, G. E. (2001) Thyroid hormones in growth and development of fish. *Comparative Biochemistry and Physiology C*, 130, 447–459.

Power, D. M., Einarsdottir, I. E., Pittman, K., Sweeney, G. E., Hildahl, J., Campinho, M. A., Silva, N., Saele, O., Galay-Burgos, M., Smaradottir, H. & Bjornsson, B. T. (2008) The molecular and endocrine basis of flatfish metamorphosis. *Reviews in Fisheries Science*, 16, 95–111.

Prasad, N. G. & Joshi, A. (2003) What have two decades of laboratory life history evolution studies on *Drosophila melanogaster* taught us? *Journal of Genetics*, 82, 45–76.

Prentice, A. M. & Prentice, A. (1988) Energy costs of lactation. *Annual Review of Nutrition*, 8, 63–79.

Prevosti, A. (1955) Geographical variability in quantitative traits in populations of *Drosophila subobscura*. *Quantitative Biology*, 20, 294–299.

Price, G. R. (1970) Selection and covariance. *Nature*, 227, 520–521.

Priest, N. K., Galloway, L. F. & Roach, D. A. (2008) Mating frequency and inclusive fitness in *Drosophila melanogaster*. *The American Naturalist*, 171, 10–21.

Prior, J. C., Vigna, Y. M. & McKay, D. W. (1992) Reproduction for the athletic woman: New understandings of physiology and management. *Sports Medicine*, 14, 190–199.

Prochnik, S. E., Umen, J., Nedelcu, A. M., Hallmann, A., Miller, S. M., Nishii, I., Ferris, P., Kuo, A., Mitros, T., Fritz-Laylin, L. K., Hellsten, U., Chapman, J., Simakov, O., Rensing, S. A., Terry, A., Pangilinan, J., Kapitonov, V., Jurka, J., Salamov, A., Shapiro, H., Schmutz, J., Grimwood, J., Lindquist, E., Lucas, S., Grigoriev, I. V., Schmitt, R. D., Kirk, D. & Rokhsar, D. S. (2010) Genomic Analysis of Organismal Complexity in the Multicellular Green Alga Volvox carteri. Science, 329, 223–226.

Purcell, J. E. (2007) Environmental effects on asexual reproduction rates of the scyphozoan, *Aurelia labiata*. *Marine Ecology Progress Series*, 348, 183–196.

Putterill, J., Laurie, R. & MacKnight, R. (2004) It's time to flower: the genetic control of flowering time. *BioEssays*, 26, 363–373.

Qazi, M. C. B., Heifetz, Y. & Wolfner, M. F. (2003) The developments between gametogenesis and fertilization: ovulation and female sperm storage in *Drosophila melanogaster*. *Developmental Biology*, 256, 195–211.

Qin, W., Chachich, M., Lane, M., Roth, G., Bryant, M., De Cabo, R., Ottinger, M. A., Mattison, J., Ingram, D., Gandy, S. & Pasinetti, G. M. (2006) Calorie restriction attenuates Alzheimer's disease type brain amyloidosis in Squirrel monkeys (*Saimiri sciureus*). *Journal of Alzheimer's Disease*, 10, 417–422.

Quinlan, R. J., Quinlan, M. B. & Flinn, M. V. (2003) Parental investment and age at weaning in a Caribbean village. *Evolution and Human Behavior*, 24, 1–17.

Qureshi, A. I., Giles, W. H., Croft, J. B. & Stern, B. J. (1997) Number of pregnancies and risk for stroke and stroke subtypes. *Archives of Neurology*, 54, 203–206.

Råberg, L., Sim, D. & Read, A. F. (2007) Disentangling genetic variation for resistance and tolerance to infectious diseases in animals. *Science*, 318, 812–814.

Råberg, L., Graham, A. L. & Read, A. F. (2009) Decomposing health: tolerance and resistance to parasites in animals. *Philosophical Transactions of the Royal Society of London B*, 364, 37–49.

Rachinsky, A., Strambi, C., Strambi, A. & Hartfelder, K. (1990) Caste and metamorphosis: hemolymph titers of juvenile hormone and ecdysteroids in last instar honeybee larvae. *General and Comparative Endocrinology*, 79, 31–38.

Radimerski, T., Montagne, J., Rintelen, F., Stocker, H., Van Der Kaay, J., Downes, C. P., Hafen, E. & Thomas, G. (2002) dS6k-regulated cell growth is dPKB/dPI(3)K-independent, but requires dPDK1. *Nature Cell Biology*, 4, 251–255.

Raff, R. A. & Byrne, M. (2006) The active evolutionary lives of echinoderm larvae. *Heredity*, 97, 244–252.

Raff, R. A. & Kaufman, T. C. (1983) *Embryos, Genes, and Evolution: Developmental-Genetic Basis of Evolutionary Change*. Bloomington, Indiana University Press,

Raine, J. C. & Leatherland, J. F. (2003) Trafficking of L-triiodothyronine between ovarian fluid and oocytes of rainbow trout (*Oncorhynchus mykiss*). *Comparative Biochemistry and Physiology B*, 136, 267–274.

Raine, J. C., Takemura, A. & Leatherland, J. F. (2001) Assessment of thyroid function in adult medaka (*Oryzias latipes*) and juvenile rainbow trout (*Oncorhynchus mykiss*) using immunostaining methods. *Journal of Experimental Zoology*, 290, 366–378.

Raine, J. C., Cameron, C., Vijayan, M. M., Lamarre, J. & Leatherland, J. F. (2004) The effect of elevated oocyte triiodothyronine content on development of rainbow trout embryos and expression of mRNA encoding for thyroid hormone receptors. *Journal of Fish Biology*, 65, 206–226.

Ramachandran, R. K., Widramanayake, A. H., Uzman, J. A., Govindarajan, V. & Tomlinson, C. R. (1997) Disruption of gastrulation and oral-aboral ectoderm differentiation in the *Lytechinus pictus* embryo by a dominant/negative PDGF receptor. *Development*, 124, 2355–2364.

Ramsey, K. M., Mills, K. F., Satoh, A. & Imai, S. (2008) Age-associated loss of Sirt1-mediated enhancement of glucose-stimulated insulin secretion in beta cell-specific Sirt1-overexpressing (BESTO) mice. *Aging Cell*, 7, 78–88.

Rassoulzadegan, F., Fenuaux, L. & Strathmann, R. R. (1984) Effect of flavor and size on selection of food by suspension-feeding plutei. *Limnology and Oceanography*, 29, 357–361.

Rathcke, B. & Lacey, E. P. (2003) Phenological patterns of terrestrial plants. *Annual Review of Ecology and Systematics*, 16, 179–214.

Ratnieks, F. L. W. (1993) Egg-laying, egg-removal, and ovary development by workers in queenright honey bee colonies. *Behavioral Ecology and Sociobiology*, 32, 191–198.

Rauschenbach, I. Y., Gruntenko, N. E., Bownes, M., Adonieva, N. V., Terashima, J., Karpova, E. K., Faddeeva, N. V. & Chentsova, N. A. (2004) The role of juvenile hormone in the control of reproductive function in *Drosophila virilis* under nutritional stress. *Journal of Insect Physiology*, 50, 323–330.

Rebeiz, M., Pool, J. E., Kassner, V. A., Aquadro, C. F. & Carroll, S. B. (2009) Stepwise modification of a modular enhancer underlies adaptation in a *Drosophila* population. *Science*, 326, 1663–1667.

Reber-Muller, S., Studer, R., Muller, P., Yanze, N. & Schmid, V. (2001) Integrin and talin in the jellyfish *Podocoryne carnea*. *Cell Biology International*, 25, 753–769.

Reboud, X. & Bell, G. (1997) Experimantal evolution in *Chamydomonas*. III. Evolution of specialist and generalist types in environments that vary in space and time. *Heredity*, 78, 507–514.

Reddy, P. K. & Lam, T. J. (1991) Effect of thyroid hormones on hatching in the tilapia, *Oreochromis mossambicus. General and Comparative Endocrinology*, 81, 484–491.

Reddy, P. K., Brown, C. L., Leatherland, J. F. & Lam, T. J. (1992) Role of thyroid hormones in tilapia larvae (*Oreochromis mossambicus*). 2. Changes in the hormones and 5′-monodeiodinase activity during development. *Fish Physiology and Biochemistry*, 9, 487–496.

Reed, W. L., Clark, M. E., Parker, P. G., Raouf, S. A., Arguedas, N., Monk, D. S., Snajdr, E., Nolan, V. & Ketterson, E. D. (2006) Physiological effects on demography: A long-term experimental study of testosterone's effects on fitness. *The American Naturalist*, 167, 667–683.

Reiling, J. H. & Hafen, E. (2004) The hypoxia-induced paralogs Scylla and Charybdis inhibit growth by downregulating S6K activity upstream of TSC in *Drosophila*. *Genes & Development*, 18, 2879–2892.

Reiner, D. J., Ailion, M., Thomas, J. H. & Meyer, B. J. (2008) *C. elegans* anaplastic lymphoma kinase ortholog SCD-2 controls dauer formation by modulating TGF-beta signaling. *Current Biology*, 18, 1101–1109.

Reiter, E. O. & Rosenfeld, R. G. (1998) Normal and aberrant growth. In Larsen, P. R., Kronenberg, H. M., Melmed, S. & Polonsky, K. S. (Eds.) *Williams Textbook of Endocrinology*. 9th edn. Philadelphia, Saunders.

Reitzel, A. M. & Heyland, A. (2007) Reduction in morphological plasticity in echinoid larvae: relationship of plasticity with maternal investment and food availability. *Evolutionary Ecology Research*, 9, 109–121.

Reitzel, A. M., Burton, P. M., Krone, C. & Finnerty, J. R. (2007) Comparison of developmental trajectories in the starlet sea anemone *Nematostella vectensis*: embryogenesis, regeneration, and two forms of asexual fission. *Invertebrate Biology*, 126, 99–112.

Reitzel, A. M., Sullivan, J. C., Traylor-Knowles, N. & Finnerty, J. R. (2008) Genomic survey of candidate stress-response genes in the estuarine anemone *Nematostella vectensis*. *Biological Bulletin*, 214, 233–254.

Reitzel, A. M., Daly, M., Sullivan, J. C. & Finnerty, J. R. (2009) Comparative anatomy and histology of developmental and parasitic stages in the life cycle of the lined sea anemone *Edwardsiella lineata*. *Journal of Parasitology*, 95, 100–112.

Rembold, H., Czoppelt, C. & Rao, P. J. (1974) Effect of juvenile hormone treatment on caste differentiation in the honeybee, *Apis mellifera*. *Journal of Insect Physiology*, 20, 1193–1202.

Remy, C. & Bounhiol, J. J. (1971) Normalized metamorphosis achieved by adrenocorticotropic hormone in hypophysectomized and thyroxined *Alytes* tadpoles. *Comptes Rendus Hebdomadaires des Seances de L'Academie des Sciences. Serie D: Sciences Naturelles*, 272, 455–458.

Rewitz, K. F., Yamanaka, N., Gilbert, L. I. & O'Connor, M. B. (2009) The insect neuropeptide PTTH activates receptor tyrosine kinase torso to initiate metamorphosis. *Science*, 326, 1403–1405.

Rey, B., Sibille, B., Romestaing, C., Belouze, M., Letexier, D., Servais, S., Barre, H., Duchamp, C. & Voituron, Y. (2008) Reptilian uncoupling protein: functionality and expression in sub-zero temperatures. *Journal of Experimental Biology*, 211, 1456–1462.

Reznick, D. (1985) Costs of Reproduction - an Evaluation of the Empirical-Evidence. *Oikos*, 44, 257–267.

Reznick, D., Nunney, L. & Tessier, A. (2000) Big houses, big cars, superfleas and the costs of reproduction. *Trends in Ecology & Evolution*, 15, 421–425.

Reznick, D., Bryant, M., Roff, D., Ghalambor, C. & Ghalambor, D. (2004) Effect of extrinsic mortality on the evolution of senescence in guppies. *Nature*, 431, 1095–1099.

Rice, W. R. & Chippindale, A. K. (2001) Intersexual ontogenetic conflict. *Journal of Evolutionary Biology*, 14, 685–693.

Richard, D. S., J. M. Jones, M. R. Barbarito, S. Cerula, J. P. Detweiler, S. J. Fisher, D. M. Brannigan, & D. M. Scheswohl. (2001) Vitellogenesis in diapausing and mutant *Drosophila melanogaster*: further evidence for the relative roles of ecdysteroids and juvenile hormones. *Journal of Insect Physiology*, 47, 905–913.

Richard, D. S., Rybczynski, R., Wilson, T. G., Wang, Y., Wayne, M. L., Zhou, Y., Partridge, L., & Harshman, L. G. (2005) Insulin signaling is necessary for vitellogenesis in *Drosophila melanogaster* independent of the roles of juvenile hormone and ecdysteroids: female sterility of the chico1 insulin signaling mutation is autonomous to the ovary. *Journal of Insect Physiology*, 51, 455–464.

Richardson, R. H. & Kojima, K. I. (1965) The kinds of genetic variability in relation to selection responses in *Drosophila* fecundity. *Genetics*, 52, 583–598.

Richardson, S. J., Aldred, A. R., Leng, S. L., Renfree, M. B., Hulbert, A. J. & Schreiber, G. (2002) Developmental profile of thyroid hormone distributor proteins in a marsupial, the tammar wallaby *Macropus eugenii*. *General and Comparative Endocrinology*, 125, 92–103.

Richardson, S. J., Monk, J. A., Shepherdley, C. A., Ebbesson, L. O. E., Sin, F., Power, D. M., Frappell, P. B., Kohrle, J. & Renfree, M. B. (2005) Developmentally regulated thyroid hormone distributor proteins in marsupials, a reptile, and fish. *American Journal of Physiology. Regulatory, Integrative and Comparative Physiology*, 288, R1264–R1272.

Ricklefs, R. E. (1974) Energetics of reproduction in birds. In Paynter JR., R. A. (Ed.) *Avian Energetics*. Cambridge, Nuttall Ornithological Club.

Ricklefs, R. (2006) Embryo development and aging in birds and mammals. *Proceedings of the Royal Society of London B*, 273, 2077–2082.

Ricklefs, R. E. & Wikelski, M. (2002) The physiology / life history nexus. *Trends in Ecology & Evolution*, 17, 462–468.

Riddiford, L. M. (1976) Hormonal control of insect epidermal cell commitment *in vitro*. *Nature*, 259, 115–117.

Riddiford, L. M. (1994) Cellular and molecular actions of juvenile hormone. I. General considerations and premetamorphic actions In Evans, P. D. (Ed.) *Advances in Insect Physiology*. London, Academic Press.

Riddiford, L. M. & Ashburner, M. (1991) Effects of juvenile hormone mimics on larval development and metamorphosis of *Drosophila melanogaster*. *General and Comparative Endocrinology*, 82, 172–183.

Rincon, M., Rudin, E. & Barzilai, N. (2005) The insulin/IGF-1 signaling in mammals and its relevance to human longevity. *Experimental Gerontology*, 40, 873–877.

Rinehart, J. P., Cikra-Ireland, R. A., Flannagan, R. D. & Denlinger, D. L. (2001) Expression of ecdysone receptor is unaffected by pupal diapause in the flesh fly, *Sarcophaga crassipalpis,* while its dimerization partner, USP, is downregulated. *Journal of Insect Physiology*, 47, 915–921.

Rinehart, J. P., Li, A., Yocum, G. D., Robich, R. M., Hayward, S. A. & Denlinger, D. L. (2007) Up-regulation of heat shock proteins is essential for cold survival during insect diapause. *Proceedings of the National Academy of Sciences of the United States of America*, 104, 11130–11137.

Rintelen, F., Stocker, H., Thomas, G. & Hafen, E. (2001) PDK1 regulates growth through Akt and S6K in *Drosophila*. *Proceedings of the National Academy of Sciences of the United States of America*, 98, 15020–15025.

Ritchie, J. W., Shi, Y. B., Hayashi, Y., Baird, F. E., Muchekehu, R. W., Christie, G. R. & Taylor, P. M. (2003) A role for thyroid hormone transporters in transcriptional regulation by thyroid hormone receptors. *Molecular Endocrinology*, 17, 653–661.

R'Kha, S., Moreteau, B., Coyne, J. A. & David, J. R. (1997) Evolution of a lesser fitness trait: egg production in the specialist *Drosophila sechelia*. *Genetical Research*, 69, 17–23.

Robert, K. A. & Bronikowski, A. M. (2010) Evolution of senescence in nature: physiological evolution in populations of garter snake with divergent life histories. *The American Naturalist*, 175, 147–159.

Robert, K. A., Brunet-Rossinni, A. & Bronikowski, A. M. (2007) Testing the 'free radical theory of aging' hypothesis: physiological differences in long-lived and short-lived Colubrid snakes. *Aging Cell*, 6, 395–404.

Robert, K., Vleck, C. & Bronikowski, A. (2009) The effects of maternal corticosterone levels on offspring behavior in fast- and slow-growth garter snakes (*Thamnophis elegans*). *Hormones and Behavior*, 55, 24–32.

Roberts, S. P. & Elekonich, M. M. (2005) Muscle biochemistry and the ontogeny of flight capacity during behavioral development in the honey bee, *Apis mellifera*. *The Journal of Experimental Biology*, 208, 4193–4198.

Roberts, M. L., Buchanan, K. L. & Evans, M. R. (2004) Testing the immunocompetence handicap hypothesis: a review of the evidence. *Animal Behaviour*, 68, 227–239.

Roberts, R. D., Kawamura, T. & Handley, C. M. (2007) Factors affecting settlement of abalone (*Haliotis iris*) larvae on benthic diatom films. *Journal of Shellfish Research*, 26, 323–334.

Robertson, A. (1968) The spectrum of genetic variation. In Lewontin, R. C. (Ed.) *Population Biology and Evolution*. Syracuse, Syracuse University Press.

Robertson, K. A. & Monteiro, A. (2005) Female *Bicyclus anynana* butterflies choose males on the basis of their dorsal UV-reflective eyespot pupils. *Proceedings of the Royal Society of London B*, 272, 1541–1546.

Robich, R. M., Rinehart, J. P., Kitchen, L. J. & Denlinger, D. L. (2007) Diapause-specific gene expression in the northern house mosquito, *Culex pipiens* L., identified by suppressive subtractive hybridization. *Journal of Insect Physiology*, 53, 235–245.

Rockman, M. V. (2008) Reverse engineering the genotype-phenotype map with natural genetic variation. *Nature*, 456, 738–44.

Rodgers, J. T., Lerin, C., Haas, W., Gygi, S. P., Spiegelman, B. M. & Puigserver, P. (2005) Nutrient control of glucose homeostasis through a complex of PGC-1α and SIRT1. *Nature*, 434, 113–118.

Rodolfo-Metalpa, R., Peirano, A., Houlbrèeue, F., Abbate, M. & Ferrier-Pagès, C. (2008) Effects of temperature, light and heterotrophy on the growth rate and budding of the temperate coral *Cladocora caespitosa*. *Coral Reefs*, 27, 17–25.

Roe, R. M., Jesudason, P., Venkatesh, K., Kallapur, V. L., Anspaugh, D. D., Majumder, C., Linderman, R. J. & Graves, D. M. (1993) Developmental role of juvenile-hormone metabolism in Lepidoptera. *American Zoologist*, 33, 375–383.

Roff, D. A. (1990) Selection for changes in the incidence of wing dimorphism in *Gryllus firmus*. *Heredity*, 65, 163–168.

Roff, D. A. (1992) *The Evolution of Life Histories: Theory and Analysis*. New York, Chapman & Hall.

Roff, D. A. (1997) *Evolutionary Quantitative Genetics*. New York, Chapman and Hall.

Roff, D. (2002) *Life History Evolution*. Sunderland, Sinauer Associates, Inc.

Roff, D. A. (2007a) A centennial celebration for quantitative genetics. *Evolution*, 61, 1017–1032.

Roff, D. A. (2007b) Contributions of genomics to life history theory. *Nature Reviews Genetics*, 8, 116–125.

Roff, D. A. & Fairbairn, D. J. (2007a) Laboratory evolution of the migratory polymorphism in the sand cricket: Combining physiology with quantitative genetics. *Physiological and Biochemical Zoology*, 80, 358–369.

Roff, D. A. & Fairbairn, D. J. (2007b) The evolution of trade-offs: where are we? *Journal of Evolutionary Biology*, 20, 433–447.

Rogina, B. & Helfand, S. L. (2004) Sir2 mediates longevity in the fly through a pathway related to calorie restriction. *Proceedings of the National Academy of Sciences of the United States of America*, 101, 15998–16003.

Rogina, B., Reenan, R. A., Nilsen, S. P. & Helfand, S. L. (2000) Extended life-span conferred by cotransporter gene mutations in *Drosophila*. *Science*, 290, 2137–2140.

Rogina, B., Helfand, S. L. & Frankel, S. (2002) Longevity regulation by *Drosophila* Rpd3 deacetylase and caloric restriction. *Science*, 298, 1745.

Roitberg, B. D. & Gordon, I. (2005) Does the Anopheles blood meal - fecundity curve, curve? *Journal of Vector Ecology*, 30, 83–86.

Rolff, J. & Siva-Jothy, M. T. (2002) Copulation corrupts immunity: A mechanism for a cost of mating in insects. *Proceedings of the National Academy of Sciences of the United States of America*, 99, 9916–9918.

Rolff, J. & Siva-Jothy, M. T. (2003) Invertebrate ecological immunology. *Science*, 301, 472–475.

Roney, J. R., Mahler, S. V. & Maestripieri, D. (2003) Behavioral and hormonal responses of men to brief interactions with women. *Evolution and Human Behavior*, 24, 365–375.

Rose, M. R. (1984) Laboratory selection of postponed senescence in *Drosophila melanogaster*. *Evolution*, 38, 1003–1010.

Rose, M. R. (1991) *Evolutionary Biology of Aging*. New York, Oxford University Press.

Rose, M. R. & Bradley, T. J. (1998) Evolutionary physiology of the cost of reproduction. *Oikos*, 83, 443–451.

Rose, M. R. & Charlesworth, B. (1981) Genetics of life history in *Drosophila melanogaster*. II. Exploratory selection experiments. *Genetics*, 97, 187–196.

Rose, M. R., Drapeau, M. D., Yazdi, P. G., Sahah, K. H., Moise, D. B., Thaker, R. R., Rauser, C. L. & Mueller, L. D. (2002) Evolution of late-life mortality in *Drosophila melanogaster*. *Evolution*, 56, 1982–1991.

Rosenberg, K. (2004) Living longer: Information revolution, population expansion, and modern human origins. *Proceedings of the National Academy of Sciences of the United States of America*, 101, 10847–10848.

Rosenberg, K. & Trevathan, W. (2002) Birth, obstetrics and human evolution. *BJOG: An International Journal of Obstetrics and Gynaecology*, 109, 1199–1206.

Rosenkilde, P. & Ussing, A. P. (1996) What mechanisms control neoteny and regulate induced metamorphosis in Urodeles? *International Journal of Developmental Biology*, 40, 665–673.

Rosenkilde, P., Mogensen, E., Centervall, G. & Jorgensen, O. S. (1982) Peaks of neuronal membrane antigen and thyroxine in larval development of the Mexican axolotl. *General and Comparative Endocrinology*, 48, 504–514.

Rosenstiel, P., Philipp, E. E. R., Schreiber, S. & Bosch, T. C. G. (2009) Evolution and function of innate immune receptors - insights from marine invertebrates. *Journal of Innate Immunity*, 1, 291–300.

Roskam, J. C. & Brakefield, P. M. (1999) Seasonal polyphenism in *Bicyclus* (Lepidoptera: Satyridae) butterflies: different climates need different cues. *Biological Journal of the Linnean Society*, 66, 345–356.

Rosta, K., Molvarec, A., Enzsoly, A., Nagy, B., Ronai, Z., Fekete, A., Sasvari-Szekely, M., Rigo, J., JR. & Ver, A. (2009) Association of extracellular superoxide dismutase (SOD3) Ala40Thr gene polymorphism with pre-eclampsia complicated by severe fetal growth restriction. *European Journal of Obstetrics, Gynecology, and Reproductive Biology*, 142, 134–138.

Roth, G. S., Ingram, D. K. & Lane, M. A. (1999) Calorie restriction in primates: will it work and how will we know? *Journal of the American Geriatrics Society*, 47, 896–903.

Rottiers, V. & Antebi, A. (2006) Control of *Caenorhabditis elegans* life history by nuclear receptor signal transduction. *Experimental Gerontology*, 41, 904–909.

Röttinger, E., Saudemont, A., Duboc, V., Bensnardeau, L., McClay, D. R. & Lepage, T. (2008) FGF signals guide migration of mesenchymal cells, control skeletal morphogenesis of the skeleton and regulate gastrulation during sea urchin development. *Development*, 135, 353–365.

Roughgarden, J. (1988) The evolution of marine life cycles. In M. W. Feldman (Ed.) *Mathematical Evolutionary Theory*. Princeton, Princeton University Press.

Rountree, D. B. & Bollenbacher, W. E. (1986) The release of the prothoracicotropic hormone in the tobacco hornworm, *Manduca sexta*, is controlled intrinsically by juvenile hormone. *Journal of Experimental Biology*, 120, 41–58.

Roux, E. A., Roux, M. & Korb, J. (2009) Selection on defensive traits in a sterile caste - caste evolution: a mechanism to overcome life history trade-offs? *Evolution & Development*, 11, 80–87.

Rowe, L. & Day, T. (2006) Detecting sexual conflict and sexually antagonistic coevolution. *Philosophical Transactions of the Royal Society of London B*, 361, 277–285.

Royet, J. & Dziarski, R. (2007) Peptidoglycan recognition proteins: pleiotropic sensors and effectors of antimicrobial defences. *Nature Reviews Microbiology*, 5, 264–277.

Rudzinska, M. A. (1951) The influence of amount of food on the reproduction rate and longevity of a sectarian (*Tokophyra infusionum*). *Science*, 113, 10–11.

Ruebenbauer, A., Schlyter, F., Hansson, B. S., Lofstedt, C. & Larsson, M. C. (2008) Genetic variability and robustness of host odor preference in *Drosophila melanogaster*. *Current Biology*, 18, 1438–1443.

Rueppell, O., Christine, S., Mulcrone, C. & Groves, L. (2007) Aging without functional senescence in honey bee workers. *Current Biology*, 17, R274–R275.

Rueppell, O., Linford, R., Gardner, P., Coleman, J. & Fine, K. (2008) Aging and demographic plasticity in response to experimental age structures in honeybees (*Apis mellifera L*). *Behavioral Ecology and Sociobiology*, 62, 1621–1631.

Ruff, C. B. (2002) Variation in human body size and shape. *Annual Review of Anthropology*, 31, 211–232.

Rulifson, E. J., Kim, S. K. & Nusse, R. (2002) Ablation of insulin-producing neurons in flies: growth and diabetic phenotypes. *Science*, 296, 1118–1120.

Ruppell, O., Pankiw, T. & Page, R. E. J. (2004) Pleiotropy, epistasis and new QTL: The genetic architecture of honey bee foraging behavior. *Journal of Heredity*, 95, 481–491.

Russell, D. W. (2003) The enzymes, regulation, and genetics of bile acid synthesis. *Annual Review of Biochemistry*, 72, 137–174.

Russell, S. J. & Kahn, C. R. (2007) Endocrine regulation of aging. *Nature Reviews Molecular Cell Biology*, 8, 681–691.

Ryan, J. & Baxevanis, A. (2007) Hox, Wnt, and the evolution of the primary body axis: insights from the early-divergent phyla. *Biology Direct*, 2, 37.

Ryan, J. F., Mazza, M. E., Pang, K., Matus, D. Q., Baxevanis, A. D., Martindale, M. Q. & Finnerty, J. R. (2007) Pre-Bilaterian origins of the Hox cluster and the Hox code: evidence from the sea anemone, *Nematostella vectensis*. *PLoS One*, 2, e153.

Rybczynski, R., Bell, S. C. & Gilbert, L. I. (2001) Activation of an extracellular signal-regulated kinase (ERK) by the insect prothoracicotropic hormone. *Molecular and Cellular Endocrinology*, 184, 1–11.

Ryu, J. H., Ha, E. M., Oh, C. T., Seol, J. H., Brey, P. T., Jin, I., Lee, D. G., Kim, J., Lee, D. & Lee, W. J. (2006) An essential complementary role of NF-kappaB pathway to microbicidal oxidants in *Drosophila* gut immunity. *EMBO Journal*, 25, 3693–3701.

Ryu, J. H., Kim, S. H., Lee, H. Y., Bai, J. Y., Nam, Y. D., Bae, J. W., Lee, D. G., Shin, S. C., Ha, E. M. & Lee, W. J. (2008) Innate immune homeostasis by the homeobox gene caudal and commensal-gut mutualism in *Drosophila*. *Science*, 319, 777–782.

Saastamoinen, M., van der Sterren, D., Vastenhout, N., Zwaan, B. J., and Brakefield, P. M. (2010). Predictive adaptive responses: Condition-dependent impact of adult nutrition and flight in the tropical butterfly, *Bicyclus anynana. American Naturalist* 176: 686–698.

Saccone, G., Pane, A. & Polito, L. C. (2002) Sex determination in flies, fruitflies and butterflies. *Genetica*, 116, 15–23.

Sackton, T. B., Lazzaro, B. P., Schlenke, T. A., Evans, J. D., Hultmark, D. & Clark, A. G. (2007) Dynamic evolution of the innate immune system in *Drosophila*. *Nature Genetics*, 39, 1461–1468.

Sadd, B. M. & Siva-Jothy, M. T. (2006) Self-harm caused by an insect's innate immunity. *Proceedings of the Royal Society of London B*, 273, 2571–2574.

Saito, M., Seki, M., Amemiya, S., Yamasu, K., Suyemitsu, T. & Ishihara, K. (1998) Induction of metamorphosis in the sand dollar *Peronella japonica* by thyroid hormones. *Development, Growth & Differentiation*, 40, 307–312.

Sakai, K. L. (2005) Language acquisition and brain development. *Science*, 310, 815–819.

Sakamoto, T. & Hirano, T. (1993) Expression of insulin-like growth factor-I gene in osmoregulatory organs during seawater adaptation of the salmonid fish: Possible mode of osmoregulatory action of growth hormone. *Proceedings of the National Academy of Sciences of the United States of America*, 90, 1912–1916.

Sakamoto, T., McCormick, S. D. & Hirano, T. (1993) Osmoregulatory actions of growth hormone and its mode of action in salmonids: A review. *Fish Physiology and Biochemistry*, 11, 155–164.

Salih, D. A. & Brunet, A. (2008) FoxO transcription factors in the maintenance of cellular homeostasis during aging. *Current Opinion in Cell Biology*, 20, 126–136.

Salmon, A. B., Marx, D. B. & Harshman, L. G. (2001) A cost of reproduction in *Drosophila melanogaster*: Stress susceptibility. *Evolution*, 55, 1600–1608.

Samis, K. E., Heath, K. D. & Stinchcombe, J. R. (2008) Discordant longitudinal clines in flowering time and *PHYTOCHROME C* in *Arabidopsis thaliana*. *Evolution*, 62, 2971–2983.

Sanchez-Blanco, A., Fridell, Y. W. & Helfand, S. L. (2005) Involvement of *Drosophila* uncoupling protein 5 in metabolism and aging. *Genetics*, 172, 1699–1710.

Sandrelli, F., Tauber, E., Pegoraro, M., Mazzotta, G., Cisotto, P., Landskron, J., Stanewsky, R., Piccin, A., Rosato, E., Zordan, M., Costa, R. & Kyriacou, C. P. (2007) A molecular basis for natural selection at the timeless locus in *Drosophila melanogaster*. *Science*, 316, 1898–1900.

Santos, C. R. A. & Power, D. M. (1999) Identification of transthyretin in fish (*Sparus aurata*): cDNA cloning and characterisation. *Endocrinology*, 140, 2430–2433.

Sato, Y., Buchholz, D. R., Paul, B. D. & Shi, Y. B. (2007) A role of unliganded thyroid hormone receptor in postembryonic development in *Xenopus laevis*. *Mechanisms of Development*, 124, 476–488.

Satterlee, D. G. & Johnson, W. A. (1988) Selection of Japanese quail for contrasting blood corticosterone response to immobilization. *Poultry Science*, 67, 25–32.

Satuito, C. G., Natoyama, K., Yamazaki, M., Shimizu, K. & Fusetani, N. (1999) Induction of metamorphosis in the pediveliger larvae of the mussel *Mytilus galloprovincialis* by neuroactive compounds. *Fisheries Science*, 65, 384–389.

Saunders, D. S. (2002) *Insect Clocks*. Amsterdam, Elsevier.

Saunders, D. S., Henrich, V. C. & Gilbert, L. I. (1989) Induction of diapause in *Drosophila melanogaster*: photoperiodic regulation and the impact of arrhythmic clock mutations on time measurement. *Evolution*, 86, 3748–3752.

Saunders, D. S., Richard, D. S., Applebaum, S. W., Ma, M. & Gilbert, L. I. (1990) Photoperiodic diapause in *Drosophila melanogaster* involves a block to the juvenile hormone regulation of ovarian maturation. *General and Comparative Endocrinology*, 79, 174–184.

Savage-Dunn, C. (2005) TGF-beta signaling. In The *C. elegans* Research Community (Ed.) *WormBook*, doi/10.1895/wormbook.1.7.1, http://www.wormbook.org.

Sbrenna-Micciarelli, A. (1977) Effects of farnesyl methyl ether on embryos of *Schistocerca gregaria* (Orthoptera). *Acta Embryologiae et Morphologiae Experimentali*, 3, 295–303.

Scarborough, C. L., Ferrari, J. & Godfray, H. C. J. (2005) Aphid protected from pathogen by endosymbiont. *Science*, 310, 1781.

Scarcelli, N., Cheverud, J. M., Schaal, B. A. & Kover, P. X. (2007) Antagonistic pleiotropic effects reduce the potential adaptive value of the *FRIGIDA* locus. *Proceedings of the National Academy of Sciences of the United States of America*, 104, 16986–16991.

Scarpulla, R. C. (2002) Nuclear activators and coactivators in mammalian mitochondrial biogenesis. *Biochimica et Biophysica Acta (BBA) - Gene Structure and Expression*, 1576, 1–14.

Schaller, F. & Charlet, M. (1980) Neuroendocrine control and rate of ecdysone biosynthesis in larvae of a paleopteran insect: *Aeshna cyanea* Muler. In Hoffman, J. A. (Ed.) *Progress in Ecdysone Research*. Amsterdam, Elsevier.

Schilder, R. J. & Marden, J. H. (2006) Metabolic syndrome and obesity in an insect. *Proceedings of the National Academy of Sciences of the United States of America*, 103, 18805–18809.

Schippers, M. P., Dukas, R., Smith, R. W., Wang, J., Smolen, K. & McClelland, G. B. (2006) Lifetime performance in foraging honeybees: behaviour and physiology. *Journal of Experimental Biology*, 209, 3828–3836.

Schläppi, M. R. (2006) *FRIGIDA LIKE 2* is a functional allele in Landsberg erecta and compensates for a nonsense allele of *FRIGIDA LIKE 1*. *Plant Physiology*, 142, 1728–1738.

Schlenke, T. A. & Begun, D. J. (2003) Natural selection drives *Drosophila* immune system evolution. *Genetics*, 164, 1471–1480.

Schlichting, C. & Pigliucci, M. (1998) *Phenotypic Evolution: A Reaction Norm Perspective*. Sunderland, Sinauer.

Schlinger, B. A. (1997) The activity and expression of aromatase in songbirds. *Brain Research*, 44, 359–364.

Schlinger, B. A. & London, S. E. (2006) Neurosteroids and the songbird model system. *Journal of Experimental Zoology A*, 305, 743–748.

Schlosser, G. & Wagner, G. P. (2004) The modularity concept in developmental and evolutionary biology. In Schlosser, G. & Wagner, G. P. (Eds.) *Modularity in Development and Evolution*. Chicago, University of Chicago Press.

Schluter, D., Clifford, E. A., Nemethy, M. & McKinnon, J. S. (2004) Parallel evolution and inheritance of quantitative traits. *The American Naturalist*, 163, 809–822.

Schmid-Hempel, P. (2003) Variation in immune defence as a question of evolutionary ecology. *Proceedings of the Royal Society of London B*, 270, 357–366.

Schmid-Hempel, P. (2005) Evolutionary ecology of insect immune defenses. *Annual Review of Entomology*, 50, 529–551.

Schmidt, H. (1970) *Anthopleura stellula* (Actiniaria: Actiniidae) and its reproduction by transverse fission. *Marine Biology*, 5, 245–255.

Schmidt, P. S. & Conde, D. R. (2006) Environmental heterogeneity and the maintenance of genetic variation for reproductive diapause in *Drosophila melanogaster*. *Evolution*, 60, 1602–1611.

Schmidt, P. S. & Paaby, A. B. (2008) Reproductive diapause and life history clines in North American populations of *Drosophila melanogaster*. *Evolution*, 62, 1204–1215.

Schmidt, P. S., Duvernell, D. D. & Eanes, W. F. (2000) Adaptive evolution of a candidate gene for aging in *Drosophila*. *Proceedings of the National Academy of Sciences of the United States of America*, 97, 10861–10865.

Schmidt, P. S., Matzkin, L. M., Ippolito, M. & Eanes, W. F. (2005a) Geographic variation in diapause incidence, life history traits and climatic adaptation in *Drosophila melanogaster. Evolution*, 59, 1721–1732.

Schmidt, P. S., Paaby, A. B. & Heschel, M. S. (2005b) Genetic variance for diapause expression and associated life histories in *Drosophila melanogaster*. *Evolution*, 59, 2616–2625.

Schmidt, P. S., Zhu, C. T., Das, J., Batavia, M., Yang, L. & Eanes, W. F. (2008) An amino acid polymorphism in the *couch potato* gene forms the basis for climatic adaptation in *Drosophila melanogaster*. *Proceedings of the National Academy of Sciences of the United States of America*, 105, 16207–16211.

Schmidt-Nielsen, K. (1984) *Scaling: why is animal size so important?* Cambridge, Cambridge University Press.

Schmitt, J. & Wulff, R. D. (1993) Light spectral quality, phytochrome, and plant competition. *Trends in Ecology & Evolution*, 8, 47–51.

Schneider, D. S. (2007) How and why does a fly turn its immune system off? *PLoS Biology*, 5, e247.

Schneider, D. S. & Ayres, J. S. (2008) Two ways to survive infection: what resistance and tolerance can teach us about treating infectious diseases. *Nature Reviews Immunology*, 8, 889–895.

Schneider, T. & Leitz, T. (1994) Protein kinase C in Hydrozoans – Involvement in metamorphosis of Hydractinia and in pattern-formation of Hydra. *Roux's Archives of Developmental Biology*, 203, 422–428.

Schneider, D. S., Ayres, J. S., Brandt, S. M., Costa, A., Dionne, M. S., Gordon, M. D., Mabery, E. M., Moule, M. G., Pham, L. N. & Shirasu-Hiza, M. M. (2007) *Drosophila eiger* mutants are sensitive to extracellular pathogens. *PLoS Pathogens*, 3, e41.

Schoech, S. J. & Hahn, T. P. (2008) Latitude affects degree of advancement in laying by birds in response to food supplementation: a meta-analysis. *Oecologia*, 157, 369–376.

Schoenmaker, M., De Craen, A. J., De Meijer, P. H., Beekman, M., Blauw, G. J., Slagboom, P. E. & Westendorp, R. G. (2006) Evidence of genetic enrichment for exceptional survival using a family approach: the Leiden Longevity Study. *European Journal of Human Genetics*, 14, 79–84.

Schoneberg, T., Hofreiter, M., Schulz, A. & Rompler, H. (2007) Learning from the past: evolution of GPCR functions. *Trends in Pharmacological Sciences*, 28, 117–121.

Schradin, C. & Anzenberger, G. (1999) Prolactin, the hormone of paternity. *News in Psychological Sciences*, 14, 223–231.

Schram, F. R. & Koenemann, S. (2001) Developmental genetics and arthropod evolution: part 1, on legs. *Evolution & Development*, 3, 343–354.

Schranz, E. M., Windsor, A. J., Song, B. H., Lawton-Rauh, A. & Mitchell-Olds, T. (2007) Comparative genetic mapping in *Boechera stricta*, a close relative of *Arabidopsis*. *Plant Physiology*, 144, 286–298.

Schreiber, A. M. & Specker, J. L. (1998) Metamorphosis in the summer flounder (*Paralichthys dentatus*): Stage-specific developmental response to altered thyroid status. *General and Comparative Endocrinology*, 111, 156–166.

Schreiber, A. M. & Specker, J. L. (1999a) Early larval development and metamorphosis in the summer flounder: changes in per cent whole-body water content and effects of altered thyroid status. *Journal of Fish Biology*, 55, 148–157.

Schreiber, A. M. & Specker, J. L. (1999b) Metamorphosis in the summer flounder *Paralichthys dentatus*: Changes in gill mitochondria-rich cells. *Journal of Experimental Biology*, 202, 2475–2484.

Schreiber, A. M. & Specker, J. L. (1999c) Metamorphosis in the summer flounder, *Paralichthys dentatus*: Thyroidal status influences salinity tolerance. *Journal of Experimental Zoology*, 284, 414–424.

Schulz, D. J. & Robinson, G. E. (1999) Biogenic amines and division of labor in honey bee colonies: behaviorally related changes in the antennal lobes and age-related changes in the mushroom bodies. *Journal of Comparative Physiology A*, 184, 481–488.

Schulz, D. J., Sullivan, J. P. & Robinson, G. E. (2002) Juvenile hormone and octopamine in the regulation of division of labor in honey bee colonies. *Hormones and Behavior*, 42, 222–231.

Schwartz, T. S., Murray, S. & Seebacher, F. (2008) Novel reptilian uncoupling proteins: molecular evolution and gene expression during cold acclimation. *Proceedings of the Royal Society of London B*, 275, 979–985.

Schwarz, J., Brokstein, P., Voolstra, C., Terry, A., Miller, D., Szmant, A., Coffroth, M. & Medina, M. (2008) Coral life history and symbiosis: functional genomic resources for two reef building Caribbean corals, *Acropora palmata* and *Montastraea faveolata*. *BMC Genomics*, 9, 97.

Scott, N. M., Haussmann, M. F., Elsey, R. M., Trosclair, P. L. & Vleck, C. M. (2006) Telomere length shortens with body length in *Alligator mississippiensis*. *Southeastern Naturalist*, 5, 685–692.

Sear, R., Mace, R. & McGregor, I. A. (2000) Maternal grandmothers improve the nutritional status and survival of children in rural Gambia. *Proceedings of the Royal Society of London B*, 267, 1641–1647.

Sebens, K. P. (1980) The regulation of asexual reproduction and indeterminate body size in the sea anemone *Anthopleura elegantissima*. *Biological Bulletin*, 158, 152–171.

Sebens, K. P. (1982a) Asexual reproduction in *Anthopleura elegantissima* (Anthozoa: Actiniaria): seasonality and spatial extent of clones. *Ecology*, 63, 434–444.

Sebens, K. P. (1982b) The limits to indeterminate growth: an optimal size model applied to passive suspension feeders. *Ecology*, 63, 209–222.

Sebens, K. P. (2002) Energetic constraints, size gradients, and size limits in benthic marine invertebrates. *Integrative and Comparative Biology*, 42, 853–861.

Secor, S. (2009) Specific dynamic action: a review of the postprandial metabolic response. *Journal of Comparative Physiology B*, 179, 1–56.

Seebacher, F. (2005) A review of thermoregulation and physiological performance in reptiles: what is the role of phenotypic flexibility? *Journal of Comparative Physiology B*, 175, 453–461.

Seebacher, F. & Murray, S. A. (2007) Transient receptor potential ion channels control thermoregulatory behaviour in reptiles. *PLoS One*, 2, e281.

Seehuus, S. C., Krekling, T. & Amdam, G. V. (2006a) Cellular senescence in honey bee brain is largely independent of chronological age. *Experimental Gerontology*, 41, 1117–1125.

Seehuus, S. C., Norberg, K., Gimsa, U., Krekling, T. & Amdam, G. V. (2006b) Reproductive protein protects functionally sterile honey bee workers from oxidative stress. *Proceedings of the National Academy of Sciences of the United States of America*, 103, 962–967.

Seeley, T. D. (1989) The honey bee colony as a superorganism. *American Scientist*, 77, 546–553.

Segre, A. V., Murray, A. W. & Leu, J. Y. (2006) High-resolution mutation mapping reveals parallel experimental evolution in yeast. *PLoS Biology*, 4, 1372–1385.

Sehnal, F., Svacha, P. & Zrzavy, J. (1996) Evolution of insect metamorphosis. In Gilbert, L. I., Tata, J. R. & Atkinson, B. G. (Eds.) *Metamorphosis*. San Diego, Academic Press.

Selman, C., Lingard, S., Choudhury, A. I., Batterham, R. L., Claret, M., Clements, M., Ramadani, F., Okkenhaug, K., Schuster, E., Blanc, E., Piper, M. D., Al-Qassab, H., Speakman, J. R., Carmignac, D., Robinson, I. C., Thornton, J. M., Gems, D., Partridge, L. & Withers, D. J. (2008) Evidence for lifespan extension and delayed age-related biomarkers in insulin receptor substrate 1 null mice. *FASEB Journal*, 22, 807–818.

Sempere, L. F., Sokol, N. S., Dubrovsky, E. B., Berger, E. M. & Ambros, V. (2003) Temporal regulation of microRNA expression in *Drosophila melanogaster* mediated by hormonal signals and broad-Complex gene activity. *Developmental Biology*, 259, 9–18.

Serhan, C. N. & Savill, J. (2005) Resolution of inflammation: the beginning programs the end. *Nature Immunology*, 6, 1191–1197.

Sewell, M. A., Cameron, M. J. & McArdle, B. H. (2004) Developmental plasticity in larval development in the echinometrid sea urchin *Evechinus chloroticus* with varying food ration. *Journal of Experimental Marine Biology and Ecology*, 309, 219–237.

Sezgin, E., Duvernell, D. D., Matzkin, L. M., Duan, Y., Zhu, C. T., Verrelli, B. C. & Eanes, W. F. (2004) Single-locus latitudinal clines and their relationship to temperate adaptation in metabolic genes and derived alleles in *Drosophila melanogaster*. *Genetics*, 168, 923–931.

Sfakianaki, A. K. & Norwitz, E. R. (2006) Mechanisms of progesterone action in inhibiting prematurity. *Journal of Maternal-Fetal & Neonatal Medicine*, 19, 763–772.

Sgrò, C. M. & Partridge, L. (1999) A delayed wave of death from reproduction in *Drosophila*. *Science*, 286, 2521–2524.

Sgrò, C. M. & Partridge, L. (2000) Evolutionary Responses of the Life History of Wild Caught *Drosophila melanogaster* to Two Standard Methods of Laboratory Culture. *The American Naturalist*, 156, 341–353.

Shamay-Tsoory, S. G., Tomer, R. & Aharon-Peretz, J. (2005) The neuroanatomical basis of understanding sarcasm and its relationship to social cognition. *Neuropsychology*, 19, 288–300.

Shanley, D. P. & Kirkwood, T. B. L. (2000) Calorie restriction and aging: a life history analysis. Evolution 54: 740–750.

Shanley, D. P. & Kirkwood, T. B. L. (2001) Caloric restriction, life history evolution, and bioenergetics, response to Mitteldorf. *Evolution*, 55, 1906–1906.

Shanley, D. P. & Kirkwood, T. B. (2006) Caloric restriction does not enhance longevity in all species and is unlikely to do so in humans. *Biogerontology*, 7, 165–168.

Shapiro, A. M. (1976) Seasonal polyphenism. *Evolutionary Biology*, 9, 259–333.

Shaw, W. M., Luo, S., Landis, J., Ashraf, J. & Murphy, C. T. (2007) The *C. elegans* TGF-beta dauer pathway regulates longevity via insulin signaling. *Current Biology*, 17, 1635–1645.

Sheaffer, K. L., Updike, D. L. & Mango, S. E. (2008) The target of rapamycin pathway antagonizes *pha-4/FoxA* to control development and aging. *Current Biology*, 18, 1355–1364.

Sheldon, B. C. & Verhulst, S. (1996) Ecological immunology: costly parasite defenses and trade-offs in evolutionary ecology. *Trends in Ecology & Evolution*, 11, 317–321.

Sheldon, C. C., Rouse, D. T., Finnegan, E. J., Peacock, W. J. & Dennis, E. S. (2000) The molecular basis of vernalization: The central role of *FLOWERING LOCUS C* (*FLC*). *Proceedings of the National Academy of Sciences of the United States of America*, 97, 3753–3758.

Shemshedini, L. & Wilson, T. G. (1990) Resistance to juvenile hormone and an insect growth regulator in *Drosophila* is associated with an altered cytosolic juvenile hormone binding protein. *Proceedings of the National Academy of Sciences of the United States of America*, 87, 2072–2076.

Shenk, M. A., Bode, H. R. & Steele, R. E. (1993) Expression of Cnox-2, a HOM/HOX homeobox gene in hydra, is correlated with axial pattern formation. *Development*, 117, 657–667.

Sherman, C. D. H. & Ayre, D. J. (2008) Fine-scale adaptation in a clonal sea anemone. *Evolution*, 62, 1373–1380.

Shi, Y.-B. (1999) *Amphibian Metamorphosis: From morphology to molecular biology*. New York, Wiley-Liss.

Shi, Y. B. (2009) Dual functions of thyroid hormone receptors in vertebrate development: the roles of histone-modifying cofactor complexes. *Thyroid*, 19, 987–999.

Shi, Y. B., Liang, V. C., Parkison, C. & Cheng, S. Y. (1994) Tissue-dependent developmental expression of a cytosolic thyroid hormone protein gene in Xenopus: its role in the regulation of amphibian metamorphosis. *FEBS Letters*, 355, 61–64.

Shi, Y., Hon, M. & Evans, R. M. (2002) The peroxisome proliferator-activated receptor delta, an integrator of transcriptional repression and nuclear receptor signaling. *Proceedings of the National Academy of Sciences of the United States of America*, 99, 2613–2618.

Shiao, J. C. & Hwang, P. P. (2006) Thyroid hormones are necessary for the metamorphosis of tarpon *Megalops cyprinoides* leptocephali. *Journal of Experimental Marine Biology and Ecology*, 331, 121–132.

Shick, J. M. (1991) *A Functional Biology of Sea Anemones*. London, New York, Chapman & Hall.

Shick, J. M., Hoffmann, R. J. & Lamb, A. N. (1979) Asexual reproduction, population structure, and genotype-environment interactions in sea anemones. *American Zoologist*, 19, 699–713.

Shifren, J. L., Braunstein, G. D., Simon, J. A., Casson, P. R., Buster, J. E., Redmond, G. P., Burki, R. E., Ginsburg, E. S., Rosen, R. C., Leiblum, S. R., Caramelli, K. E. & Mazer, N. A. (2000) Transdermal testosterone treatment in women with impaired sexual function after oophorectomy. *New England Journal of Medicine*, 343, 682–688.

Shimizu, K. K. & Purugganan, M. D. (2005) Evolutionary and ecological genomics of Arabidopsis. *Plant Physiology*, 138, 578–84.

Shimizu, K., Hunter, E. & Fusetani, N. (2000) Localisation of biogenic amines in larvae of *Bugula neritina* (Bryozoa: Cheilostomatida) and their effects on settlement. *Marine Biology*, 136, 1–9.

Shindo, C., Aranzana, M. J., Lister, C., Baxter, C., Nicholls, C., Nordborg, M. & Dean, C. (2005) Role of *FRIGIDA* and *FLOWERING LOCUS C* in determining variation in flowering time of *Arabidopsis*. *Plant Physiology*, 138, 1163–1173.

Shine, R. (2005) Life history evolution in reptiles. *Annual Review of Ecology, Evolution, and Systematics*, 36, 23–46.

Shine, R. & Madsen, T. (1997) Prey abundance and predator reproduction: Rats and pythons on a tropical Australian floodplain. *Ecology*, 78, 1078–1086.

Shingleton, A. W. (2005) Body-size regulation: combining genetics and physiology. *Current Biology*, 15, R825–R827.

Shingleton, A. W. (2010) The regulation of organ size in *Drosophila*: Physiology, plasticity, patterning and physical force. *Organogenesis*, 6, 1–13.

Shingleton, A. W., Das, J., Vinicius, L. & Stern, D. L. (2005) The temporal requirements for insulin signaling during development in *Drosophila*. *PLoS Biology*, 3, e289.

Shingleton, A. W., Frankino, W. A., Flatt, T., Nijhout, H. F. & Emlen, D. J. (2007) Size and shape: The developmental regulation of static allometry in insects. *BioEssays*, 29, 536–548.

Shingleton, A. W., Mirth, C. K. & Bates, P. W. (2008) Developmental model of static allometry in holometabolous insects. *Proceedings of the Royal Society of London B*, 275, 1875–1885.

Shingleton, A. W., Estep, C. M., Driscoll, M. V. & Dworkin, I. (2009) Many ways to be small: different environmental regulators of size generate distinct scaling relationships in *Drosophila melanogaster*. *Proceedings of the Royal Society of London B*, 276, 2625–2633.

Shintani, N., Nohira, T., Hikosaka, A. & Kawahara, A. (2002) Tissue-specific regulation of type III iodothyronine 5-deiodinase gene expression mediates the effects of prolactin and growth hormone in *Xenopus* metamorphosis. *Development, Growth & Differentiation*, 44, 327–335.

Shiomi, K. & Yamaguchi, M. (2008) Expression patterns of three *Par*-related genes in sea urchin embryos. *Gene Expression Patterns*, 8, 323–330.

Shoguchi, E., Yharada, Y., Numakunai, T. & Satoh, N. (2000) Expression of the Otx gene in the ciliary bands during sea cucumber embryogenesis. *Genesis*, 27, 58–63.

Short, S. M. & Lazzaro, B. P. (2010) Female and male genetic contributions to female post-mating susceptibility to infection in *Drosophila melanogaster. Proceedings of the Royal Society, B: Biological Sciences*, 277: 3649–3657.

Shostak, S. (1993) Studies of asexual reproduction in Cnidaria. In Adiyodi, K. G. & Adiyodi, R. G. (Eds.) *Reproductive Biology of Invertebrates*. New York, John Wiley and Sons.

Sibly, R. & Calow, P. (1986) Why breeding earlier is always worthwhile. *Journal of Theoretical Biology*, 123, 311–319.

Siedlinski, M., Van Diemen, C. C., Postma, D. S., Vonk, J. M. & Boezen, H. M. (2009) Superoxide dismutases, lung function and bronchial responsiveness in a general population. *European Respiratory Journal*, 33, 986–992.

Siefker, B., Kroiher, M. & Berking, S. (2000) Induction of metamorphosis from the larval to the polyp stage is similar in Hydrozoa and a subgroup of Scyphozoa (Cnidaria, Semaeostomeae). *Helgoland Marine Research*, 54, 230–236.

Siegal, M. & Varley, R. (2002) Neural systems involved with 'Theory of Mind'. *Nature Reviews Neuroscience*, 3, 463–471.

Silbermann, R. & Tatar, M. (2000) Reproductive costs of heat shock protein in transgenic *Drosophila melanogaster*. *Evolution*, 54, 2038–2045.

Silverin, B., Baillien, M., Foidart, A. & Balthazart, J. (2000) Distribution of aromatase activity in the brain and peripheral tissue of passerine and nonpasserine avian species. *General and Comparative Endocrinology*, 117, 34–53.

Sim, C. & Denlinger, D. L. (2008) Insulin signaling and FOXO regulate the overwintering diapause of the mosquito *Culex pipiens*. *Proceedings of the National Academy of Sciences of the United States of America*, 105, 6777–6781.

Simandle, E. T., Espinoza, R. E., Nussear, K. E. & Tracy, C. R. (2001) Lizards, lipids, and dietary links to animal function. *Physiological and Biochemical Zoology*, 74, 625–640.

Simmons, D., Shaw, J., McKenzie, A., Eaton, S., Cameron, A. J. & Zimmet, P. (2006) Is grand multiparity associated with an increased risk of dysglycaemia? *Diabetologia*, 49, 1522–1527.

Simon, A. F., Shih, C., Mack, A. & Benzer, S. (2003) Steroid control of longevity in *Drosophila melanogaster*. *Science*, 299, 1407–1410.

Simpson, P., Berreur, P. & Berreurbonnenfant, J. (1980) The initiation of pupariation in *Drosophila* – dependence on growth of the imaginal disks. *Journal of Embryology and Experimental Morphology*, 57, 155–165.

Sinervo, B. (1999) Mechanistic analysis of natural selection and a refinement of Lack's and William's principles. *The American Naturalist*, 154, S26–S42.

Sinervo, B. (2000) Adaptation, natural selection, and optimal life history allocation in the face of genetically-based trade-offs. In Mousseau, T., Sinervo, B. & Endler, J. A. (Eds.) *Adaptive Genetic Variation in the Wild*. Oxford, Oxford University Press.

Sinervo, B. & Calsbeek, R. (2003) Physiological epistasis, ontogenetic conflict and natural selection on physiology and life history. *Integrative and Comparative Biology*, 43, 419–430.

Sinervo, B. & Calsbeek, R. (2006) The developmental, physiological, neural and genetical causes and consequences of frequency dependent selection in the wild. *Annual Review of Ecology, Evolution and Systematics*, 37, 581–610.

Sinervo, B. & Clobert, J. (2003) Morphs, dispersal behavior, genetic similarity, and the evolution of cooperation. *Science*, 300, 1949–1951.

Sinervo, B. & Clobert, J. (2008) Life history strategies, multi-dimentional trade-offs and behavioural syndromes. In Danchin, E., Giraldeau, L.-A. & Cézilly, F. (Eds.) *Behavioural Ecology*. Oxford, Oxford University Press.

Sinervo, B. & DeNardo, D. F. (1996) Costs of reproduction in the wild: path analysis of natural selection and experimental tests of causation. *Evolution*, 50, 1299–1313.

Sinervo, B. & Licht, P. (1991). The physiological and hormonal control of clutch size, egg size, and egg shape in *Uta stansburiana*: Constraints on the evolution of lizard life histories. J. Exp. Zool. 257: 252–264.

Sinervo, B. & Lively, C. M. (1996) The rock-paper-scissors game and the evolution of alternative male strategies. *Nature*, 380, 240–243.

Sinervo, B. & McAdam, A. G. (2008) Maturational costs of reproduction due to clutch size and ontogenetic conflict as revealed in the invisible fraction. *Proceedings of the Royal Society of London B*, 275, 629–638.

Sinervo, B. & Miles, D. B. (2010) Hormones and behavior of reptiles. In Norris, D. O. & Lopez, K. H. (Eds.) *Hormones and Reproduction of Vertebrates*. London, Academic Press.

Sinervo, B. & Svensson, E. (1998) Mechanistic and selective causes of life history trade-offs and plasticity. *Oikos*, 83, 432–442.

Sinervo, B. & Svensson, E. (2002) Correlational selection and the evolution of genomic architecture. *Heredity*, 89, 329–338.

Sinervo, B., Doughty, P., Huey, R. B. & Zamudio, K. (1992) Allometric engineering: a causal analysis of natural selection on offspring size. *Science*, 258, 1927–1930.

Sinervo, B., Svensson, E. & Comendant, T. (2000) Density cycles and an offspring quantity and quality game driven by natural selection. *Nature*, 406, 985–988.

Sinervo, B., Bleay, C. & Adamopoulou, C. (2001) Social causes of correlational selection and the resolution of a heritable throat color polymorphism in a lizard. *Evolution*, 55, 2040–2052.

Sinervo, B., Chaine, A., Clobert, J., Calsbeek, R., Hazard, L., Lancaster, L., McAdam, A. G., Alonzo, S., Corrigan, G. & Hochberg, M. E. (2006) Color morphs and genetic cycles of greenbeard mutualism and transient altruism. *Proceedings of the National Academy of Sciences of the United States of America*, 102, 7372–7377.

Sinervo, B., Huelin, B., Surget-Groba, Y., Clobert, J., Miles, D. B., Corl, A., Chaine, A. & Davis, A. (2007) Models of density-dependent genic selection and a new Rock-Paper-Scissors social system. *The American Naturalist*, 170, 663–680.

Sinervo, B., Clobert, J., Miles, D. B., McAdam, A. G. & Lancaster, L. T. (2008) The role of pleiotropy vs signaller–receiver gene epistasis in life history trade-offs: dissecting the genomic architecture of organismal design in social systems. *Heredity*, 101, 197–211.

Sisodia, S. & Singh, B. N. (2004) Size dependent sexual selection in *Drosophila ananassae*. *Genetica*, 121, 207–217.

Siva-Jothy, M. T., Moret, Y. & Rolff, J. (2005) Insect immunity: An evolutionary ecology perspective. *Advances in Insect Physiology*, 32, 1–48.

Skorupa, D. A., Dervisefendic, A., Zwiener, J. & Pletcher, S. D. (2008) Dietary composition specifies consumption, obesity, and lifespan in *Drosophila melanogaster*. *Aging Cell*, 7, 478–490.

Skulason, S. & Smith, T. B. (1995) Resource polymorphisms in vertebrates. *Trends in Ecology & Evolution*, 10, 366–370.

Slack, C., Werz, C., Wieser, D., Alic, N., Foley, A., Stocker, H., Withers, D. J., Thornton, J. M., Hafen, E. & Partridge, L. (2010) Regulation of lifespan, metabolism and stress responses by the *Drosophila* SH2B protein, Lnk. *PLoS Genetics*, 6, e1000881.

Slatkin, M. (1981) Estimating levels of gene flow in natural populations. *Annual Review of Ecology and Systematics*, 16, 393–430.

Slotte, T., Huang, H. R., Holm, K., Ceplitis, A., Onge, K. S., Chen, J., Lagercrantz, U. & Lascoux, M. (2009) Splicing variation at a *FLOWERING LOCUS C* homeolog is associated with flowering time variation in the tetraploid *Capsella bursa-pastoris*. *Genetics*, 183, 337–345.

Sly, B. J., Snoke, M. S. & Raff, R. A. (2003) Who came first – larvae or adults? Origins of bilaterian metazoan larvae. *International Journal of Developmental Biology*, 47, 623–632.

Smith, D. C. (1987) Adult recruitment in chorus frogs: Effects of size and date at metamorphosis. *Ecology*, 68, 344–350.

Smith, B. H. (1992) Life history and the evolution of human maturation. *Evolutionary Anthropology*, 1, 134–142.

Smith, C. C. & Fretwell, S. D. (1974) The optimal balance between size and number of offspring. *The American Naturalist*, 108, 499–506.

Smith, M. M. & Krupina, N. I. (2001) Conserved developmental processes constrain evolution of lungfish dentitions. *Journal of Anatomy*, 199, 161–168.

Smith, N. & Lenhoff, H. M. (1976) Regulation of pedal laceration in a sea anemone. In Mackie, G. (Ed.) *Coelenterate Ecology and Behavior*. New York, Plenum Press.

Smith, W., Priester, J. & Morais, J. (2003) PTTH-stimulated ecdysone secretion is dependent upon tyrosine phosphorylation in the prothoracic glands of *Manduca sexta*. *Insect Biochemistry & Molecular Biology*, 33, 1317–1325.

Smith, J. J., Kenney, R. D., Gagne, D. J., Frushour, B. P., Ladd, W., Galonek, H. L., Israelian, K., Song, J., Razvadauskaite, G., Lynch, A. V., Carney, D. P., Johnson, R. J., Lavu, S., Iffland, A., Elliot, P. J., Lambert, P. D., Elliston, K. O., Jirousek, M. R., Milne, J. C. & Boss, O. (2009) Small molecule activators of SIRT1 replicate signaling pathways triggered by calorie restriction *in vivo*. *BMC Systems Biology*, 3, 31.

Soars, N. A., Prowse, T. A. A. & Byrne, M. (2009) Overview of phenotypic plasticity in echinoid larvae, '*Echinopluteus transversus*' type vs. typical echinoplutei. *Marine Ecology Progress Series*, 383, 113–125.

Socha, R., Sula, J., Kodrik, D. & Gelbic, I. (1991) Hormonal control of vitellogenin synthesis in *Pyrrhocoris apterus* (L.) (Heteroptera). *Journal of Insect Physiology*, 37, 805–816.

Sodergren, E., Weinstock, G. M., Davidson, E. H., Cameron, R. A., Gibbs, R. A., Angerer, R. C., Angerer, L. M., Arnone, M. I., Burgess, D. R., Burke, R. D., Coffman, J. A., Dean, M., Elphick, M. R., Ettensohn, C. A., Foltz, K. R., Hamdoun, A., Hynes, R. O., Klein, W. H., Marzluff, W., McClay, D. R., Morris, R. L., Mushegian, A., Rast, J. P., Smith, L. C., Thorndyke, M. C., Vacquier, V. D., Wessel, G. M., Wray, G., Zhang, L., Elsik, C. G., Ermolaeva, O., Hlavina, W., Hofmann, G., Kitts, P., Landrum, M. J., MacKey, A. J., Maglott, D., Panopoulou, G., Poustka, A. J., Pruitt, K., Sapojnikov, V., Song, X., Souvorov, A., Solovyev, V., Wei, Z., Whittaker, C. A., Worley, K., Durbin, K. J., Shen, Y., Fedrigo, O., Garfield, D., Haygood, R., Primus, A., Satija, R., Severson, T., Gonzalez-Garay, M. L., Jackson, A. R., Milosavljevic, A., Tong, M., Killian, C. E., Livingston, B. T., Wilt, F. H., Adams, N., Belle, R., Carbonneau, S., Cheung, R., Cormier, P., Cosson, B., Croce, J., Fernandez-Guerra, A., Geneviere, A.-M., Goel, M., Kelkar, H., Morales, J., Mulner-Lorillon, O., Robertson, A. J., Goldstone, J. V., Cole, B., Epel, D., Gold, B., Hahn, M. E., Howard-Ashby, M., Scally, M., Stegeman, J. J., Allgood, E. L., Cool, J., Judkins, K. M., McCafferty, S. S., Musante, A. M., Obar, R. A., Rawson, A. P., Rossetti, B. J., Gibbons, I. R., Hoffman, M. P., Leone, A., Istrail, S., Materna, S. C., Samanta, M. P., Stolc, V., et al. (2006) The genome of the sea urchin *Strongylocentrotus purpuratus*. *Science*, 314, 941–952.

Soetaert, K., Muthumbi, A. & Heip, C. (2002) Size and shape of ocean margin nematodes: morphological diversity and depth-related patterns. *Marine Ecology Progress Series*, 242, 179–193.

Sohal, R. S., Mockett, R. J. & Orr, W. C. (2002) Mechanisms of aging: an appraisal of the oxidative stress hypothesis. *Free Radical Biology & Medicine*, 33, 575–586.

Solari, F. & Ahringer, J. (2000) Nurd-complex genes antagonise Ras-induced vulval development in *C. elegans*. *Current Biology*, 10, 223–226.

Solari, C. A., Kessler, J. O. & Michod, R. E. (2006a) A hydrodynamics approach to the evolution of multicellularity: Flagellar motility and germ-soma differentiation in volvocalean green algae. *The American Naturalist*, 167, 537–554.

Solari, C. A., Ganguly, S., Kessler, J. O., Michod, R. E., and Goldstein, R. E. 2006b. Multicellularity and the functional interdependence of motility and molecular transport. *Proceedings of the National Academy of Sciences of the United States of America* 103: 1353–1358.

Soller, M., Bownes, M. & Kubli, E. (1999) Control of oocyte maturation in sexually mature *Drosophila* females. *Developmental Biology*, 208, 337–351.

Soma, K. K. (2006) Testosterone and aggression: berthold, birds and beyond. *Journal of Neuroendocrinology*, 18, 543–551.

Soma, K. K., Hartman, V. N., Wingfield, J. C. & Brenowitz, E. Z. (1999) Seasonal changes in androgen receptor immunoreactivity in the song nucleus HVc of a wild bird. *Journal of Comparative Neurology*, 409, 224–236.

Soma, K. K., Schlinger, B. A., Wingfield, J. C. & Saldanha, C. J. (2003) Brain aromatase, 5 alpha-reductase, and 5 beta-reductase change seasonally in wild male song sparrows: relationship to aggressive and sexual behavior. *Journal of Neurobiology*, 56, 209–221.

Sommer, U. & Gliwicz, Z. M. (1986) Long-range vertical migration of *Volvox* in tropical Lake Cahora bassa (Mozambique). *Limnology and Oceanography*, 31, 650–653.

Song, C. & Liao, S. (2000) Cholestenoic acid is a naturally occurring ligand for liver X receptor alpha. *Endocrinology*, 141, 4180–4184.

Soong, K. & Lang, J. C. (1992) Reproductive integration in reef corals. *Biological Bulletin*, 183, 418–431.

Sorensen, J. G., Nielsen, M. M. & Loeschcke, V. (2007) Gene expression profile analysis of *Drosophila melanogaster* selected for resistance to environmental stressors. *Journal of Evolutionary Biology*, 20, 1624–1636.

Soronen, P., Laiti, M., Torn, S., Harkonen, P., Patrikainen, L., Li, Y., Pulkka, A., Kurkela, R., Herrala, A., Kaija, H., Isomaa, V. & Vihko, P. (2004) Sex steroid hormone metabolism and prostate cancer. *Journal of Steroid Biochemistry & Molecular Biology* 92, 281–286.

Sowell, R. A., Hersberger, K. E., Kaufman, T. C. & Clemmer, D. E. (2007) Examining the proteome of *Drosophila* across organism lifespan. *Journal of Proteome Research*, 6, 3637–3647.

Sower, S. A. (1998) Brain and pituitary hormones of lampreys, recent findings and their evolutionary significance. *American Zoologist*, 38, 15–38.

Sower, S. A., Freamat, M. & Kavanaugh, S. I. (2009) The origins of the vertebrate hypothalamic-pituitary-gonadal (HPG) and hypothalamic-pituitary-thyroid (HPT) endocrine systems: New insights from lampreys. *General and Comparative Endocrinology*, 161, 20–29.

Spangenberg, D. B. (1965) A study of strobilation in *Aurelia aurita* under controlled conditions. *Journal of Experimental Biology*, 160, 1–10.

Spangenberg, D. B. (1967) Iodine induction of metamorphosis in *Aurelia*. *Journal of Experimental Biology*, 165, 441–449.

Spangenberg, D. B. (1972) Thyroxine induced metamorphosis in *Aurelia*. *Journal of Experimental Biology*, 178, 183–194.

Sparkman, A. & Palacios, M. G. (2009) A test of life history theories of immune defense in two ecotypes of the garter snake, *Thamnophis elegans*. *Journal of Animal Ecology*, 78, 1242–1248.

Sparkman, A. M., Arnold, S. J. & Bronikowski, A. M. (2007) An empirical test of evolutionary theories for reproductive senescence and reproductive effort in the garter snake *Thamnophis elegans*. *Proceedings of the Royal Society of London B*, 274, 943–950.

Sparkman, A. M., Vleck, C. M. & Bronikowski, A. M. (2009) Evolutionary ecology of endocrine-mediated life history variation in the garter snake *Thamnophis elegans*. *Ecology*, 90, 720–728.

Sparks, T. C., Hammock, B. D. & Riddiford, L. M. (1983) The hemolymph juvenile-hormone esterase of *Manduca sexta* (L) – inhibition and regulation. *Insect Biochemistry*, 13, 529–541.

Specker, J. L., Eales, J. G., Tagawa, M. & Tyler, W. A. (2000) Parr-smolt transformation in Atlantic salmon: Thyroid hormone deiodination in liver and brain and endocrine correlates of change in rheotactic behavior. *Canadian Journal of Zoology-Revue Canadienne de Zoologie*, 78, 696–705.

Sperry, T. S. & Thomas, P. (1999) Characterization of two nuclear androgen receptors in Atlantic croaker: comparison of their biochemical properties and binding specificities. *Endocrinology*, 140, 1602–1611.

Spindler, S. R. (2010) Caloric restriction: from soup to nuts. *Aging Research Reviews*, 9, 324–353.

Srinivasan, J., Kaplan, F., Ajredini, R., Zachariah, C., Alborn, H. T., Teal, P. E., Malik, R. U., Edison, A. S., Sternberg, P. W. & Schroeder, F. C. (2008) A blend of small molecules regulates both mating and development in *Caenorhabditis elegans*. *Nature*, 454, 1115–1118.

Stampar, S. N., Silveira, F. L. D. & Morandini, A. C. (2007) Asexual reproduction of *Nausithoe aurea* (Cnidaria, Scyphozoa, Coronatae) induced by sterile polystyrene dishes. *Brazilian Journal of Oceanography*, 55, 231–233.

Stark, K. & Schmitt, R. (2002) Genetic control of germ-soma differentiation in *Volvox carteri*. *Protist*, 153, 99–107.

Stark, K., Kirk, D. L. & Schmitt, R. (2001) Two enhancers and one silencer located in the introns of reg A control somatic cell differentiation in *Volvox reinhardtii. Genes & Development*, 15, 1449–1460.

Starr, R. (1970) Control of differentiation in *Volvox*. *Developmental Biology* 4, 59–100.

Stay, B., Friedel, T., Tobe, S. S. & Mundall, E. C. (1980) Feedback control of juvenile-hormone synthesis in cockroaches - possible role for ecdysterone. *Science*, 207, 898–900.

St-Cyr, J., Derome, N. & Bernatchez, L. (2008) The transcriptomics of life history trade-offs in whitefish species pairs (*Coregonus* sp.). *Molecular Ecology*, 17, 1850–1870.

Stearns, S. C. (1976) Life history tactics: a review of the ideas. *Quarterly Review of Biology*, 51, 3–47.

Stearns, S. C. (1986) Natural selection and fitness, adaptation and constraint. In Raup, D. M. & Jablonski D. (Eds.) *Patterns and Processes in the History of Life*. Berlin, Springer.

Stearns, S. C. (1989) Trade-offs in life history evolution. *Functional Ecology*, 3, 259–268.

Stearns, S. C. (1992) *The Evolution of Life Histories*. Oxford, Oxford University Press.

Stearns, S. (1994) The evolutionary links between fixed and variable traits. *Acta Paleontologica Polonica*, 38, 215–232.

Stearns, S. C. (2000) Life history evolution: successes, limitations, and prospects. *Naturwissenschaften*, 87, 476–486.

Stearns, S. C. (2005) Issues in evolutionary medicine. *American Journal of Human Biology*, 17, 131–140.

Stearns, S. & Kaiser, M. (1996) Effects on fitness components of P-element inserts in *Drosophila melanogaster*: Analysis of trade-offs. *Evolution*, 50, 795–806.

Stearns, S. C. & Koella, J. C. (1986) The evolution of phenotypic plasticity in life-history traits: predictions of reaction norms for age and size at maturity. *Evolution*, 40, 893–913.

Stearns, S. C. & Koella, J. C. (Eds.) (2008) *Evolution in Health and Disease*. Oxford, Oxford University Press.

Stearns, S. C. & Magwene, P. (2003) The naturalist in a world of genomics. *The American Naturalist*, 161, 171–180.

Stearns, S. C. & Partridge, L. (2001) The genetics of aging in *Drosophila*. In Masoro, E. & Austad, S. (Eds.) *Handbook of the Biology of Aging*, 5th edn. New York, Academic Press.

Stearns, S. C., Ackermann, M., Doebele, M. & Kaiser, M. (2000) Experimental evolution of aging, growth and reproduction in fruit flies. *Proceedings of the National Academy of Sciences of the United States of America*, 97, 3309–3313.

Stearns, S. C., Nesse, M. N. & Haig, D. (2008) Introducing evolutionary thinking for medicine. In Stearns, S. C. & Koella, J. C. (Eds.) *Evolution in Health and Disease*. Oxford, New York, Oxford University Press.

Steenstrup, J. J. S. 1845. On the Alternation of Generations. Translated from the German version of C. H. Lorenzen by G. Busk. Ray Society, London.

Stefansson, S. O., Bjornsson, B., Ebbesson, L. O. E., McCormick (2008) Smoltification. In Finn, R. N. & Kapoor, B. G. (Eds.) *Fish Larval Physiology*. New Delhi, Enfield (NH), Science Publishers, Inc. & IBH Publishing Co. Pvt. Ltd.

Stéhlík, J., Závodská, R., Shimada, K., Sauman, I. & Kostál, V. (2008) Photoperiodic induction of diapause requires regulated transcription of timeless in the larval brain of *Chymomyza costata*. *Journal of Biological Rhythms*, 23, 129–139.

Steigenga, M. J., Hoffmann, K. H. & Fischer, K. (2006) Effects of the juvenile hormone mimic pyriproxyfen on female reproduction and longevity in the butterfly *Bicyclus anynana*. *Entomological Science*, 9, 269–279.

Steinacker, J. M., Brkic, M., Simsch, C., Nething, K., Kresz, A., Prokopchuk, O. & Liu, Y. (2005) Thyroid hormones, cytokines, physical training and metabolic control. *Hormone and Metabolic Research*, 37, 538–544.

Stephenson, T. A. (1935) *The British Sea Anemones, Volume II*. London, The Ray Society.

Stern, D. L. (2000) Perspective: Evolutionary developmental biology and the problem of variation. *Evolution*, 54, 1079–1091.

Stern, D. L. (2010) *Evolution, Development, and the Predictable Genome*. Greenwood Village, Colorado, Roberts and Company Publishers.

St Germain, D. L., Schwartzman, R. A., Croteau, W., Kanamori, A., Wang, Z., Brown, D. D. & Galton, V. A. (1994) A thyroid hormone-regulated gene in *Xenopus laevis* encodes a type III iodothyronine 5-deiodinase. *Proceedings of the National Academy of Sciences of the United States of America*, 91, 7767–7771.

Stieper, B. C., Kupershtok, M., Driscoll, M. V. & Shingleton, A. W. (2008) Imaginal discs regulate developmental timing in *Drosophila melanogaster*. *Developmental Biology*, 321, 18–26.

Stinchcombe, J. R. & Hoekstra, H. E. (2008) Combining population genomics and quantitative genetics: finding the genes underlying ecologically important traits. *Heredity*, 100, 158–170.

Stinchcombe, J. R., Dorn, L. A. & Schmitt, J. (2004) Flowering time plasticity in *Arabidopsis thaliana*: a reanalysis of Westerman & Lawrence (1970). *Journal of Evolutionary Biology*, 17, 197–207.

Stoleru, D., Nawathean, P., De La Paz Fernandez, M., Menet, J. S., Fernanda Ceriani, M. & Rosbash, M. (2007) The *Drosophila* circadian network is a seasonal timer. *Cell*, 129, 207–219.

Storey, K. B. (2006) Reptile freeze tolerance: Metabolism and gene expression. *Cryobiology*, 52, 1–16.

Storey, K. B. (2007) Anoxia tolerance in turtles: Metabolic regulation and gene expression. *Comparative Biochemistry and Physiology A*, 147, 236–276.

Storey, K. B. (2010) Out cold: Biochemical regulation of mammalian hibernation – a mini-review. *Gerontology*, 56, 220–230.

Storey, A. E., Walsh, C. J., Quinton, R. L. & Wynn-Edwards, K. E. (2000) Hormonal correlates of paternal responsiveness in new and expectant fathers. *Evolution and Human Behavior*, 21, 79–95.

Strassman, B. (1996) Energy economy in the evolution of menstruation. *Evolutionary Anthropology*, 5, 157–164.

Strathmann, R. R. (1971) The feeding behavior of planktotrophic echinoderm larvae: mechanisms, regulation, and rates of suspension feeding. *Journal of Experimental Marine Biology and Ecology*, 6, 109–160.

Strathmann, R. R. (1975) Larval feeding in echinoderms. *American Zoologist*, 15, 717–730.

Strathmann, R. R. (1978) Evolution and loss of feeding larval stages of marine invertebrates. *Evolution*, 32, 894–906.

Strathmann, R. R. (1985) Feeding and nonfeeding larval development and life history evolution in marine invertebrates. *Annual Review of Ecology and Systematics*, 16, 339–361.

Strathmann, R. R. (1990) Why life histories evolve differently in the sea. *American Zoologist*, 30, 197–207.

Strathmann, R. R. (2007) Time and extent of ciliary response to particles in a non-filtering feeding mechanism. *Biological Bulletin*, 212, 93–103.

Strathmann, R. R., Fenaux, L. & Strathmann, M. F. (1992) Heterochronic developmental plasticity in larval sea-urchins and its implications for evolution of nonfeeding larvae. *Evolution*, 46, 972–986.

Strathmann, R. R., Fenaux, L., Sewell, M. A. & Strathmann, M. F. (1993) Abundance of food affects relative size of larval and postlarval structures of a molluscan veliger. *Biological Bulletin*, 185, 232–239.

Strathmann, R. R., Foley, G. P. & Hysert, A. N. (2008) Loss and gain of the juvenile rudiment and metamorphic competence during starvation and feeding of bryozoan larvae. *Evolution & Development*, 10, 731–736.

Stuart, L. M. & Ezekowitz, R. A. (2008) Phagocytosis and comparative innate immunity: learning on the fly. *Nature Reviews Immunology*, 8, 131–141.

Su, Y., Li, E., Geiss, G. K., Longabaugh, W. J. R., Kämer, A. & Davidson, E. H. (2009) A perturbation model of the gene regulatory network for oral and aboral ectoderm specficiation in the sea urchin embryo. *Developmental Biology*, 329, 410–421.

Suarez-Lopez, P., Wheatley, K., Robson, F., Onouchi, H., Valverde, F. & Coupland, G. (2001) CONSTANS mediates between the circadian clock and the control of flowering in *Arabidopsis*. *Nature*, 410, 1116–1120.

Suh, Y., Atzmon, G., Cho, M. O., Hwang, D., Liu, B., Leahy, D. J., Barzilai, N. & Cohen, P. (2008) Functionally significant insulin-like growth factor I receptor mutations in centenarians. *Proceedings of the National Academy of Sciences of the United States of America*, 105, 3438–3442.

Sula, J., Kodrik, D. & Socha, R. (1995) Hexameric haemolymph protein related to adult diapause in the red firebug, *Pyrrhocoris apterus* (L.) (Heteroptera). *Journal of Insect Physiology*, 41, 793–800.

Sultan, S. E. (2007) Development in context: the timely emergence of eco-devo. *Trends in Ecology & Evolution*, 22, 575–582.

Sutter, N. B., Bustamante, C. D., Chase, K., Gray, M. M., Zhao, K., Zhu, L., Padhukasahasram, B., Karlins, E., Davis, S., Jones, P. G., Quignon, P., Johnson, G. S., Parker, H. G., Fretwell, N., Mosher, D. S., Lawler, D. F., Satyaraj, E., Nordborg, M., Lark, K. G., Wayne, R. K. & Ostrander, E. A. (2007) A single IGF-1 allele is a major determinant of small size in dogs. *Science*, 316, 112–115.

Suzuki, Y., Truman, J. W. and Riddiford, L. M. (2008) The role of Broad in the development of *Tribolium castaneum*: implication s for the evolution of the holometabolous insect pupa. *Development*, 135, 569–577.

Svensson, E., Sinervo, B. & Comendant, T. (2001a) Condition, genotype-by-environment interaction, and correlational selection in lizard life history morphs. *Evolution*, 55, 2053–2069.

Svensson, E., Sinervo, B. & Comendant, T. (2001b) Density-dependent competition and selection on immune function in genetic lizard morphs. *Proceedings of the National Academy of Sciences of the United States of America*, 98, 12561–12565.

Svensson, E., Sinervo, B. & Comendant, T. (2002) Mechanistic and experimental analysis of condition and reproduction in a polymorphic lizard. *Journal of Evolutionary Biology*, 15, 1034–1047.

Svensson, E., McAdam, A. G. & Sinervo, B. (2009) Intralocus sexual conflict over immune defense resolves gender load and affects sex-specific signaling in a natural lizard population. *Evolution*, 63, 3124–3135.

Swanson, R. L., De Nys, R., Huggett, M. J., Green, J. K. & Steinberg, P. D. (2006) In situ quantification of a natural settlement cue and recruitment of the Australian sea urchin *Holopneustes purpurascens*. *Marine Ecology Progress Series*, 314, 1–14.

Swanson, R. L., Marshall, D. J. & Steinberg, P. D. (2007) Larval desperation and histamine: how simple responses can lead to complex changes in larval behaviour. *The Journal of Experimental Biology*, 210, 3228–3235.

Swarup, K., Alonso-Blanco, C., Lynn, J. R., Michaels, S. D., Amasino, R. M., Koornneef, M. & Millar, A. J. (1999) Natural allelic variation identifies new genes in the *Arabidopsis* circadian system. *Plant Journal*, 20, 67–77.

Swoap, S. J. & Weinshenker, D. (2008) Norepinephrine controls both torpor initiation and emergence via distinct mechanisms in the mouse. *PLoS One*, 3, e4038.

Sze, J. Y., Victor, M., Loer, C., Shi, Y. & Ruvkun, G. (2000) Food and metabolic signalling defects in a *C. elegans* serotonin-synthesis mutant. *Nature*, 403, 560–564.

Szewczyk, N. J., Udranszky, I. A., Kozak, E., Sunga, J., Kim, S. K., Jacobson, L. A. & Conley, C. A. (2006) Delayed development and lifespan extension as features of metabolic lifestyle alteration in *C. elegans* under dietary restriction. *Journal of Experimental Biology*, 209, 4129–4139.

Tagawa, M. & Hirano, T. (1987) Presence of thyroxine in eggs and changes in its content during early development of chum salmon, *Oncorhynchus keta*. *General and Comparative Endocrinology*, 68, 129–135.

Tagawa, M. & Hirano, T. (1991) Effects of thyroid hormone deficiency in eggs on early development of the medaka, *Oryzias latipes*. *Journal of Experimental Zoology*, 257, 360–366.

Tagawa, M., Miwa, S., Inui, Y., de Jesus, E. G. & Hirano, T. (1990a) Changes in thyroid hormone concentrations during early development and metamorphosis of the flounder, *Paralichthys olivaceus*. *Zoological Science*, 7, 93–96.

Tagawa, M., Tanaka, M., Matsumoto, S. & Hirano, T. (1990b) Thyroid hormones in eggs of various freshwater, marine and diadromous teleosts and their changes during egg development. *Fish Physiology and Biochemistry*, 8, 515–520.

Taguchi, A., Wartschow, L. M. & White, M. F. (2007) Brain IRS2 signaling coordinates lifespan and nutrient homeostasis. *Science*, 317, 369–372.

Takada, Y., Ye, X. & Simon, S. (2007) The integrins. *Genome Biology*, 8, 215.

Takahashi, N., Yoshihama, K., Kikuyama, S., Yamamoto, K., Wakabayashi, K. & Kato, Y. (1990) Molecular cloning and nucleotide sequence analysis of complementary DNA for bullfrog prolactin. *Journal of Molecular Endocrinology*, 5, 281–287.

Takano, T. S. (1998) Loss of notum macrochaetae as an interspecific hybrid anomaly between *Drosophila melanogaster* and *D. simulans*. *Genetics*, 149, 1435–1450.

Takken, W. & Knols, B. G. J. (1999) Odor-mediated behavior of Afrotropical malaria mosquitoes. *Annual Review of Entomology*, 44, 131–157.

Tan, F. C. & Swain, S. M. (2006) Genetics of flower initiation and development in annual and perennial plants. *Physiologia Plantarum*, 128, 8–17.

Tanaka, K. & Truman, J.W. (2007) Molecular patterning mechanism underlying metamorphosis of the thoracic leg in *Manduca sexta*. *Developmental Biology*, 305, 539–550.

Tang, X. C., Liu, X. C., Zhang, Y., Zhu, P. & Lin, H. R. (2008) Molecular cloning, tissue distribution and expression profiles of thyroid hormone receptors during embryogenesis in orange-spotted grouper (*Epinephelus coioides*). *General and Comparative Endocrinology*, 159, 117–124.

Tata, J. R. (1958) A cellular thyroxine-binding protein fraction. *Biochimica et Biophysica Acta*, 28, 91–94.

Tata, J. R. (1996) Amphibian metamorphosis: An exquisite model for hormonal regulation of postembryonic development in vertebrates. *Development, Growth & Differentiation*, 38, 223–231.

Tata, J. R., Kawahara, A. & Baker, B. S. (1991) Prolactin inhibits both thyroid hormone-induced morphogenesis and cell death in cultured amphibian larval tissues. *Developmental Biology*, 146, 72–80.

Tatar, M. (1999) Transgenes in the analysis of lifespan and fitness. *The American Naturalist*, 154, S67–S81.

Tatar, M. (2004) The neuroendocrine regulation of *Drosophila* aging. *Experimental Gerontology*, 39, 1745–1750.

Tatar, M. & Carey, J. R. (1995) Nutrition mediates reproductive trade-offs with age-specific mortality in the beetle *Callosobruchus maculatus*. *Ecology*, 76, 2066–2073.

Tatar, M. & Yin, C. M. (2001) Slow aging during insect reproductive diapause: why butterflies, grasshoppers and flies are like worms. *Experimental Gerontology*, 36, 723–738.

Tatar, M., Chien, S. A. & Priest, N. K. (2001a) Negligible senescence during reproductive dormancy in *Drosophila melanogaster*. *The American Naturalist*, 158, 248–258.

Tatar, M., Kopelman, A., Epstein, D., Tu, M. P., Yin, C. M. & Garofalo, R. S. (2001b) A mutant *Drosophila* insulin receptor homolog that extends life-span and impairs neuroendocrine function. *Science*, 292, 107–110.

Tatar, M., Bartke, A. & Antebi, A. (2003) The endocrine regulation of aging by insulin-like signals. *Science*, 299, 1346–1351.

Tauber, M. J., Tauber, C. A. & Masaki, S. (1986) *Seasonal Adaptations of Insects*. New York, Oxford University Press.

Tauber, E., Zordan, M., Sandrelli, F., Pegoraro, M., Osterwalder, N., Breda, C., Daga, A., Selmin, A., Monger, K., Benna, C., Rosato, E., Kyriacou, C. P. & Costa, R. (2007) Natural selection favors a newly derived *timeless* allele in *Drosophila melanogaster*. *Science*, 316, 1895–1898.

Temin, G., Zander, M. & Roussel, J. P. (1986) Physiochemical (Gc-MS) measurements of juvenile hormone III titres during embryogenesis of *Locusta migratoria*. *International Journal of Invertebrate Reproduction and Development* 9, 105–112.

Tennekoon, K. H. & Karunanayake, E. H. (1993) Serum FSH, LH, and testosterone concentrations in presumably fertile men: effect of age. *International Journal of Fertility*, 38, 108–112.

Teotónio, H., Chelo, I. M., Bradic, M., Rose, M. R. & Long, A. D. (2009) Experimental evolution reveals natural selection on standing genetic variation. *Nature Genetics*, 41, 251–257.

Terashima, J. & Bownes, M. (2004) Translating available food into the number of eggs laid by *Drosophila melanogaster*. *Genetics*, 167, 1711–1719.

Terashima, J., Takaki, K., Sakurai, S. & Bownes, M. (2005) Nutritional status affects 20-hydroxyecdysone concentration and progression of oogenesis in *Drosophila melanogaster*. *Journal of Endocrinology*, 187, 69–79.

Terry, D. F., Wyszynski, D. F., Nolan, V. G., Atzmon, G., Schoenhofen, E. A., Pennington, J. Y., Andersen, S. L., Wilcox, M. A., Farrer, L. A., Barzilai, N., Baldwin, C. T. & Asea, A. (2006) Serum heat shock protein 70 level as a biomarker of exceptional longevity. *Mechanisms of Ageing and Development*, 127, 862–868.

Thibaudeau, G. & Altig, R. (1999) Endotrophic anurans: Development and Evolution. In McDiarmid, R. W. (Ed.) *Tadpoles: The Biology of Anuran Larvae*. Chicago, Chicago University Press.

Thisse, C., Degrave, A., Kryukov, G. V., Gladyshev, V. N., Obrecht-Pflumio, S., Krol, A., Thisse, B. & Lescure, A. (2003) Spatial and temporal expression patterns of selenoprotein genes during embryogenesis in zebrafish. *Gene Expression Patterns*, 3, 525–532.

Thomas, T. D. (2008) The effect of in vivo and in vitro applications of ethrel and GA(3) on sex expression in bitter melon (*Momordica charantia* L.). *Euphytica*, 164, 317–323.

Thomas, J. H., Birnby, D. A. & Vowels, J. J. (1993) Evidence for parallel processing of sensory information controlling dauer formation in *C. elegans*. *Genetics*, 134, 1105–1117.

Thorpe, J. E. (1977) Bimodal distribution of length of juvenile Atlantic Salmon (Salmo salar L.) under artificial rearing conditions. *Journal of Fish Biology*, 11, 175–184.

Thorpe, J. E. (1986) Age at first maturity in Atlantic salmon, *Salmo salar*: freshwater period influences and conflicts with smolting. In Meerburg, D. J. (Ed.) *Salmonid Age at Maturity*. Ottawa, National Research Council of Canada.

Thorpe, J. E. (1987) Smolting versus residency: developmental conflict in salmonids. *American Fisheries Society Symposium*, 1, 244–252.

Thorpe, J. E. (1994a) An alternative view of smolting in salmonids. *Aquaculture*, 121, 105–113.

Thorpe, J. E. (1994b) Reproductive strategies in Atlantic salmon, *Salmo salar* L. *Aquaculture*, 25, 77–87.

Thorpe, J. E., Mangel, M., Metcalfe, N. B. & Huntingford, F. A. (1998) Modelling the proximate basis of salmonid life history variation, with application to Atlantic salmon, *Salmo salar* L. *Evolutionary Ecology*, 12, 581–599.

Tian, D., Traw, M. B., Chen, J. Q., Kreitman, M. & Bergelson, J. (2003) Fitness costs of R-gene-mediated resistance in *Arabidopsis thaliana*. *Nature*, 423, 74–77.

Tissenbaum, H. A. & Guarente, L. (2001) Increased dosage of a *sir-2* gene extends lifespan in *Caenorhabditis elegans*. *Nature*, 410, 227–230.

Tissenbaum, H. A., Hawdon, J., Perregaux, M., Hotez, P., Guarente, L. & Ruvkun, G. (2000) A common muscarinic pathway for diapause recovery in the distantly related nematode species *Caenorhabditis elegans* and *Ancylostoma caninum*. *Proceedings of the National Academy of Sciences of the United States of America*, 97, 460–465.

Todesco, M., Balasubramanian, S., Hu, T. A., Traw, M. B., Horton, M., Epple, P., Kuhns, C., Sureshkumar, S., Schwrartz, C., Lanz, C., Laitinen, R. A. E., Huang, Y., Chory, J., Lipka, V., Borevitz, J. O., Dangl, J. L., Bergelson, J., Magnus, N. & Weigel, D. (2010) Natural allelic variation underlying a major fitness trade-off in *Arabidopsis thaliana*. *Nature*, 465, 632–636.

Toivonen, J. M. & Partridge, L. (2009) Endocrine regulation of aging and reproduction in *Drosophila*. *Molecular and Cellular Endocrinology*, 299, 39–50.

Toivonen, J. M., Walker, G. A., Martinez-Diaz, P., Bjedov, I., Driege, Y., Jacobs, H. T., Gems, D. & Partridge, L. (2007) No influence of Indy on lifespan in *Drosophila* after correction for genetic and cytoplasmic background effects. *PLoS Genetics*, 3, e95.

Tomasello, M. (1999) *The Cultural Origins of Human Cognition*. Cambridge, Harvard University Press.

Tooby, J. & Cosmides, L. (1992) The psychological foundations of culture. In Barkow, J. H., Cosmides, L. & Tooby, J. (Eds.) *The Adapted Mind*. New York, Oxford University Press.

Toomajian, C., Hu, T. T., Aranzana, M. J., Lister, C., Tang, C., Zheng, H., Zhao, K., Calabrese, P., Dean, C. & Nordborg, M. (2006) A nonparametric test reveals selection for rapid flowering in the *Arabidopsis* genome. *PLoS Biology*, 4, e137.

Toonen, R. J. & Pawlik, J. R. (2001) Foundations of gregariousness: A dispersal polymorphism among the planktonic larvae of a marine invertebrate. *Evolution*, 55, 2439–2454.

Toonen, R. J. & Tyre, A. J. (2007) If larvae were smart: a simple model for optimal settlement behavior of competent larvae. *Marine Ecology Progress Series*, 349, 43–61.

Touhara, K. & Vosshall, L. B. (2009) Sensing odorants and pheromones with chemosensory receptors. *Annual Review of Physiology*, 71, 307–332.

Tower, J. (2004) There's a problem in the furnace. *Science of Aging Knowledge Environment*, 2004, pe1.

Townsend, C. R. & Calow, P. (1981) *Physiological Ecology. An Evolutionary Approach to Resource use*. Oxford, Blackwell Scientific Publications.

Travers, S. E., Smith, M. D., Bai, J., Hulbert, S. H., Leach, J. E., Schnable, P. S., Knapp, A. K., Milliken, G. A., Fay, P. A., Saleh, A. & Garrett, K. A. (2007) Ecological genomics: making the leap from model systems in the lab to native populations in the field. *Frontiers in Ecology and the Environment*, 5, 19–24.

Trembley, A. 1744. Mémoires pour server a l'histoire d'un genre de polypes de l'eau douce, à bras en forme de cornes. Verbeek, Leiden.

Trivers, R. L. & Willard, D. E. (1973) Natural selection of parental ability to vary sex-ratio of offspring. *Science*, 179, 90–92.

Troemel, E. R., Chu, S. W., Reinke, V., Lee, S. S., Ausubel, F. M. & Kim, D. H. (2006) p38 MAPK regulates expression of immune response genes and contributes to longevity in *C. elegans*. *PLoS Genetics*, 2, e183.

Troen, A. M., French, E. E., Roberts, J. F., Selhub, J., Ordovas, J. M., Parnell, L. D. & Lai, C. Q. (2007) Lifespan modification by glucose and methionine in *Drosophila melanogaster* fed a chemically defined diet. *Age*, 29, 29–39.

True, J. R. & Carroll, S. B. (2002) Gene co-option in physiological and morphological evolution. *Annual Review of Cell and Developmental Biology*, 18, 53–80.

True, J. R. & Haag, E. S. (2001) Developmental system drift and flexibility in evolutionary trajectories. *Evolution & Development*, 3, 109–119.

Truman, J. W. (1972) Physiology of insect rhythms. 1. Circadian organization of endocrine events underlying molting cycle of larval tobacco hornworms. *Journal of Experimental Biology*, 57, 805–820.

Truman, J. W. & Riddiford, L. M. (1974) Physiology of insect rhythms. 3. The temporal organization of the endocrine events underlying pupation of the tobacco hornworm. *Journal of Experimental Biology*, 60, 371–382.

Truman, J. W. & Riddiford, L. M. (1999) The origins of insect metamorphosis. *Nature*, 401, 447–452.

Truman, J. W. & Riddiford, L. M. (2002) Endocrine insights into the evolution of metamorphosis in insects. *Annual Review of Entomology*, 47, 467–500.

Truman, J. W. & Riddiford, L. M. (2007) The morphostatic actions of juvenile hormone. *Insect Biochemistry & Molecular Biology*, 37, 761–770.

Truman, J. W., Hiruma, K., Allee, J. P., MacWhinnie, S. G. B., Champlin, D. T. & Riddiford, L. M. (2006) Juvenile hormone is required to couple imaginal disc formation with nutrition in insects. *Science*, 312, 1385–1388.

Tsong, A. E., Tuch, B. B., Li, H. & Johnson, A. D. (2006) Evolution of alternative transcriptional circuits with identical logic. *Nature*, 443, 415–420.

Tsutsui, K., Saigoh, E., Yin, H., Ubuka, T., Chowdhury, V. S., Osugi, T., Uena, K. & Sharp, P. J. (2009) A new key neurohormone controlling reproduction, gonadotrophin-lnhibitory hormone in birds: discovery, progress and prospects. *Journal of Neuroendocrinology*, 21, 271–275.

Tu, M. P. & Tatar, M. (2003) Juvenile diet restriction and the aging and reproduction of adult *Drosophila melanogaster*. *Aging Cell*, 2, 327–333.

Tu, M. P., Yin, C. M. & Tatar, M. (2005) Mutations in insulin signaling pathway alter juvenile hormone synthesis in *Drosophila melanogaster*. *General and Comparative Endocrinology*, 142, 347–356.

Tu, Q., Brown, C. T., Davidson, E. H. & Oliveri, P. (2006) Sea urchin Forkhead gene family: phylogeny and embryonic expression. *Developmental Biology*, 300, 49–62.

Tullet, J. M., Hertweck, M., An, J. H., Baker, J., Hwang, J. Y., Liu, S., Oliveira, R. P., Baumeister, R. & Blackwell, T. K. (2008) Direct inhibition of the longevity-promoting factor SKN-1 by insulin-like signaling in *C. elegans*. *Cell*, 132, 1025–1038.

Tulving, E. (2002) Episodic memory: from mind to brain. *Annual Review of Psychology*, 53, 1–25.

Turner, P., Cooper, V. & Lenski, R. (1998) Tradeoff between horizontal and vertical modes of transmission in bacterial plasmids. *Evolution*, 52, 315–329.

Turner, T. L., Levine, M. T., Eckert, M. L. & Begun, D. J. (2008) Genomic analysis of adaptive differentiation in *Drosophila melanogaster*. *Genetics*, 179, 455–473.

Turri, M. G., Henderson, N. D., Defries, J. C. & Flint, J. (2001) Quantitative trait locus mapping in laboratory mice derived from a replicated selection experiment for open-field activity. *Genetics*, 158, 1217–1226.

Tzou, P., Ohresser, S., Ferrandon, D., Capovilla, M., Reichhart, J. M., Lemaitre, B., Hoffmann, J. A. & Imler, J. L. (2000) Tissue-specific inducible expression of antimicrobial peptide genes in *Drosophila* surface epithelia. *Immunity*, 13, 737–748.

Uhlirova, M., Foy, B. D., Beaty, B. J., Olson, K. E., Riddiford, L. M. & Jindra, M. (2003) Use of Sindbus virus-mediated RNA interference to demonstrate a conserved role of Broad-Complex in insect metamorphosis. *Proceedings of the National Academy of Sciences of the United States of America*, 100, 15607–15612.

Ujvari, B. & Madsen, T. (2009) Short telomeres in hatchling snakes: erythrocyte telomere dynamics and longevity in tropical pythons. *PLoS One*, 4, e7493.

Umen, J. G. & Goodenough, U. W. (2001) Control of cell division by a retinoblastoma protein homolog in *Chlamydomonas*. *Genes & Development*, 15, 1652–1661.

Ungar, P., Grine, F. E., Teaford, M. F. & El Zaatari, S. (2006) Dental microwear and diets in early African *Homo*. *Journal of Human Evolution*, 50, 78–95.

Ungerer, M. C. & Reiseberg, L. H. (2003) Genetic architecture of a selection response in *Arabidopsis thaliana*. *Evolution*, 57, 2531–2539.

Ungerer, M. C., Linder, C. R. & Reiseberg, L. H. (2003) Effects of genetic background on response to selection in experimental populations of *Arabidopsis thaliana*. *Genetics*, 163, 277–286.

Urrutia, P. M., Okamoto, K. & Fusetani, N. (2004) Acetylcholine and serotonin induce larval metamorphosis of the Japanese short-neck clam *Ruditapes philippinarum*. *Journal of Shellfish Research*, 23, 93–100.

Uvnas-Moberg, K. (1998) Antistress pattern induced by oxytocin. *News in Psychological Sciences*, 13, 22–26.

Vacher, C., Garcia-Oroz, L. & Rubinsztein, D. C. (2005) Overexpression of yeast hsp104 reduces polyglutamine aggregation and prolongs survival of a transgenic mouse model of Huntington's disease. *Human Molecular Genetics*, 14, 3425–3433.

Vagelli, A. A. (2007) New observations on the asexual reproduction of *Aurelia aurita* (Cnidaria, Scyphozoa) with comments on its life cycle and adaptive significance. *Invertebrate Zoology*, 4, 111–127.

Valdivia, P. A., Zenteno-Savin, T., Gardner, S. C. & Aguirre, A. A. (2007) Basic oxidative stress metabolites in eastern Pacific green turtles (*Chelonia mydas agassizii*). *Comparative Biochemistry and Physiology C*, 146, 111–117.

Vale, P. F. & Little, T. J. (2009) Measuring parasite fitness under genetic and thermal variation. *Heredity*, 103, 102–109.

Van Breusegem, F., Vranova, E., Dat, J. & Inze, D. (2001) The role of active oxygen species in plant signal transduction. *Plant Science*, 161, 405–414.

Vance, R. R. (1973a) More on reproductive strategies in marine benthic invertebrates. *The American Naturalist*, 107, 353–361.

Vance, R. R. (1973b) Reproductive strategies in marine benthic invertebrates. *The American Naturalist*, 107, 339–352.

Van Den Beld, A. W., De Jong, F. H., Grobbee, D. E., Pols, H. A. & Lamberts, S. W. (2000) Measures of bioavailable serum testosterone and estradiol and their relationships with muscle strength, bone density, and body composition in elderly men. *Journal of Clinical Endocrinology and Metabolism*, 85, 3276–3282.

Vandenbergh, J. G. (1967) Effect of the presence of a male on sexual maturation of female mice. *Endocrinology*, 81, 345–349.

Vandenbergh, J. G. (1973) Acceleration and inhibition of puberty in female mice by pheromones. *Journal of Reproduction and Fertility*, 19, 411–419.

Van Den Elzen, P., Garg, S., León, L., Brigl, M., Leadbetter, E. A., Gumperz, J. E., Dascher, C. C., Cheng, T. Y., Sacks, F. M., Illarionov, P. A., Besra, G. S., Kent, S. C., Moody, D. B. & Brenner, M. B. (2005) Apolipoprotein-mediated pathways of lipid antigen presentation. *Nature*, 437, 906–910.

Van Der Have, T. M. & De Jong, G. (1996) Adult size in ectotherms: Temperature effects on growth and differentiation. *Journal of Theoretical Biology*, 183, 329–340.

Van Der Meij, L., Buunk, A. P., Van De Sande, J. P. & Alicia, S. (2008) The presence of a woman increases testosterone in aggressive dominant men. *Hormones and Behavior*, 54, 640–644.

Van Dyck, H. & Wiklund, C. (2002) Seasonal butterfly design: morphological plasticity among three developmental pathways relative to sex, flight and thermoregulation. *Journal of Evolutionary Biology*, 15, 216–225.

Van Heemst, D., Beekman, M., Mooijaart, S. P., Heijmans, B. T., Brandt, B. W., Zwaan, B. J., Slagboom, P. E. & Westendorp, R. G. (2005a) Reduced insulin/IGF-1 signaling and human longevity. *Aging Cell*, 4, 79–85.

Van Heemst, D., Mooijaart, S. P., Beekman, M., Schreuder, J., De Craen, A. J., Brandt, B. W., Slagboom, P. E. & Westendorp, R. G. (2005b) Variation in the human TP53 gene affects old age survival and cancer mortality. *Experimental Gerontology*, 40, 11–15.

Van Noordwijk, A. J. & De Jong, G. (1986) Acquisition and allocation of resources - Their influence on variation in life history tactics. *The American Naturalist*, 128, 137–142.

Van Straalen, N. M. & Hoffmann, A. A. (2000) Review of evidence for physiological costs of tolerance to toxicants. In Kammenga, J. E. & Laskowski, R. (Eds.) *Demography in Ecotoxicology*. Chichester, John Wiley.

Van Straalen, N. M. & Roelofs, D. (2006) *Introduction to Ecological Genomics*. Oxford, Oxford University Press.

Van't Land, J., Van Putten, P., Villarroel, H., Kamping, A. & Van Delden, W. (1995) Latitudinal variation in wing length and allele frequencies for Adh and a-Gpdh in populations of *Drosophila melanogaster* from Ecuador and Chile. *Drosophila Information Service*, 76.

Vaziri, H., Dessain, S. K., Ng Eaton, E., Imai, S. I., Frye, R. A., Pandita, T. K., Guarente, L. & Weinberg, R. A. (2001) hSIR2(SIRT1) functions as an Nad-dependent p53 deacetylase. *Cell*, 107, 149–159.

Vellai, T., Takacs-Vellai, K., Zhang, Y., Kovacs, A. L., Orosz, L. & Muller, F. (2003) Influence of TOR kinase on lifespan in *C. elegans*. *Nature*, 426, 620.

Vernace, V. A., Arnaud, L., Schmidt-Glenewinkel, T. & Figueiredo-Pereira, M. E. (2007) Aging perturbs 26S proteasome assembly in *Drosophila melanogaster*. *FASEB Journal*, 21, 2672–2682.

Verrelli, B. C. & Eanes, W. F. (2001a) Clinal Variation for amino acid polymorphisms at the *Pgm* locus in *Drosophila melanogaster*. *Genetics*, 157, 1649–1663.

Verrelli, B. C. & Eanes, W. F. (2001b) The functional impact of *Pgm* amino acid polymorphism on glycogen content in *Drosophila melanogaster*. *Genetics*, 159, 201–210.

Via, S., Gomulkiewicz, R., de Jong, G., Scheiner, S. M., Schlichting, C. D. & van Tienderen, P. H. (1995) Adaptive Phenotypic Plasticity: Consensus and Controversy. *Trends in Ecology and Evolution*, 10, 212–216.

Videan, E. N., Fritz, J., Heward, C. B. & Murphy, J. (2006) The effects of aging on hormone and reproductive cycles in female chimpanzees *(Pan troglodytes)*. *Comparative Medicine*, 56, 291–299.

Visser, W. E., Frieserna, E. C. H., Jansen, J. & Visser, T. J. (2008) Thyroid hormone transport in and out of cells. *Trends in Endocrinology & Metabolism*, 19, 50–56.

Viswanathan, S. R., Daley, G. Q. & Gregory, R. I. (2008) Selective blockade of microRNA processing by Lin28. *Science*, 320, 97–100.

Vize, P. D. (2009) Transcriptome analysis of the circadian regulatory network in the coral *Acropora millepora*. *Biological Bulletin*, 216, 131–137.

Vlaeminck-Guillem, V., Safi, R., Guillem, P., Leteurtre, E., Duterque-Coquillaud, M. & Laudet, V. (2006) Thyroid hormone receptor expression in the obligatory paedomorphic salamander *Necturus maculosus*. *International Journal of Developmental Biology*, 50, 553–560.

von Dassow, G., Meir, E., Munro, E. M. & Odell, G. M. (2000) The segment polarity network is a robust developmental module. *Nature*, 406, 188–192.

Von Zglinicki, T. & Sitte, N. (2003) Free Radical Production and Antioxidant Defense: A Primer. In Von Zglinicki, T. (Ed.) *Aging at the Molecular Level*. Dordrecht, Kluwer.

Vourisalo, T. & Muitkainen, P. (1999) Preface. In Vourisalo, T. & Muitkainen, P. (Eds.) *Life History Evolution in Plants*. Boston, Kluwer.

Wagner, G. P., Pavlicev, M. & Cheverud, J. M. (2007) The road to modularity. *Nature Reviews Genetics*, 8, 921–931.

Wahl, M. (1985) *Metridium senile*: dispersion and small scale colonization by the combined strategy of locomotion and asexual reproduction (laceration). *Marine Ecology Progress Series*, 26, 271–277.

Wakelin, D. & Blackwell, J. (Eds.) (1988) *Genetics of Resistance to Bacterial and Parasite Infection*. London, Taylor & Francis.

Walford, R. L., Harris, S. B. & Gunion, M. W. (1992) The calorically restricted low-fat nutrient-dense diet in Biosphere 2 significantly lowers blood glucose, total leukocyte count, cholesterol, and blood pressure in humans. *Proceedings of the National Academy of Sciences of the United States of America*, 89, 11533–11537.

Walford, R. L., Mock, D., Verdery, R. & MacCallum, T. (2002) Calorie restriction in biosphere 2: alterations in physiologic, hematologic, hormonal, and biochemical parameters in humans restricted for a 2-year period. *Journal of Gerontology A*, 57, B211–B224.

Walker, R. & Hill, K. (2003) Modeling growth and senescence in physical performance among the ache of eastern Paraguay. *American Journal of Human Biology*, 15, 196–208.

Walker, A. & Leakey, R. E. (1993) *The Skull*. Berlin, Springer.

Walkiewicz, M. & Stern, M. (2009) Increased insulin/insulin growth factor signaling advances the onset of metamorphosis in *Drosophila*. *PLoS One*, 4, e5072.

Walpita, C. N., Van Der Geyten, S., Rurangwa, E. & Darras, V. M. (2007) The effect of 3,5,3′-triiodothyronine supplementation on zebrafish (*Danio rerio*) embryonic development and expression of iodothyronine deiodinases and thyroid hormone receptors. *General and Comparative Endocrinology*, 152, 206–214.

Walpita, C. N., Crawford, A. D., Janssens, E. D. R., Van Der Geyten, S. & Darras, V. M. (2009) Type 2 iodothyronine deiodinase is essential for thyroid hormone-dependent embryonic development and pigmentation in zebrafish. *Endocrinology*, 150, 530–539.

Wang, J. & Kim, S. K. (2003) Global analysis of dauer gene expression in *C. elegans*. *Development*, 130, 1621–1634.

Wang, Y. & Levy, D. E. (2006) *C. elegans* STAT cooperates with DAF-7/TGF-beta signaling to repress dauer formation. *Current Biology*, 16, 89–94.

Wang, Y. & Tissenbaum, H. A. (2006) Overlapping and distinct functions for a *Caenorhabditis elegans* SIR2 and DAF-16/FOXO. *Mechanisms of Ageing and Development*, 127, 48–56.

Wang, Y., Salmon, A. B. & Harshman, L. G. (2001) A cost of reproduction: oxidative stress susceptibility is associated with increased egg production in *Drosophila melanogaster*. *Experimental Gerontology*, 36, 1349–1359.

Wang, T., Hung, C. C. Y. & Randall, D. J. (2006a) The comparative physiology of food deprivation: from feast to famine. *Annual Review of Physiology*, 68, 223.

Wang, Y., Jorda, M., Jones, P. L., Maleszka, R., Ling, X., Robertson, H. M., Mizzen, C. A., Peinado, M. A. & Robinson, G. E. (2006b) Functional CpG methylation system in a social insect. *Science*, 314, 645–647.

Wang, M. C., O'Rourke, E. J. & Ruvkun, G. (2008) Fat metabolism links germline stem cells and longevity in *C. elegans*. *Science*, 322, 957–960.

Wang, M., Zhang, X., Zhao, H., Wang, Q. & Pan, Y. (2009a) FoxO gene family evolution in vertebrates. *BMC Evolutionary Biology*, 9, 222.

Wang, P. Y., Neretti, N., Whitaker, R., Hosier, S., Chang, C., Lu, D., Rogina, B. & Helfand, S. L. (2009b) Long-lived Indy and calorie restriction interact to extend life span. *Proceedings of the National Academy of Sciences of the United States of America*, 106, 9262–9267.

Wang, Z., Zhou, X. E., Motola, D. L., Gao, X., Suino-Powell, K., Conneely, A., Ogata, C., Sharma, K. K., Auchus, R. J., Lok, J. B., Hawdon, J. M., Kliewer, S. A., Xu, H. E. & Mangelsdorf, D. J. (2009c) Identification of the nuclear receptor Daf-12 as a therapeutic target in parasitic Nematodes. *Proceedings of the National Academy of Sciences of the United States of America*, 106, 9138–9143.

Wang, Q., Sajja, U., Rosloski, S., Humphrey, T., Kim, M. C., Bomblies, K., Weigel, D., and Grbic, V. 2007. *HUA2* caused natural variation in shoot morphology of A. thaliana. Current Biology 17: 1513–1519.

Wang, Y., Mutti, N. S., Ihle, K. E., Siegel, A., Dolezal, A. G., Kaftanoglu, O. & Amdam, G. V. (2010) Down-Regulation of Honey Bee IRS Gene Biases Behavior toward Food Rich in Protein. PLoS Genetics, 6, e1000896.

Warner, R. R. (1984) Deferred reproduction as a response to sexual selection in a coral-reef fish - a test of the life historical consequences. *Evolution*, 38, 148–162.

Warner, D., Lovern, M. & Shine, R. (2007) Maternal nutrition affects reproductive output and sex allocation in a lizard with environmental sex determination. *Proceedings of the Royal Society of London B*, 274, 883–890.

Warren, J., Yerushalmi, Y., Shimell, M., O'Connor, M., Restifo, L. & Gilbert, L. (2006) Discrete pulses of molting hormone, 20-hydroxyecdysone, during late larval development of *Drosophila melanogaster*: Correlations with changes in gene activity. *Developmental Dynamics*, 235, 315–326.

Wasser, S. K. & Barash, D. P. (1983) Reproductive suppression among female mammals: implications for biomedicine and sexual selection theory. *Quarterly Review of Biology*, 58, 513–538.

Waterhouse, R. M., Kriventseva, E. V., Meister, S., Xi, Z., Alvarez, K. S., Bartholomay, L. C., Barillas-Mury, C., Bian, G., Blandin, S., Christensen, B. M., Dong, Y., Jiang, H., Kanost, M. R., Koutsos, A. C., Levashina, E. A., Li, J., Ligoxygakis, P., MacCallum, R. M., Mayhew, G. F., Mendes, A., Michel, K., Osta, M. A., Paskewitz, S., Shin, S. W., Vlachou, D., Wang, L., Wei, W., Zheng, L., Zou, Z., Severson, D. W., Raikhel, A. S., Kafatos, F. C., Dimopoulos, G., Zdobnov, E. M. & Christophides, G. K. (2007) Evolutionary dynamics of immune-related genes and pathways in disease-vector mosquitoes. *Science*, 316, 1738–1743.

Watson, G. M. & Hessinger, D. A. (1989) Cnidocyte mechanoreceptors are tuned to the movements of swimming prey by chemoreceptors. *Science*, 243, 1589–1591.

Watson, G. M. & Mire, P. (2004) Dynamic tuning of hair bundle mechanoreceptors in a sea anemone during predation. *Hydrobiologia*, 530/531, 123–128.

Watson, R. D., Agui, N., Haire, M. E. & Bollenbacer, W. E. (1987) Juvenile hormone coordinates the regulation of the hemolymph ecdysteroid titer during pupal commitment in *Manduca sexta*. *Journal of Experimental Zoology*, 252, 255–263.

Watt, W. B. (1968) Adaptive significance of pigment polymorphisms in Colias butterflies. I. Variation of melanin pigment in relation to thermoregulation. *Evolution*, 22, 437–458.

Weber, K. E., Greenspan, R. J., Chicoine, D. R., Fiorentino, K., Thomas, M. H. & Knight, T. L. (2008) Microarray analysis of replicate populations selected against a wing-shape correlation in *Drosophila melanogaster*. *Genetics*, 178, 1093–1108.

Wedekind, C. & Folstad, I. (1994) Adaptive or nonadaptive immunosuppression by sex-hormones. *The American Naturalist*, 143, 936–938.

Weigel, D. & Nordborg, M. (2005) Natural variation in *Arabidopsis*. How do we find the causal genes? *Plant Physiology*, 138, 567–8.

Weindruch, R. (1989) Dietary restriction, tumors, and aging in rodents. *Journal of Gerontology*, 44, 67–71.

Weindruch, R. & Walford, R. L. (1982) Dietary restriction in mice beginning at 1 year of age: effect on life-span and spontaneous cancer incidence. *Science*, 215, 1415–1418.

Weinig, C. & Schmitt, J. (2004) Environmental effects on the expression of quantitative trait loci and implications for phenotypic evolution. *Bioscience*, 54, 627–635.

Weinkove D, Neufeld TP, Twardzik T, Waterfield MD, Leevers SJ. 1999. Regulation of imaginal disc cell size, cell number and organ size by *Drosophila* class I(A) phosphoinositide 3-kinase and its adaptor. *Current Biology*, 9, 1019–1029.

Wenseleers, T., Ratnieks, F. L. W., De Ribeiro, M., De A Alves, D. & Imperatriz-Fonseca, V.-L. (2005) Working class royalty: bees beat the caste system. *Biology Letters*, 1, 125–128.

Werner, J. D., Borevitz, J. O., Uhlenhaut, N. H., Ecker, J. R., Chory, J. & Weigel, D. (2005) Frigida-independent variation in flowering time of natural *Arabidopsis thaliana* accessions. *Genetics*, 170, 1197–1207.

Werren, J. H. & Charnov, E. L. (1978) Facultative sex-rations and population dynamics. *Nature*, 272, 349–350.

Wessells, R. J., Fitzgerald, E., Cypser, J. R., Tatar, M. & Bodmer, R. (2004) Insulin regulation of heart function in aging fruit flies. *Nature Genetics*, 36, 1275–1281.

West, G. B., Brown, J. H. & Enquist, B. J. (1997) A general model for the origin of allometric scaling laws in biology. *Science*, 276, 122–126.

West, G. B., Brown, J. H. & Enquist, B. J. (2001) A general model for ontogenetic growth. *Nature*, 413, 628–631.

West, G. B., Savage, V. M., Gillooly, J., Enquist, B. J., Woodruff, W. H. & Brown, J. H. (2003) Physiology: Why does metabolic rate scale with body size? *Nature*, 421, 713–713.

West-Eberhard, M. J. (1983) Sexual selection, social competition, and speciation. *Quarterly Review of Biology*, 58, 155–183.

West-Eberhard, M. J. (2003) *Developmental Plasticity and Evolution*. Oxford, Oxford University Press.

Westendorp, R. G. & Kirkwood, T. B. (1998) Human longevity at the cost of reproductive success. *Nature*, 396, 743–746.

Weyrich, P., Machicao, F., Reinhardt, J., Machann, J., Schick, F., Tschritter, O., Stefan, N., Fritsche, A. & Haring, H. U. (2008) SIRT1 genetic variants associate with the metabolic response of Caucasians to a controlled lifestyle intervention--the TULIP Study. *BMC Medical Genetics*, 9, 100.

Wheeler, W. C., Whitting, M., Wheeler, Q.M. and Carpenter, J.M. (2001) The phylogeny of the extant hexapod orders. *Cladistics*, 17, 113–169.

Wheeler, D. E., Buck, N. & Evans, J. D. (2006) Expression of insulin pathway genes during the period of caste determination in the honey bee, *Apis mellifera*. *Insect Biochemistry & Molecular Biology*, 15, 597–602.

White B. A., Nicoll C. S. (1981). Hormonal control of amphibian metamorphosis. In Gilbert, L. I. & Frieden, E. (Eds.) *Metamorphosis: A Problem in Developmental Biology*. New York, Plenum Press.

Whitfield, C. W., Cziko, A. M. & Robinson, G. E. (2003) Gene expression profiles in the brain predict behavior in individual honey bees. *Science*, 302, 296–299.

Whitfield, C. W., Ben-Shahar, Y., Brillet, C., Leoncini, I., Crauser, D., Leconte, Y., Rodriguez-Zas, S. & Robinson, G. E. (2006) Genomic dissection of behavioral maturation in the honey bee. *Proceedings of the National Academy of Sciences of the United States of America*, 103, 16068–16075.

Whitman, D. W. & Ananthakrishnan, T. N. (2009) *Phenotypic Plasticity of Insects*. Enfield, Science Publishers.

Wichman, H. A., Badgett, M. R., Scott, L. A., Boulianne, C. M. & Bull, J. J. (1999) Different trajectories of parallel evolution during viral adaptation. *Science*, 285, 422–424.

Wiederman, M. W. (1997) Extramarital sex: prevalence and correlates in a national survey. *Journal of Sex Research*, 34, 167–174.

Wiersma, P., Munoz-Garcia, A., Walker, A. & Williams, J. B. (2007) Tropical birds have a slow pace of life. *Proceedings of the National Academy of Sciences of the United States of America*, 104, 9340–9345.

Wigby, S. & Chapman, T. (2005) Sex peptide causes mating costs in female *Drosophila melanogaster*. *Current Biology*, 15, 316–321.

Wigby, S., Sirot, L. K., Linklater, J. R., Buehner, N., Calboli, F. C. F., Bretman, A., Wolfner, M. F. & Chapman, T. (2009)

Seminal fluid protein allocation and male reproductive success. *Current Biology*, 19, 751–757.

Wigglesworth, V. B. (1934) The physiology of ecdysis in Rhodnius prolixus. II. Factors controlling moulting and metamorphosis. *Quarterly Journal of Microscopic Sciences*, 77, 191–222.

Wigglesworth, V. B. (1936) The function of the corpora allatum in the growth and reproduction of *Rhodnius prolixus* (Hemiptera). *Quarterly Journal of Microscopic Sciences* 79, 91–121.

Wijngaarden, P. J., Koch, P. B. & Brakefield, P. M. (2002) Artificial selection on the shape of reaction norms for eyespot size in the butterfly *Bicyclus anynana*: direct and correlated responses. *Journal of Evolutionary Biology*, 15, 290–300.

Wikelski, M., Hau, M. & Wingfield, J. C. (1999) Social instability increases testosterone year-round in a tropical bird. *Proceedings of the Royal Society of London B*, 266, 1–6.

Wikelski, M., Hau, M. & Wingfield, J. C. (2000) Seasonality of reproduction in a neotropical rain forest bird. *Ecology*, 81, 2458–2472.

Wiklund, C., Persson, A. & Wickman, P. O. (1983) Larval estivation and direct development as alternative strategies in the speckled wood butterfly, *Pararge aegeria*, in Sweden. *Ecological Entomology*, 8, 233–238.

Wilbur, H. M. (1977) Propagule size, number, and dispersion patterns in *Ambystoma* and *Asclepias*. *The American Naturalist*, 111, 43–68.

Wilbur, H. M. & Collins, J. P. (1973) Ecological aspects of amphibian metamorphosis: Nonnormal distributions of competitive ability reflect selection for facultative metamorphosis. *Science* 182, 1305–1314.

Wilcox, A. J., Baird, D. D. & Weinberg, C. J. (1999) Time of implantation of the conceptus and loss of pregnancy. *New England Journal of Medicine*, 30, 1796–1799.

Wilczek, A. M., Roe, J. L., Knapp, M. C., Cooper, M. D., Lopez-Gallego, C., Martin, L. J., Muir, C. D., Sim, S., Walker, A., Anderson, J., Egan, J. F., Moyers, B. T., Petipas, R., Giakountis, A., Charbit, E., Coupland, G., Welch, S. M. & Schmitt, J. (2009) Effects of genetic perturbation on seasonal life history plasticity. *Science*, 323, 930–934.

Wilfert, L., Gadau, J. & Schmid-Hempel, P. (2007) The genetic architecture of immune defense and reproduction in male *Bombus terrestris* bumblebees. *Evolution*, 61, 804–815.

Willcox, S., Moltschaniwskyj, N. A. & Crawford, C. (2007) Asexual reproduction in scyphistomae of *Aurelia sp.*: Effects of temperature and salinity in an experimental study. *Journal of Experimental Marine Biology and Ecology*, 353, 107–114.

Willcox, B. J., Donlon, T. A., He, Q., Chen, R., Grove, J. S., Yano, K., Masaki, K. H., Willcox, D. C., Rodriguez, B. & Curb, J. D. (2008) FOXO3A genotype is strongly associated with human longevity. *Proceedings of the National Academy of Sciences of the United States of America*, 105, 13987–13992.

Williams, G. C. (1957) Pleiotropy, natural selection, and the evolution of senescence. *Evolution*, 11, 398–411.

Williams, G.C. (1966a). Adaptation and Natural Selection: A Critique of Some Current Evolutionary Thought. Princeton University Press, Princeton, NJ.

Williams, G. C. (1966b) Natural selection, the costs of reproduction, and a refinement of Lack's Principle. *The American Naturalist*, 100, 687–690.

Williams, T. D. (2008) Individual variation in endocrine systems: moving beyond the 'tyranny of the Golden Mean'. *Philosophical Transactions of the Royal Society of London B*, 363, 1687–1698.

Williams, E. A. & Degnan, S. M. (2009) Carry-over effect of larval settlement cue on postlarval gene expression in the marine gastropod *Haliotis asinina*. *Molecular Ecology*, 18, 4434–4449.

Williams, K. D., Busto, M., Suster, M. L., So, A. K., Ben-Shahar, Y., Leevers, S. J. & Sokolowski, M. B. (2006a) Natural variation in *Drosophila melanogaster* diapause due to the insulin-regulated PI3-kinase. *Proceedings of the National Academy of Sciences of the United States of America*, 103, 15911–15915.

Williams, P. D., Day, T., Fletcher, Q. & Rowe, L. (2006b) The shaping of senescence in the wild. *Trends in Ecology & Evolution*, 21, 458–463.

Williams, J. B., Roberts, S. P. & Elekonich, M. M. (2008) Age and natural metabolically-intensive behavior affect oxidative stress and antioxidant mechanisms. *Experimental Gerontology*, 43, 538–549.

Williams, E. A., Degnan, B. M., Gunter, H., Jackson, D. J., Woodcroft, B. J. & Degnan, S. M. (2009a) Widespread transcriptional changes pre-empt the critical pelagic-benthic transition in the vetigastropod *Haliotis asinina*. *Molecular Ecology*, 18, 1006–1025.

Williams, K. D., Schmidt, P. S. & Sokolowski, M. B. (2009b) Photoperiodism in Insects: Molecular Basis and Consequences of Diapause. In Nelson, R. J., Denlinger, D. L. & Somers, R. J. (Eds.) *Photoperiodism: The Biological Calendar*. Oxford, Oxford University Press.

Wilson, T. G. & Ashok, M. (1998) Insecticide resistance resulting from an absence of target-site gene product. *Proceedings of the National Academy of Sciences of the United States of America*, 95, 14040–14044.

Wilson, M. & Daly, M. (1985) Competitiveness, risk taking, and violence: the young male syndrome. *Ethology and Sociobiology*, 6, 59–73

Wilson, T. G. & Fabian, J. (1986) A *Drosophila melanogaster* mutant resistant to a chemical analog of juvenile hormone. *Developmental Biology*, 118, 190–201.

Wilson, R. B. & Tatchell, K. (1988) SRA5 encodes the low-Km cyclic-AMP phosphodiesterase of *Saccharomyces cerevisiae*. *Molecular and Cellular Biology*, 8, 505–510.

Wilson, K., Thorndyke, M., Nilsen, F., Rogers, A. & Martinez, P. (2005) Marine systems: moving into the genomics era. *Marine Ecology*, 26, 3–16.

Windig, J. J., Brakefield, P. M., Reitsma, N. & Wilson, J. G. M. (1994) Seasonal polyphenism in the wild: survey of wing patterns in five species of *Bicyclus* butterflies in Malawi. *Ecological Entomology*, 19, 285–298.

Wingfield, J. C. (2006) Communicative behaviors, hormone-behavior interactions, and reproduction in vertebrates. In Neill, J. D. (Ed.) *Physiology of Reproduction*. New York, Academic Press.

Wingfield, J. C. (2008) Comparative endocrinology, environment and global change. *General and Comparative Endocrinology*, 157, 207–216.

Wingfield, J. C. & Farner, D. S. (1993) Endocrinology of reproduction in wild species. In Farner, D. S., King, J. R. & Parkes, K. C. (Eds.) *Avian Biology*. London, Academic Press.

Wingfield, J. & Moore, M. C. (1987) Hormonal, social and environmental factors in the reproductive biology of free-living male birds. In Crews, D. (Ed.) *Psychobiology of Reproductive Behavior: An Evolutionary Perspective*. Englewood Cliffs, NJ, Prentice Hall.

Wingfield, J. C., Hegner, R. E., Dufty, A. M. J. & Ball, G. F. (1990) The 'challenge-hypothesis': theoretical implications for patterns of testosterone secretion, mating systems, and breeding strategies. *The American Naturalist*, 136, 829–846.

Wingfield, J. C., Hahn, T. P., Levin, R. & Honey, P. (1992) Environmental predictability and control of gonadal cycles in birds. *Journal of Experimental Zoology A*, 261, 214–231.

Wingfield, J. C., Lynn, S. E. & Soma, K. K. (2001) Avoiding the 'costs' of testosterone: ecological bases of hormone-behavior interactions. *Brain, Behavior and Evolution* 57, 239–251.

Wingfield, J. C., Meddle, S. L., Moore, I., Busch, S., Wacker, D., Lynn, S., Clark, A., Vasquez, R. A. & Addis, E. (2007) Endocrine responsiveness to social challenges in northern and southern hemisphere populations of *Zonotrichia*. *Journal of Ornithology*, 148, S435–S441.

Winston, A. L. (1987) *The Biology of the Honeybee*. Cambridge, MA, Harvard University Press.

Winther, R. G. (2001) Varieties of modules: kinds, levels, origins, and behaviors. *Journal of Experimental Zoology*, 291, 116–129.

Witte, A. V., Fobker, M., Gellner, R., Knecht, S. & Floel, A. (2009) Caloric restriction improves memory in elderly humans. *Proceedings of the National Academy of Sciences of the United States of America*, 106, 1255–1260.

Wolf, J. B. & Hager, R. (2006) A maternal–offspring coadaptation theory for the evolution of genomic imprinting. *PLoS Biology*, 4: e380.

Wolf, J. B., Brodie, E. D., Cheverud, J. M., Moore, A. J. & Wade, M. J. (1998) Evolutionary consequences of indirect genetic effects. *Trends in Ecology & Evolution*, 13, 64–69.

Wolfe, K. H., Gouy, M. L., Yang, Y. W., Sharp, P. M. & Li, W. H. (1989) Date of the monocot dicot divergence estimated from chloroplast DNA sequence data. *Proceedings of the National Academy of Sciences of the United States of America*, 86, 6201–6205.

Wolff, S., Ma, H., Burch, D., Maciel, G. A., Hunter, T. & Dillin, A. (2006) SMK-1, an essential regulator of DAF-16-mediated longevity. *Cell*, 124, 1039–1053.

Wolschin, F. & Amdam, G. V. (2007a) Plasticity and robustness of protein patterns during reversible development in the honey bee (*Apis mellifera*). *Analytical and Bioanalytical Chemistry*, 389, 1095–1100.

Wolschin, F. & Amdam, G. V. (2007b) Comparative proteomics reveal characteristics of life history transitions in a social insect. *Proteome Science*, 5, 10.

Wolschin, F., Munch, D. & Amdam, G. V. (2009) Structural and proteomic analyses reveal regional brain differences during honeybee aging. *Journal of Experimental Biology*, 212, 4027–4032.

Wolschin F, Mutti NS, Amdam GV (2011) Insulin receptor substrate influences female caste development in honeybees. *Biology Letters*, 23, 112–115.

Wong, J. M. & Shi, Y. B. (1995) Coordinated regulation of and transcriptional activation by *Xenopus* thyroid hormone and retinoid-X-receptors. *Journal of Biological Chemistry*, 270, 18479–18483.

Wood, J. (1994) *Dynamics of Human Reproduction: Biology, Biometry, Demography*. Hawthorne, Aldine de Gruyter.

Wood, J. G., Rogina, B., Lavu, S., Howitz, K., Helfand, S. L., Tatar, M. & Sinclair, D. (2004) Sirtuin activators mimic caloric restriction and delay aging in Metazoans. *Nature*, 430, 686–689.

Wood, T. E., Burke, J. M. & Reiseberg, L. H. (2005) Parallel genotypic adaptation: when evolution repeats itself. *Genetica*, 123, 157–170.

Woods, R., Schneider, D., Winkworth, C. L., Riley, M. A. & Lenski, R. E. (2006) Tests of parallel molecular evolution in a long-term experiment with *Escherichia coli*. *Proceedings of the National Academy of Sciences of the United States of America*, 103, 9107–9112.

Wootton, R. J. & Kukalova-Peck, J. (2000) Flight adaptations in Palaeozoic Palaeoptera (Insecta). *Biological*

Reviews of the Cambridge Philosophical Society 75, 129–167.

Worley, A. C., Houle, D. & Barrett, S. C. H. (2003) Consequences of hierarchical allocation for the evolution of life history traits. *The American Naturalist*, 161, 153–167.

Wrangham, R. W. & Peterson, D. (1996) *Demonic males*. New York, Houghton Mifflin Company.

Wray, G. A. (1994) Developmental evolution – new paradigms and paradoxes. *Developmental Genetics*, 15, 1–6.

Wray, G. A. (1995) Evolution of larvae and developmental modes. In McEdward, L. (Ed.) *Ecology of Marine Invertebrate Larvae*. Boca Raton, CRC Press.

Wray, G. A. (1996) Parallel evolution of nonfeeding larvae in Echinoids. *Systematic Biology*, 45, 308–322.

Wright, G. M. & Youson, J. H. (1977) Serum thyroxine concentrations in larval and metamorphosing anadromous sea lamprey, *Petromyzon marinus* L. *Journal of Experimental Zoology*, 202, 27–32.

Wright, G. M. & Youson, J. H. (1980) Transformation of the endostyle of the anadromous sea lamprey, *Petromyzon marinus* L, during metamorphosis. 2. Electron-microscopy. *Journal of Morphology*, 166, 231–257.

Wu, X. H., Hopkins, P. M., Palli, S. R. & Durica, D. S. (2004) Crustacean retinoid-X receptor isoforms: distinctive DNA binding and receptor-receptor interaction with a cognate ecdysteroid receptor. *Molecular and Cellular Endocrinology*, 218, 21–38.

Wu, Q., Zhang, Y., Xu, H. & Shen, P. (2005) Regulation of hunger-driven behaviors by neural ribosomal S6 kinase in *Drosophila*. *Proceedings of the National Academy of Sciences of the United States of America*, 102, 13289–13294.

Wu, P., Shen, Q., Dong, S., Xu, Z., Tsien, J. Z. & Hu, Y. (2008) Calorie restriction ameliorates neurodegenerative phenotypes in forebrain-specific presenilin-1 and presenilin-2 double knockout mice. *Neurobiology of Aging*, 29, 1502–1511.

Wulff, J. L. (1991) Asexual fragmentation, genotype success, and population dynamics of erect branching sponges. *Journal of Experimental Marine Biology and Ecology*, 149, 227–247.

Wyatt, G. R. (1997) Juvenile hormone in insect reproduction – a paradox? *European Journal of Entomology*, 94, 323–333.

Wykoff, D. D., Davies, J. P., Melis, A. & Grossman, A. R. (1998) The regulation of photosynthetic electron transport during nutrient deprivation in *Chlamydomonas reinhardtii*. *Plant Physiology*, 117, 129–139.

Wynne-Edwards, K. E. (2003) From dwarf hamster to daddy: The intersection of ecology, evolution, and physiology that produces paternal behavior. In Slater, P. J. B., Rosenblatt, J. S., Snowden, C. T. & Roper, T. J. (Eds.) *Advances in the Study of Behavior*. San Diego, Academic Press.

Xu, S. (2003) Theoretical basis of the Beavis effect. *Genetics*, 165, 2259–2268.

Yamada, H., Ohta, H. & Yamauchi, K. (1993) Serum thyroxine, estradiol-17-beta, and testosterone profiles during the parr-smolt transformation of Masu Salmon, *Oncorhynchus masou*. *Fish Physiology and Biochemistry*, 12, 1–9.

Yamamoto, K. & Kikuyama, S. (1982) Radioimmunoassay of prolactin in plasma of bullfrog tadpoles. *Endocrinologia Japonica*, 29, 159–167.

Yamamoto, H., Tachibana, A., Kawaii, S., Matsumura, K. & Fusetani, N. (1996) Serotonin involvement in larval settlement of the barnacle, *Balanus amphitrite*. *Journal of Experimental Zoology*, 275, 339–345.

Yamano, K. & Miwa, S. (1998) Differential gene expression of thyroid hormone receptor alpha and beta in fish development. *General and Comparative Endocrinology*, 109, 75–85.

Yamano, K., Miwa, S., Obinata, T. & Inui, Y. (1991a) Thyroid hormone regulates developmental changes in muscle during flounder metamorphosis. *General and Comparative Endocrinology*, 81, 464–472.

Yamano, K., Tagawa, M., de Jesus, E. G., Hirano, T., Miwa, S. & Inui, Y. (1991b) Changes in whole-body concentrations of thyroid hormones and cortisol in metamorphosing conger eel. *Journal of Comparative Physiology B*, 161, 371–375.

Yamano, K., Takanoohmuro, H., Obinata, T. & Inui, Y. (1994) Effect of thyroid hormone on developmental transition of myosin light chains during flounder metamorphosis. *General and Comparative Endocrinology*, 93, 321–326.

Yamasaki, S., Fujii, N. & Takahashi, H. (2005) Hormonal regulation of sex expression in plants. *Plant Hormones*. San Diego, Elsevier Academic Press Inc.

Yamauchi, K. & Tata, J. R. (1994) Purification and characterization of a cytosolic thyroid-hormone-binding protein (CTBP) in *Xenopus* liver. *European Journal of Biochemistry / FEBS*, 225, 1105–1112.

Yamauchi, K. & Tata, J. R. (1997) Tissue-dependent and developmentally regulated cytosolic thyroid-hormone-binding proteins (CTBPs) in Xenopus. *Comparative Biochemistry and Physiology C*, 118, 27–32.

Yamauchi, K., Kasahara, T., Hayashi, H. & Horiuchi, R. (1993) Purification and characterization of a 3,5,3′-L-triiodothyronine-specific binding protein from bullfrog tadpole plasma: A homolog of mammalian transthyretin. *Endocrinology*, 132, 2254–2261.

Yan, G. & Norman, S. (1995) Infection of *Tribolium* beetles with a tapeworm: variation in susceptibility within and between species and among genetic strains. *Journal of Parasitology*, 81, 37–42.

Yan, G. & Stevens, L. (1995) Selection by parasites on components of fitness in *Tribolium* beetles: the effect of intraspecific competition. *The American Naturalist*, 146, 795–813.

Yan, G. Y., Stevens, L., Goodnight, C. J. & Schall, J. J. (1998) Effects of a tapeworm parasite on the competition of *Tribolium* beetles. *Ecology*, 79, 1093–1103.

Yanai, S., Okaichi, Y. & Okaichi, H. (2004) Long-term dietary restriction causes negative effects on cognitive functions in rats. *Neurobiology of Aging*, 25, 325–332.

Yang, H., Zhao, Z. G., Qiang, W. Y., An, L. Z., Xu, S. J. & Wang, X. L. (2004) Effects of enhanced Uv-B radiation on the hormonal content of vegetative and reproductive tissues of two tomato cultivars and their relationships with reproductive characteristics. *Plant Growth Regulation*, 43, 251–258.

Yang, J., Anzo, M. & Cohen, P. (2005) Control of aging and longevity by IGF-I signaling. *Experimental Gerontology*, 40, 867–872.

Yang, C. H., Belawat, P., Hafen, E., Jan, L. Y. & Jan, Y. N. (2008) *Drosophila* egg-laying site selection as a system to study simple decision-making processes. *Science*, 319, 1679–1683.

Yano, M., Katayose, Y., Ashikari, M., Yamanouchi, U., Monna, L., Fuse, T., Baba, T., Yamamoto, K., Umehara, Y., Nagamura, Y. & Sasaki, T. (2000) *Hd1*, a major photoperiod sensitivity quantitative trait locus in rice, is closely related to the *Arabidopsis* flowering time gene *CONSTANS*. *Plant Cell*, 12, 2473–2483.

Yaoita, Y., Shi, Y. & Brown, D. (1990) *Xenopus laevis* alpha and beta thyroid hormone receptors. *Proceedings of the National Academy of Sciences of the United States of America*, 87, 7090–7094.

Ye, Y. H., Chenoweth, S. F. & McGraw, E. A. (2009) Effective but costly, evolved mechanisms of defense against a virulent opportunistic pathogen in *Drosophila melanogaster*. *PLoS Pathogens*, 5, e1000385.

Yen, P. M. (2001) Physiological and molecular basis of thyroid hormone action. *Physiological Reviews*, 81, 1097–1142.

Yerex, R. P., Young, C. W., Donker, J. D. & Marx, G. D. (1988) Effects of selection for body size on feed efficiency and size of Holsteins. *Journal of Dairy Science*, 71, 1355–1360.

Yin, T. J. & Quinn, J. A. (1995) Tests of a mechanistic model of one hormone regulating both sexes in *Cucumis sativus* (Cucurbitaceae). *American Journal of Botany*, 82, 1537–1546.

Yoshiga, T., Georgieva, T., Dunkov, B. C., Harizanova, N., Ralchev, K. & Law, J. H. (1999) *Drosophila melanogaster* transferrin. Cloning, deduced protein sequence, expression during the life cycle, gene localization and up-regulation on bacterial infection. *European Journal of Biochemistry*, 260, 414–420.

Yoshizato, K., Kistler, A. & Frieden, E. (1975) Metal ion dependence of the binding of triiodothyronine by cytosol proteins of bullfrog tadpole tissues. *Journal of Biological Chemistry*, 250, 8337–8343.

Young, L. J. & Insel, T. R. (2002) Hormones and parental behavior. In Becker, J. B., Breedlove, S. M. & McCarthy, M. M. (Eds.) *Behavioral Endocrinology*. Cambridge, MIT Press.

Youson, J. H. (1988) First Metamorphosis. In Hoar, W.S. and Randall, D. J. (Eds.) *Fish Physiology: The Physiology of Developing Fish*. Toronto, Academic Press, Inc.

Youson, J. H. (2004) The Impact of Environmental and Hormonal Cues on the Evolution of Fish Metamorphosis. In Hall, B. K., Pearson, R. D., Muller, G. B., (Eds.), *Environment, Development, and Evolution: Toward a Synthesis*. Cambridge, London, MIT Press.

Youson, J. H. & Potter, I. C. (1979) Description of the stages in the metamorphosis of the anadromous sea lamprey, *Petromyzon marinus L. Canadian Journal of Zoology-Revue Canadienne de Zoologie*, 57, 1808–1817.

Youson, J. H. & Sower, S. A. (2001) Theory on the evolutionary history of lamprey metamorphosis: role of reproductive and thyroid axes. *Comparative Biochemistry and Physiology B*, 129, 337–345.

Youson, J. H., Plisetskaya, E. M. & Leatherland, J. F. (1994) Concentrations of insulin and thyroid hormones in the serum of landlocked sea lampreys (*Petromyzon marinus*) of 3 larval year classes, in larvae exposed to 2 temperature regimes, and in individuals during and after metamorphosis. *General and Comparative Endocrinology*, 94, 294–304.

Youson, J. H., Holmes, J. A. & Leatherland, J. F. (1995) Serum concentrations of thyroid hormones in KClO4-treated larval sea lampreys (*Petromyzon marinus L*) *Comparative Biochemistry and Physiology C*, 111, 265–270.

Youson, J. H., Manzon, R. G., Peck, B. J. & Holmes, J. A. (1997) Effects of exogenous thyroxine (T4) and triiodothyronine (T3) on spontaneous metamorphosis and serum T4 and T3 levels in immediately premetamorphic sea lampreys, *Petromyzon marinus. Journal of Experimental Zoology*, 279, 145–155.

Youson, J. H. (2007) Peripheral Endocrine Glands. I. The gastroenteropancreatic endocrine system and the thyroid gland. In McKenzie D. J., Farrell A. P., and Brauner C. J. (Eds.), *Primitive Fishes*. New York, Academic Press.

Yu, J., Vodyanik, M. A., Smuga-Otto, K., Antosiewicz-Bourget, J., Frane, J. L., Tian, S., Nie, J., Jonsdottir, G. A., Ruotti, V., Stewart, R., Slukvin, I. & Thomson, J. A. (2007a) Induced pluripotent stem cell lines derived from human somatic cells. *Science*, 318, 1917–1920.

Yu, X. J., Yan, Y. & Gu, J. D. (2007b) Attachment of the biofouling Bryozoan *Bugula neritina* larvae affected by inorganic and organic chemical cues. *International Biodeterioration & Biodegradation*, 60, 81–89.

Zakon, H. H. (1998) The effects of steroid hormones on electrical activity of excitable cells. *Trends in Neurosciences*, 21, 202–207.

Zamudio, K. R. & Sinervo, E. (2000) Polygyny, mate-guarding, and posthumous fertilization as alternative male mating strategies. *Proceedings of the National Academy of Sciences of the United States of America*, 97, 14427–14432.

Zavala, J. A., Patankar, K., Gase, K. & Baldwin, I. T. (2004) Constitutive and inducible trypsin proteinase inhibitor production incurs large fitness costs in *Nicotiana attenuata*. *Proceedings of the National Academy of Sciences of the United States of America*, 101, 1607–1612.

Zega, G., Pennati, R., Groppelli, S., Sotgia, C. & De Bernardi, F. (2005) Dopamine and serotonin modulate the onset of metamorphosis in the Ascidian *Phallusia mammillata*. *Developmental Biology*, 282, 246–256.

Zega, G., Pennati, R., Fanzago, A. & De Bernardi, F. (2007) Serotonin involvement in the metamorphosis of the hydroid *Eudendrium racemosum*. *International Journal of Developmental Biology*, 51, 307–313.

Zera, A. J. (2005) Intermediary metabolism and life history trade-offs: Lipid metabolism in lines of the wing-polymorphic cricket, *Gryllus firmus*, selected for flight capability vs. early age reproduction. *Integrative and Comparative Biology*, 45, 511–524.

Zera, A. J. (2009) Wing polymorphism in crickets. In Whitman, D. W. & Ananthakrishnan, T. N. (Eds.) *Phenotypic Plasticity of Insects*. Enfield, Science Publishers.

Zera, A. J. (2011) Microevolution of intermediary metabolism: Evolutionary genetics meets metabolic biochemistry. Journal of Experimental Biology, 214, 179–190.

Zera, A. J. & Brink, T. (2000) Nutrient absorption and utilization by wing and flight muscle morphs of the cricket *Gryllus firmus*: implications for the trade-off between flight capability and early reproduction. *Journal of Insect Physiology*, 46, 1207–1218.

Zera, A. J. & Harshman, L. G. (2001) The physiology of life history trade-offs in animals. *Annual Review of Ecology and Systematics*, 32, 95–126.

Zera, A. J. & Harshman, L. G. (2009) Laboratory selection studies of life history physiology in insects. In Garland, T. & Rose, M. R. (Eds.) *Experimental Evolution: Methods and Applications*. Berkeley, University of California Press.

Zera, A. J. & Larsen, A. (2001) The metabolic basis of life history variation: Genetic and phenotypic differences in lipid reserves among life history morphs of the wing-polymorphic cricket, *Gryllus firmus*. *Journal of Insect Physiology*, 47, 1147–1160.

Zera, A. J. & Zhao, Z. (2003) Life history evolution and the microevolution of intermediary metabolism: activities of lipid-metabolizing enzymes in life history morphs of a wing-dimorphic cricket. *Evolution*, 57, 568–596.

Zera, A. J. & Zhao, Z. (2004) Effect of a juvenile hormone analogue on lipid metabolism in a wing-polymorphic cricket: implications for the biochemical basis of the trade-off between reproduction and dispersal. *Biochemical and Physiological Zoology*, 77, 255–266.

Zera, A. J. & Zhao, Z. (2006) Intermediary metabolism and life history trade-offs: differential metabolism of amino acids underlies the dispersal-reproduction trade-off in a wing-polymorphic cricket. *The American Naturalist*, 167, 889–900.

Zera, A. J., Koehn, R. K. & Hall, J. G. (1985) Allozymes and biochemical adaptation. In Kerkut, G. A. & Gilbert, L. I. (Eds.) *Comprehensive Insect Physiology Biochemistry and Pharmacology*. Oxford, Pergamon.

Zera, A. J., Harshman, L. G. & Williams, T. (2007) Evolutionary endocrinology: the developing synthesis between endocrinology and evolutionary genetics. *Annual Review of Ecology and Systematics*, 38, 793–817.

Zera, A. J., Berkheim, D., Newman, S., Black, C., Klug, L., and E. Crone. 2011. Purification and characterization of cytoplasmic NADP+-isocitrate dehydrogenase, and amplification of the Nadp+-Idh gene from the wing-dimorphic cricket, Gryllus firmus. Journal of Insect Science. In Press.

Zhan, M., Yamaza, H., Sun, Y., Sinclair, J., Li, H. & Zou, S. (2007) Temporal and spatial transcriptional profiles of aging in *Drosophila melanogaster*. *Genome Research*, 17, 1236–1243.

Zhang, H., Liu, J., Li, C. R., Momen, B., Kohanski, R. A. & Pick, L. (2009) Deletion of *Drosophila* insulin-like peptides causes growth defects and metabolic abnormalities. *Proceedings of the National Academy of Sciences of the United States of America*, 106, 19617–19622.

Zhao, Z. and Zera, A. J. (2001) Enzymological and radiotracer studies of lipid metabolism in t he flight-capable and flightless morphs of the wing-polymorphic cricket, *Gryllus firmus*. *Journal of Insect Physiology*, 47, 1337–2347.

Zhao, Z. & Zera, A. J. (2002) Differential lipid biosynthesis underlies a trade-off between reproduction and flight capability in a wing-polymorphic cricket. *Proceedings of the National Academy of Sciences of the United States of America*, 99, 16829–16834.

Zhao, Y., Sun, H., Lu, J., Li, X., Chen, X., Tao, D., Huang, W. & Huang, B. (2005) Lifespan extension and elevated hsp gene expression in *Drosophila* caused by histone deacetylase inhibitors. *Journal of Experimental Biology*, 208, 697–705.

Zheng, J., Edelman, S. W., Tharmarajah, G., Walker, D. W., Pletcher, S. D. & Seroude, L. (2005) Differential patterns of apoptosis in response to aging in *Drosophila*. *Proceedings of the National Academy of Sciences of the United States of America*, 102, 12083–12088.

Zhong, D. B., Pai, A. & Yan, G. Y. (2005) Costly resistance to parasitism: Evidence from simultaneous quantitative rait loci mapping for resistance and fitness in *Tribolium castaneum*. *Genetics*, 169, 2127–2135.

Zhou, B., & Riddiford, L.M. (2001) Hormonal regulation and patterning of the broad-complex in the epidermis and wing discs of the tobacco hornworm, *Manduca sexta*. *Developmental Biology*, 231, 125–137.

Zhou, B., & Riddiford, L.M. (2002) Broad specifies pupal development and mediates the 'status quo' action of juvenile hormone on the pupal-adult transformation in *Drosophila* and *Manduca*. *Development*, 129, 2259–2269.

Zhou, B., Hiruma, K., Shinoda, T. and Riddiford, L. M. (1998) Juvenile hormone prevents ecdysteroid-induced expression of broad complex RNAs in the epidermis of the tobacco hornworm. *Developmental Biology*, 203, 233–244.

Zhou, N., Wilson, K. A., Andrews, M. E., Kauffman, J. S. & Raff, R. A. (2003) Evolution of Otp-independent larval skeleton patterning in the direct-developing sea urchin, *Heliocidaris erythogramma*. *Journal of Experimental Zoology B*, 300, 58–71.

Zhou, G. L., Pennington, J. E. & Wells, M. A. (2004) Utilization of pre-existing energy stores of female *Aedes aegypti* mosquitoes during the first gonotrophic cycle. *Insect Biochemistry & Molecular Biology*, 34, 919–925.

Zhou, B., Williams, D. W., Altman, J., Riddiford, L. M. & Truman, J. W. (2009) Temporal patterns of Broad isoform expression during the development of neuronal lineages in *Drosophila*. *Neural Development*, 4, 4–39.

Zid, B. M., Rogers, A. N., Katewa, S. D., Vargas, M. A., Kolipinski, M. C., Lu, T. A., Benzer, S. & Kapahi, P. (2009) 4E-BP extends lifespan upon dietary restriction by enhancing mitochondrial activity in *Drosophila*. *Cell*, 139, 149–160.

Ziegler, T. E. & Snowdon, C. T. (1997) Role of prolactin in paternal care in a monogamous New World primate, *Saguinus oedipus*. *Annals of the New York Academy of Sciences*, 807, 599–601.

Zijlstra, W. G., Steigenga, M. J., Brakefield, P. M. & Zwaan, B. J. (2003) Simultaneous selection on two fitness-related traits in the butterfly *Bicyclus anynana*. *Evolution*, 57, 1852–1862.

Zijlstra, W. G., Steigenga, M. J., Koch, P. B., Zwaan, B. J. & Brakefield, P. M. (2004) Butterfly selected lines explore the hormonal basis of interactions between life histories and morphology. *The American Naturalist*, 163, 76–87.

Zimmer, R. K. & Butman, C. A. (2000) Chemical signaling processes in the marine environment. *Biological Bulletin*, 198, 168–187.

Zirkin, B. R. & Chen, H. (2000) Regulation of Leydig cell steroidogenic function during aging. *Biology of Reproduction*, 63, 977–981.

Zuk, M. & Stoehr, A. M. (2002) Immune defense and host life history. *The American Naturalist*, 160, S9–S22.

Zwaan, B. J. (1999) The evolutionary genetics of aging and longevity. *Heredity*, 82, 589–597.

Zwaan, B., Bijlsma, R. & Hoekstra, R. F. (1995) Direct selection on life-span in *Drosophila melanogaster*. *Evolution*, 49, 649–659.

Zwaan, B. J., Azevedo, R. B., James, A. C., Van't Land, J. & Partridge, L. (2000) Cellular basis of wing size variation in *Drosophila melanogaster*: a comparison of latitudinal clines on two continents. *Heredity*, 84, 338–347.