



Universiteit  
Leiden  
The Netherlands

## Targeting environmental and genetic aspects affecting life history traits

Baldal, E.A.

### Citation

Baldal, E. A. (2006, November 23). *Targeting environmental and genetic aspects affecting life history traits*. Retrieved from <https://hdl.handle.net/1887/4987>

Version: Corrected Publisher's Version

License: [Licence agreement concerning inclusion of doctoral thesis in the Institutional Repository of the University of Leiden](#)

Downloaded from: <https://hdl.handle.net/1887/4987>

**Note:** To cite this publication please use the final published version (if applicable).

## Literature Cited



## Literature Cited

- Ackermann, M., R. Bijlsma, A. C. James, L. Partridge, B. J. Zwaan, and S. C. Stearns. 2001. Effects of assay conditions in life history experiments with *Drosophila melanogaster*. *Journal of Evolutionary Biology* 14:199-209.
- Alcedo, J., and C. Kenyon. 2004. Regulation of *C. elegans* longevity by specific gustatory and olfactory neurons. *Neuron* 41:45-55.
- Anderson, R. M., K. J. Bitterman, J. G. Wood, O. Medvedik, and D. A. Sinclair. 2003. Nicotinamide and PNC1 govern lifespan extension by calorie restriction in *Saccharomyces cerevisiae*. *Nature* 423:181-185.
- Anonymus. 1972. Diet and coronary heart disease - Joint statement of food nutrition board, division of biology and agriculture, national academy of sciences, national research council and council of foods and nutrition, American medical association July, 1972. *Nutrition reviews* 30:223-225.
- Archer, M. A., J. P. Phelan, K. A. Beckman, and M. R. Rose. 2003. Breakdown in correlations during laboratory evolution. II. Selection on stress resistance in *Drosophila* populations. *Evolution* 57:536-543.
- Arking, R., S. Buck, A. Berrios, S. Dwyer, and G. T. Baker. 1991. Elevated paraquat resistance can be used as a bioassay for longevity in a genetically based long-lived strain of *Drosophila*. *Developmental Genetics* 12:362-370.
- Arking, R., V. Burde, K. Graves, R. Hari, E. Feldman, A. Zeevi, S. Soliman, A. Saraiya, S. Buck, J. Vettraino, and K. Sathrasala. 2000. Identical longevity phenotypes are characterized by different patterns of gene expression and oxidative damage. *Experimental Gerontology* 35:353-373.
- Ashburner, M., K. G. Golic, and R. Scott Hawley. 1989. *Drosophila* - a laboratory handbook. Cold Spring Harbor Laboratory Press
- Baldal, E. A., K. van der Linde, J. J. M. van Alphen, P. M. Brakefield, and B. J. Zwaan. 2005. The effects of larval density on adult life-history traits in three species of *Drosophila*. *Mechanisms of Ageing and Development* 126:407-416.
- Baldal, E.A., P.M. Brakefield, and B.J. Zwaan. (2006). Multitrait evolution in lines of *Drosophila melanogaster* selected for increased starvation resistance: the role of metabolic rate and implications for the evolution of longevity. *Evolution* 60(7): 1435-1444.
- Barnes, A. I., and L. Partridge. 2003. Costing reproduction. *Animal Behaviour* 66:199-204.
- Bhui-Kaur, A., M. F. Goodman, and J. Tower. 1998. DNA mismatch repair catalyzed by extracts of mitotic, post-mitotic, and senescent *Drosophila* tissues and involvement of *mei-9* gene function for full activity. *Molecular and Cellular Biology* 18:1436-1443.
- Bluher, M., B. B. Kahn, and C. R. Kahn. 2003. Extended longevity in mice lacking the insulin receptor in adipose tissue. *Science* 299:572-574.
- Boggs, C. L., and K. D. Freeman. 2005. Larval food limitation in butterflies: effects on adult resource allocation and fitness. *Oecologia* 144:353-361.
- Borash, D. J., A. G. Gibbs, A. Joshi, and L. D. Mueller. 1998. A genetic polymorphism maintained by natural selection in a temporally varying environment. *American Naturalist* 151:148-156.
- Borash, D. J., and G. T. Ho. 2001. Patterns of selection: stress resistance and energy storage in density-dependent populations of *Drosophila melanogaster*. *Journal of Insect Physiology* 47:1349-1356.

- Borash, D. J., H. Teotonio, M. R. Rose, and L. D. Mueller. 2000. Density-dependent natural selection in *Drosophila*: correlations between feeding rate, development time and viability. *Journal of Evolutionary Biology* 13:181-187.
- Bouletreau-Merle, J., and P. Fouillet. 2002. How to overwinter and be a founder: egg-retention phenotypes and mating status in *Drosophila melanogaster*. *Evolutionary Ecology* 16:309-332.
- Braeckman, B. P., K. Houthoofd, and J. R. Vanfleteren. 2001. Insulin-like signaling, metabolism, stress resistance and aging in *Caenorhabditis elegans*. *Mechanisms of Ageing and Development* 122:673-693.
- Brakefield, P. M., D. Gems, T. Cowen, K. Christensen, B. Grubeck-Loebenstein, L. Keller, J. Oepfen, A. Rodriguez-Pena, M. A. Stazi, M. Tatar, and R. G. J. Westendorp. 2005. What are the effects of maternal and pre-adult environments on ageing in humans, and are there lessons from animal models? *Mechanisms of Ageing and Development* 126:431-438.
- Brakefield, P. M., F. Kesbeke, and P. B. Koch. 1998. The regulation of phenotypic plasticity of eyespots in the butterfly *Bicyclus anynana*. *American Naturalist* 152:853-860.
- Broughton, S. J., M. D. W. Piper, T. Ikeya, T. M. Bass, J. Jacobson, Y. Drieger, P. Martinez, E. Hafen, D. J. Withers, S. J. Leivers, and L. Partridge. 2005. Longer lifespan, altered metabolism, and stress resistance in *Drosophila* from ablation of cells making insulin-like ligands. *Proc. Nat. Acad. Sci. USA* 102:3105-3110.
- Bubli, O. A., and V. Loeschcke. 2005. Correlated responses to selection for stress resistance and longevity in a laboratory population of *Drosophila melanogaster*. *Journal Of Evolutionary Biology* 18:789-803.
- Carlson, K. A., and L. G. Harshman. 1999. Extended longevity lines of *Drosophila melanogaster*: Abundance of yolk protein gene mRNA in fat body and ovary. *Experimental Gerontology* 34:173-184.
- Chapman, T., and L. Partridge. 1996. Female fitness in *Drosophila melanogaster*: An interaction between the effect of nutrition and of encounter rate with males. *Proc. R. Soc. Lond. B* 263:755-759.
- Chippindale, A. K., T. J. F. Chu, and M. R. Rose. 1996. Complex trade-offs and the evolution of starvation resistance in *Drosophila melanogaster*. *Evolution* 50:753-766.
- Chippindale, A. K., A. M. Leroi, S. B. Kim, and M. R. Rose. 1993. Phenotypic plasticity and selection in *Drosophila* life history evolution. 1. Nutrition and the cost of reproduction. *Journal of Evolutionary Biology* 6:171-193.
- Clancy, D. J., D. Gems, E. Hafen, S. J. Leivers, and L. Partridge. 2002. Dietary restriction in long-lived dwarf flies. *Science* 296:319-319.
- Clancy, D. J., D. Gems, L. G. Harshman, S. Oldham, H. Stocker, E. Hafen, S. J. Leivers, and L. Partridge. 2001. Extension of life-span by loss of CHICO, a *Drosophila* insulin receptor substrate protein. *Science* 292:104-106.
- Cook-Wiens, E., and M. S. Grotewiel. 2002. Dissociation between functional senescence and oxidative stress resistance in *Drosophila*. *Experimental Gerontology* 37:1347-1357.
- DaCunha, G. L., I. B. M. DaCruz, P. Fiorino, and A. K. DeOliveira. 1995. Paraquat resistance and starvation conditions in the selection for longevity extremes in *Drosophila melanogaster* populations previously selected for long and short developmental period. *Developmental Genetics* 17:352-361.
- Davidowitz, G., L. J. D'Amico, and H. F. Nijhout. 2003. Critical weight in the development of insect body size. *Evolution & Development* 5:188-197.

- Dawkins, R. 1976. *The Selfish Gene*. Oxford University Press
- Diamond, J. 2003. The double puzzle of diabetes. *Nature* 423:599-602.
- Dillin, A., D. K. Crawford, and C. Kenyon. 2002. Timing requirements for insulin/IGF-1 signaling in *C. elegans*. *Science* 298:830-834.
- Djawdan, M., A. K. Chippindale, M. R. Rose, and T. J. Bradley. 1998. Metabolic reserves and evolved stress resistance in *Drosophila melanogaster*. *Physiological Zoology* 71:584-594.
- Djawdan, M., M. R. Rose, and T. J. Bradley. 1997. Does selection for stress resistance lower metabolic rate? *Ecology* 78:828-837.
- Djawdan, M., T. T. Sugiyama, L. K. Schlaeger, T. J. Bradley, and M. R. Rose. 1996. Metabolic aspects of the trade-off between fecundity and longevity in *Drosophila melanogaster*. *Physiological Zoology* 69:1176-1195.
- Duvernell, D. D., P. S. Schmidt, and W. F. Eanes. 2003. Clines and adaptive evolution in the *methuselah* gene region in *Drosophila melanogaster*. *Molecular Ecology* 12:1277-1285.
- Feder, M. E., and J. C. Walser. 2005. The biological limitations of transcriptomics in elucidating stress and stress responses. *Journal Of Evolutionary Biology* 18:901-910.
- Flatt, T. 2004. Assessing natural variation in genes affecting *Drosophila* lifespan. *Mechanisms of Ageing and Development* 125:155-159.
- Flatt, T., and T. J. Kawecki. 2004. Pleiotropic effects of methoprene-tolerant (Met), a gene involved in juvenile hormone metabolism, on life history traits in *Drosophila melanogaster*. *Genetica* 122:141-160.
- Fontana, L., T. E. Meyer, S. Klein, and J. O. Holloszy. 2004. Long-term calorie restriction is highly effective in reducing the risk for atherosclerosis in humans. *Proc. Nat. Acad. Sci. USA* 101:6659-6663.
- Force, A. G., T. Staples, S. Soliman, and R. Arking. 1995. Comparative biochemical and stress analysis of genetically selected *Drosophila* strains with different longevity. *Developmental Genetics* 17:340-351.
- Geiger-Thornsberry, G. L., and T. F. C. Mackay. 2004. Quantitative trait loci affecting natural variation in *Drosophila* longevity. *Mechanisms of Ageing and Development* 125:179-189.
- Gems, D., and J. J. McElwee. 2005. Broad spectrum detoxification: the major longevity assurance process regulated by insulin/IGF-1 signaling? *Mechanisms of Ageing and Development* 126:381-387.
- Graves, J. L., and L. D. Mueller. 1993. Population-density effects on longevity. *Genetica* 91:99-109.
- Graves, J. L., E. C. Toolson, C. Jeong, L. N. Vu, and M. R. Rose. 1992. Desiccation, flight, glycogen, and postponed senescence in *Drosophila melanogaster*. *Physiological Zoology* 65:268-286.
- Hales, C. N., and D. J. P. Barker. 1992. Type-2 (on-insulin-dependent) diabetes mellitus - the thrifty phenotype hypothesis. *Diabetologia* 35:595-601.
- Hales, C. N., and D. J. P. Barker. 2001. The thrifty phenotype hypothesis. *British Medical Bulletin* 60:5-20.
- Harbison, S. T., S. Chang, K. P. Kamdar, and T. F. C. Mackay. 2005. Quantitative genomics of starvation stress resistance in *Drosophila*. *Genome Biology* 6
- Harbison, S. T., A. H. Yamamoto, J. J. Fanara, K. K. Norga, and T. F. C. Mackay. 2004. Quantitative trait loci affecting starvation resistance in *Drosophila melanogaster*. *Genetics* 166:1807-1823.
- Harshman, L. G., A. A. Hoffmann, and A. G. Clark. 1999a. Selection for starvation resistance in *Drosophila melanogaster*: physiological correlates, enzyme

- activities and multiple stress responses. *Journal of Evolutionary Biology* 12:370-379.
- Harshman, L. G., K. M. Moore, M. A. Sty, and M. M. Magwire. 1999b. Stress resistance and longevity in selected lines of *Drosophila melanogaster*. *Neurobiology of Aging* 20:521-529.
- Harshman, L. G., and J. L. Schmid. 1998. Evolution of starvation resistance in *Drosophila melanogaster*: Aspects of metabolism and counter-impact selection. *Evolution* 52:1679-1685.
- Hawkes, K., J. F. O'Connell, N. G. B. Jones, H. Alvarez, and E. L. Charnov. 1998. Grandmothering, menopause, and the evolution of human life histories. *Proc. Nat. Acad. Sci. USA* 95:1336-1339.
- Hoekstra, R. F. 1993. Senescence and evolution. *Netherlands journal of Zoology* 43:352-358.
- Hoffmann, A. A. 2000. Laboratory and field heritabilities - Some lessons from *Drosophila*. *Adaptive genetic variation in the wild*:200-218.
- Hoffmann, A. A., and L. G. Harshman. 1999. Desiccation and starvation resistance in *Drosophila*: patterns of variation at the species, population and intrapopulation levels. *Heredity* 83:637-643.
- Holzenberger, M., J. Dupont, B. Ducos, P. Leneuve, A. Geloën, P. C. Even, P. Cervera, and Y. Le Bouc. 2003. IGF-1 receptor regulates lifespan and resistance to oxidative stress in mice. *Nature* 421:182-187.
- Houthoofd, K., B. P. Braeckman, T. E. Johnson, and J. R. Vanfleteren. 2003. Life extension via dietary restriction is independent of the Ins/IGF-1 signalling pathway in *Caenorhabditis elegans*. *Experimental Gerontology* 38:947-954.
- Huey, R. B., J. Suess, H. Hamilton, and G. W. Gilchrist. 2004. Starvation resistance in *Drosophila melanogaster*: testing for a possible 'cannibalism' bias. *Functional Ecology* 18:952-954.
- Hulbert, A. J., D. J. Clancy, W. Mair, B. P. Braeckman, D. Gems, and L. Partridge. 2004. Metabolic rate is not reduced by dietary-restriction or by lowered insulin/IGF-1 signalling and is not correlated with individual lifespan in *Drosophila melanogaster*. *Experimental Gerontology* 39:1137-1143.
- Joshi, A., C. D. Knight, and L. D. Mueller. 1996. Genetics of larval urea tolerance in *Drosophila melanogaster*. *Heredity* 77:33-39.
- Kaeberlein, M., K. T. Kirkland, S. Fields, and B. K. Kennedy. 2004. Sir2-independent life span extension by calorie restriction in yeast. *Plos Biology* 2:1381-1387.
- Kaitala, A. 1987. Dynamic life-history strategy of the waterstrider *Gerris thoracicus* as an adaptation to food and habitat variation. *Oikos* 48:125-131.
- Kaitala, A. 1991. Phenotypic plasticity in reproductive behavior of waterstriders - Trade-offs between reproduction and longevity during food stress. *Functional Ecology* 5:12-18.
- Kim, S. K., and E. J. Rulifson. 2004. Conserved mechanisms of glucose sensing and regulation by *Drosophila corpora cardiaca* cells. *Nature* 431:316-320.
- Kirkwood, T. B., and R. Holliday. 1979. The evolution of ageing and longevity. *Proc. R. Soc. Lond. B.* 205:531-546.
- Kirkwood, T. B. L. 1977. Evolution of ageing. *Nature* 270:301-304.
- Kirkwood, T. B. L. 2001. Sex and ageing. *Experimental Gerontology* 36:413-418.
- Kirkwood, T. B. L. 2002. Evolution of ageing. *Mechanisms of Ageing and Development* 123:737-745.
- Kirkwood, T. B. L., and M. R. Rose. 1991. Evolution of senescence: late survival sacrificed for reproduction. *Phil. Trans. R. Soc. Lond. B* 332:15-24.

- Krijger, C. L. 2000. Spatio-temporal heterogeneity and local insect diversity - a case study on neotropical *Drosophila* communities. Thesis Leiden University
- Krijger, C. L., Y. C. Peters, and J. G. Sevenster. 2001. Competitive ability of neotropical *Drosophila* predicted from larval development times. *Oikos* 92:325-332.
- Leips, J., and T. F. C. Mackay. 2000. Quantitative trait loci for life span in *Drosophila melanogaster*: Interactions with genetic background and larval density. *Genetics* 155:1773-1788.
- Leroi, A. M. 2001. Molecular signals versus the *Loi de Balancement*. *Trends in Ecology & Evolution* 16:24-29.
- Leroi, A. M., W. R. Chen, and M. R. Rose. 1994a. Long term laboratory evolution of a genetic life history trade-off in *Drosophila melanogaster*. 2. Stability of genetic correlations. *Evolution* 48:1258-1268.
- Leroi, A. M., A. K. Chippindale, and M. R. Rose. 1994b. Long term laboratory evolution of a genetic life history trade-off in *Drosophila melanogaster*. 1. The role of genotype-by-environment interaction. *Evolution* 48:1244-1257.
- Leroi, A. M., S. B. Kim, and M. R. Rose. 1994c. The evolution of phenotypic life-history trade-offs - an experimental study using *Drosophila melanogaster*. *American Naturalist* 144:661-676.
- Lin, S. J., M. Kaeberlein, A. A. Andalis, L. A. Sturtz, P. A. Defossez, V. C. Culotta, G. R. Fink, and L. Guarente. 2002. Calorie restriction extends *Saccharomyces cerevisiae* lifespan by increasing respiration. *Nature* 418:344-348.
- Lin, Y. J., L. Seroude, and S. Benzer. 1998. Extended life-span and stress resistance in the *Drosophila* mutant methuselah. *Science* 282:943-946.
- Lints, F. A., and C. V. Lints. 1969. Influence of preimaginal environment on fecundity and ageing in *Drosophila melanogaster* hybrids I. Preimaginal population density. *Experimental Gerontology* 4:231-244.
- Longo, V. D., and P. Fabrizio. 2002. Visions & reflections - regulation of longevity and stress resistance: a molecular strategy conserved from yeast to humans? *Cellular and Molecular Life Sciences* 59:903-908.
- Longo, V. D., and C. E. Finch. 2003. Evolutionary medicine: From dwarf model systems to healthy centenarians? *Science* 299:1342-1346.
- Luckinbill, L. S., and M. J. Clare. 1986. A density threshold for the expression of longevity in *Drosophila melanogaster*. *Heredity* 56:329-335.
- Mair, W., P. Goymer, S. D. Pletcher, and L. Partridge. 2003. Demography of dietary restriction and death in *Drosophila*. *Science* 301:1731-1733.
- Mair, W., M. D. W. Piper, and L. Partridge. 2005. Calories do not explain extension of life span by dietary restriction in *Drosophila*. *Plos Biol.* 3:e223.
- Mair, W., C. M. Sgro, A. P. Johnson, T. Chapman, and L. Partridge. 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.
- Malthus, T. R. 1798. *Essay on the principle of population*.
- Marden, J. H., B. Rogina, K. L. Montooth, and S. L. Helfand. 2003. Conditional tradeoffs between aging and organismal performance of Indy long-lived mutant flies. *Proc. Nat. Acad. Sci. USA* 100:3369-3373.
- Marron, M. T., T. A. Markow, K. J. Kain, and A. G. Gibbs. 2003. Effects of starvation and desiccation on energy metabolism in desert and mesic *Drosophila*. *Journal of Insect Physiology* 49:261-270.
- Matsukawa, J., A. Matsuzawa, K. Takeda, and H. Ichijo. 2004. The ASK-1MAP kinase cascades in mammalian stress response. *J. Biochem.* 136:261-265.



- McCulloch, D., and D. Gems. 2003. Body size, insulin/IGF signaling and aging in the nematode *Caenorhabditis elegans*. *Experimental Gerontology* 38:129-136.
- McElwee, J. J., E. Schuster, E. Blanc, J. H. Thomas, and D. Gems. 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.
- Merry, B. J. 2002. Molecular mechanisms linking calorie restriction and longevity. *Int. j. Bioch. & Cell Biol.* 1291:1-15.
- Miller, R. S., and J. L. Thomas. 1958. The effects of larval crowding and body size on the longevity of adult *Drosophila melanogaster*. *Ecology* 39:118-125.
- Mourikis, P., G. D. Hurlbut, and S. Artavanis-Tsakonas. 2006. Enigma, a mitochondrial protein affecting lifespan and oxidative stress response in *Drosophila*. *Proc. Nat. Acad. Sci. USA* 103:1307-1312.
- Mousseau, T. A., and D. A. Roff. 1987. Natural selection and the heritability of fitness components. *Heredity* 59:181-197.
- Mueller, L. D., J. L. Graves, and M. R. Rose. 1993. Interactions between density-dependent and age-specific selection in *Drosophila melanogaster*. *Functional Ecology* 7:469-479.
- Neel, J. V. 1962. Diabetes mellitus - a thrifty genotype rendered detrimental by progress. *American journal of Human Genetics* 14:353-362.
- O'Grady, P. M., and M. G. Kidwell. 2002. Phylogeny of the subgenus *Sophophora* (*Diptera: Drosophilidae*) based on combined analysis of nuclear and mitochondrial sequences. *Molecular Phylogenetics and Evolution* 22:442-453.
- Packer, C., M. Tatar, and A. Collins. 1998. Reproductive cessation in female mammals. *Nature* 392:807-811.
- Partridge, L., and D. Gems. 2002. Ageing: a lethal side-effect. *Nature* 418:921-921.
- Partridge, L., and D. Gems. 2002. Mechanisms of ageing: public or private? *Nature Reviews Genetics* 3:165-175.
- Patel, M. N., C. G. Knight, C. Karageorgi, and A. M. Leroi. 2002. Evolution of germline signals that regulate growth and aging in nematodes. *Proc. Nat. Acad. Sci. USA* 99:769-774.
- Perez, A., and C. Garcia. 2002. Evolutionary responses of *Drosophila melanogaster* to selection at different larval densities: changes in genetic variation, specialization and phenotypic plasticity. *Journal of Evolutionary Biology* 15:524-536.
- Phelan, J. P., M. A. Archer, K. A. Beckman, A. K. Chippindale, T. J. Nusbaum, and M. R. Rose. 2003. Breakdown in correlations during laboratory evolution. I. Comparative analyses of *Drosophila* populations. *Evolution* 57:527-535.
- Prowse, N., and L. Partridge. 1997. The effects of reproduction on longevity and fertility in male *Drosophila melanogaster*. *Journal of Insect Physiology* 43:501-512.
- Rauschenbach, I. Y., N. E. Gruntenko, M. Bownes, N. V. Adonieva, J. Terashima, E. K. Karpova, N. V. Faddeeva, and N. A. Chentsova. 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.
- Ricklefs, R. E., and M. Wikelski. 2002. The physiology/life-history nexus. *Trends in Ecology & Evolution* 17:462-468.
- Riha, V. F., and L. S. Luckinbill. 1996. Selection for longevity favors stringent metabolic control in *Drosophila melanogaster*. *Journals of Gerontology Series a-Biological Sciences and Medical Sciences* 51:B284-B294.

- Robinson, S. J. W., B. Zwaan, and L. Partridge. 2000. Starvation resistance and adult body composition in a latitudinal cline of *Drosophila melanogaster*. *Evolution* 54:1819-1824.
- Rogina, B., R. A. Reenan, S. P. Nilsen, and S. L. Helfand. 2000. Extended life-span conferred by cotransporter gene mutations in *Drosophila*. *Science* 290:2137-2140.
- Rose, M. R. 1984. Laboratory evolution of postponed senescence in *Drosophila melanogaster*. *Evolution* 38:1004-1010.
- Rose, M. R., L. N. Vu, S. U. Park, and J. L. Graves. 1992. Selection on stress resistance increases longevity in *Drosophila melanogaster*. *Experimental Gerontology* 27:241-250.
- Santos, M., K. Fowler, and L. Partridge. 1994. Gene-environment interaction for body size and larval density in *Drosophila melanogaster* - an investigation of effects on development time, thorax length and adult sex-ratio. *Heredity* 72:515-521.
- Schmidt, P. S., D. D. Duvernell, and W. F. Eanes. 2000. Adaptive evolution of a candidate gene for aging in *Drosophila*. *Proc. Nat. Acad. Sci. USA* 97:10861-10865.
- Serafini, M., R. Bugianesi, G. Maiani, S. Valtuena, S. De Santis, and A. Crozier. 2003. Plasma antioxidants from chocolate - Dark chocolate may offer its consumers health benefits the milk variety cannot match. *Nature* 424:1013-1013.
- Service, P. M. 1987. Physiological mechanisms of increased stress resistance in *Drosophila melanogaster* selected for postponed senescence. *Physiological Zoology* 60:321-326.
- Service, P. M. 1989. The effect of mating status on lifespan, egg-laying, and starvation resistance in *Drosophila melanogaster* in relation to selection on longevity. *Journal of Insect Physiology* 35:447-452.
- Service, P. M., E. W. Hutchinson, M. D. Mackinley, and M. R. Rose. 1985. Resistance to environmental stress in *Drosophila melanogaster* selected for postponed senescence. *Physiological Zoology* 58:380-389.
- Sevenster, J. G., and J. J. M. Van Alphen. 1993. A life-history trade-off in *Drosophila* species and community structure in variable environments. *Journal of Animal Ecology* 62:720-736.
- Sherman, P. W. 1998. Animal behavior - The evolution of menopause. *Nature* 392:759-+.
- Simmons, F. H., and T. J. Bradley. 1997. An analysis of resource allocation in response to dietary yeast in *Drosophila melanogaster*. *Journal of Insect Physiology* 43:779-788.
- Smith, L. C., and B. D. Murphy. 2004. Genetic and epigenetic aspects of cloning and potential effects on offspring of cloned mammals. *Cloning and Stem Cells* 6:126-132.
- Song, W., R. Ranjan, K. Dawson-Scully, P. Bronk, L. Marin, L. Seroude, Y. J. Lin, Z. P. Nie, H. L. Atwood, S. Benzer, and K. E. Zinsmaier. 2002. Presynaptic regulation of neurotransmission in *Drosophila* by the G protein-coupled receptor Methuselah. *Neuron* 36:105-119.
- Sorensen, J. G., and V. Loeschcke. 2001. Larval crowding in *Drosophila melanogaster* induces *Hsp70* expression, and leads to increased adult longevity and adult thermal stress resistance. *Journal of Insect Physiology* 47:1301-1307.

- Spencer, C. C., C. E. Howell, A. R. Wright, and D. E. L. Promislow. 2003. Testing an 'aging gene' in long-lived *Drosophila* strains: increased longevity depends on sex and genetic background. *Aging Cell* 2:123-130.
- Stearns, S. C. 1992. The evolution of life histories. Oxford University Press
- Takahashi, E., T. H. Marczylo, T. Watanabe, S. Nagai, H. Hayatsu, and T. Negishi. 2001. Preventive effects of anthraquinone food pigments on the DNA damage induced by carcinogens in *Drosophila*. *Mutation Research-Fundamental and Molecular Mechanisms of Mutagenesis* 480:139-145.
- Tatar, M., A. Bartke, and A. Antebi. 2003. The endocrine regulation of aging by insulin-like signals. *Science* 299:1346-1351.
- Tatar, M., A. Kopelman, D. Epstein, M. P. Tu, C. M. Yin, and R. S. Garofalo. 2001. A mutant *Drosophila* insulin receptor homolog that extends life-span and impairs neuroendocrine function. *Science* 292:107-110.
- Tu, M. P., D. Epstein, and M. Tatar. 2002. The demography of slow aging in male and female *Drosophila* mutant for the insulin-receptor substrate homologue *chico*. *Aging Cell* 1:75-80.
- Tu, M. P., and M. Tatar. 2003. Juvenile diet restriction and the aging and reproduction of adult *Drosophila melanogaster*. *Aging Cell* 2:327-333.
- Tu, M. P., C. M. Yin, and M. Tatar. 2002. Impaired ovarian ecdysone synthesis of *Drosophila melanogaster* insulin receptor mutants. *Aging Cell* 1:158-160.
- Van Noordwijk, A. J., and G. De Jong. 1986. Acquisition and allocation of resources - their influence on variation in life history tactics. *American Naturalist* 128:137-142.
- Van Straalen, N. M., and D. Roelofs. 2006. Introduction to ecological genomics.
- Vermeulen, C. J. 2005. Genetics of lifespan determination in *Drosophila melanogaster*. Thesis, University of Groningen
- Vermeulen, C. J., and R. Bijlsma. 2006. Changes in genetic architecture during relaxation in *Drosophila melanogaster* selected on divergent virgin life span. *Journal of Evolutionary Biology* 19:216-227.
- Vermeulen, C. J., L. van de Zande, and R. Bijlsma. 2006. Resistance to oxidative stress induced by paraquat correlates well with both decreased and increased lifespan in *Drosophila melanogaster*. *Biogerontology* 6:387-395.
- Vettraino, J., S. Buck, and R. Arking. 2001. Direct selection for paraquat resistance in *Drosophila* results in a different extended longevity phenotype. *Journals of Gerontology Series a-Biological Sciences and Medical Sciences* 56:B415-B425.
- Vieira, C., E. G. Pasyukova, Z. B. Zeng, J. B. Hackett, R. F. Lyman, and T. F. C. Mackay. 2000. Genotype-environment interaction for quantitative trait loci affecting life span in *Drosophila melanogaster*. *Genetics* 154:213-227.
- Wagensberg, J. 2000. Complexity versus uncertainty: The question of staying alive. *Biology & Philosophy* 15:493-508.
- Walker, G. A., and G. J. Lithgow. 2003. Lifespan extension in *C. elegans* by a molecular chaperone dependent upon insulin-like signals. *Aging Cell* 2:131-139.
- Williams, G. C. 1957. Pleiotropy, natural selection, and the evolution of senescence. *Evolution* 11:398-411.
- Wu, Q., and M. R. Brown. 2006. Signaling and function of insulin-like peptides in insects. *Annual Review of Entomology* 51:1-24.
- Zera, A. J., and L. G. Harshman. 2001. The physiology of life history trade-offs in animals. *Annual Review of Ecology and Systematics* 32:95-126.

- Zera, A. J., and Z. W. Zhao. 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* 57:586-596.
- Zhuang, Z. H., Y. Zhou, M. C. Yu, N. Silverman, and B. X. Ge. 2006. Regulation of *Drosophila* p38 activation by specific MAP2 kinase and MAP3 kinase in response to different stimuli. *Cellular Signalling* 18:441-448.
- Zijlstra, W. G. 2002. Evolutionary constraints on the life history of the butterfly *Bicyclus anynana*. Thesis, Leiden University
- Zinke, I., C. S. Schutz, J. D. Katzenberger, M. Bauer, and M. J. Pankratz. 2002. Nutrient control of gene expression in *Drosophila*: microarray analysis of starvation and sugar-dependent response. *EMBO Journal* 21:6162-6173.
- Zwaan, B. J. 2003. Linking development and aging. *Sci. Aging Knowledge Environ.* 2003:pe32.
- Zwaan, B. J., R. Bijlsma, and R. F. Hoekstra. 1991. On the developmental theory of aging. 1. Starvation resistance and longevity in *Drosophila melanogaster* in relation to pre-adult breeding conditions. *Heredity* 66:29-39.
- Zwaan, B. J., R. Bijlsma, and R. F. Hoekstra. 1995a. Artificial selection for developmental time in *Drosophila melanogaster* in relation to the evolution of aging - Direct and correlated responses. *Evolution* 49:635-648.
- Zwaan, B. J., R. Bijlsma, and R. F. Hoekstra. 1995b. Direct selection on life-span in *Drosophila melanogaster*. *Evolution* 49:649-659.

