THE ROLE OF EPIGENETICS IN SOCIAL INSECTS EVO DEVO

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Objective. For my fellowship at Wiko, I proposed a project to achieve a better understanding of the roles of epigenetics in social insect evo devo. My goal was motivated by recent work by my group and my collaborators, which suggested that selection on epigenetic regulators can be central to the evolution of honey bee social behaviour.

Visitors and interactions at Wiko. My work benefited greatly from the visits of Dr. Andrew Feinberg from Johns Hopkins University USA, who is an expert on epigenetic plasticity; of B. S. Ingrid Spilde, popular science writer for the website www.forskning.no in Norway, and of Dr. Thomas Flatt, a productive young scientist at the University of Veterinary Medicine in Vienna, Austria who studies the evolution and current regulation of life-history variation in *Drosophila melanogaster*.

My three visitors stayed at Wiko, each for 3–4 days, and all interacted with other Wiko Fellows and/or the Wiko staff. My collaboration with Andrew Feinberg is moving forward with the submission of two manuscripts this fall. Ingrid Spilde published this article about Wiko: http://www.forskning.no/artikler/2010/mars/243758. Thomas Flatt provided very useful feedback on my writing at Wiko as well as afterward.

Andrew Feinberg and I next developed an experiment to test the effects of the environmental factors on the epigenome. These experiments have been conducted, they were successful, and we are co-authoring a manuscript to publish the results. In brief, our data show that epigenetic DNA methylation patterns in the brains of honey bees respond to changes in the social environment. The patterns, furthermore, appear to be associated with differences in the DNA splice variants that are produced by the methylated genes. Such alternative splicing can have profound effects on phenotypes.

These are very exciting findings, and we can now move forward toward the goal of understanding how epigenetics contributes during the evolution and current regulation of sociality in insects.

In addition to my interactions with Feinberg, Spilde and Flatt, I enjoyed my discussions with the resident Fellows, particularly Drs. Page, Raghavendra, Wilkins and Linksvayer. Unfortunately, I could rarely attend the meals at Wiko due to a food allergy. I feel, however, that my stay was very good also socially.

Progress. At Wiko, my progress was primarily in developing a framework to address how honey bee phenotypes are affected by environmental factors, with a focus on interindividual interactions and social stress. My thoughts on this topic are summarized in my paper submitted to *Aging Cell* (see summary of writing).

Summary. My Fellowship at Wiko was very useful for me as a scientist and as a person. It enabled me to think about aspects of what I do that I rarely or never have time to consider. I appreciate the opportunities and inspirations this has given me, and I am very thankful for it.

Articles published or prepared while Fellow at Wiko

1. Wang, Y., N. S. Mutti, K. E. Ihle, A. Siegel, A. G. Dolezal, O. Kaftanoglu, and G. V. Amdam (2010). "Down-regulation of honeybee IRS gene biases behavior toward food rich in protein." *PLoS Genetics*. 6, e1000896. Featured in *Nature* Research Highlights (vol. 464, p. 961) and *Science News* (vol. 177/9, 16).
2. Amdam, G. V., E. Fennern, N. Baker, and B. Rascón (2010). "Honeybee associative learning performance and metabolic stress resilience are positively associated." *PLoS ONE* 5, e9740.
3. Münch, D. and G. V. Amdam (2010). "The curious case of aging plasticity in honey bees." *FEBS* Letters 584, 2496–2503.
4. Wang, Y., O. Kaftanoglu, A. J. Siegel, R. E. Page, and G. V. Amdam (December 2010). "Surgically increased ovarian mass in the honey bee confirms link between reproductive physiology and worker behavior." *Journal of Insect Physiology* 56, 12: 1816–1824.
5. Havukainen, H., Ø. Halskau, L. Skjaerven, B. Smedal, and G. V. Amdam (2011). "Deconstructing honeybee vitellogenin: novel 40 kDa fragment assigned to its N-terminus." *Journal of Experimental Biology* 214, 582–592.
6. Tolfsen, C. C., N. Baker, C. Kreibich, and G. V. Amdam. "Flight restriction prevents associative learning deficits but not changes in brain protein adduct-formation during honeybee ageing." *Journal of Experimental Biology* (in revision).
7. Amdam, G. V. "Social context, stress, and plasticity of aging." *Aging Cell* (in revision).
8. Baker, N., F. Wolschin, and G. V. Amdam. "Age-related learning deficits can be reversed in honeybees *Apis mellifera*." *Journal of Experimental Biology* (submitted).