

Final Progress Report for the ICES Science Fund

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I received a research grant of 75 000 DKK from the ICES Science Fund for the time period of 1.6.2014-31.5.2015. The grant is budgeted to cover research visits related to my project titled “The molecular mechanisms and reversibility of fisheries-induced evolution”, travel costs to conferences and potential laboratory expenses. Currently, the money has been available for the project for 10 months.

In my research project, I have two sub-projects. The first one is to identify genetic signatures of size-selective harvesting in experimentally exploited fish populations. Our previous results (accepted in *Evolutionary Applications*) indicated that five generations of size-selective harvesting induced genetic changes in the single nucleotide polymorphism (SNP) allele frequencies as we identified 22 outlier loci that had excessively high F_{st} compared to the neutral expectations. To take it one step further, I proposed to use transcriptome sequencing to study the molecular mechanisms of the evolutionary change, in other words identify signals of gene expression evolution (regulatory evolution) and / or structural evolution (evolution in coding sequence) induced by size-selective harvesting. We have found signals of both types of evolution: ***five generations of size-selective harvesting have induced significant gene expression changes in almost 4 500 genes and we have also identified over 700 outlier SNPs that are candidates of being subject to selection.*** These SNPs can be used in further analyses to identify whether our results can be applied to the population level, i.e., whether five generations of size-selective harvesting caused significant and replicable changes in allele frequencies of these outlier SNPs. ***We have also identified signals of significant gene expression changes caused by domestication. This result is extremely relevant from the management (i.e., supportive stocking) perspective.***

The second part of the project is focused on the potential reversibility of any observed molecular level and phenotypic changes. ***Our results show that experimentally exploited populations seem to recover at the gene expression level (but not at the sequence evolution level). The gene expression changes caused by several generations of domestication were substantial.*** A draft of the manuscript titled “Molecular mechanisms and the reversibility of fisheries-induced evolution” has been already written and will be submitted to *Nature* in May 2015.

We have showed that five generations of size-selective harvesting induced various phenotypic changes in the experimentally exploited fish populations (accepted in *Evolutionary Applications*). The selection was operating on body size but other life-history traits (mainly reproductive traits and growth) and behavioral traits changed in concert. These data was collected during my PhD-project (at the Leibniz-Institute of Freshwater Ecology and Inland Fisheries (IGB), Berlin) under the supervision of Prof. Robert Arlinghaus, who is also a co-applicant of the current project. I have monitored the reversibility of phenotypic changes at the IGB, that is, in similar conditions than the phenotypic changes were monitored after five generations of size-selective harvesting. This makes our results more comparable as environment could also affect the some of the traits we are interested

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in (as shown by significant differences in gene expression profile between fish reared at the University of Turku and at the IGB). Part of the data collection (monitoring the reversibility of reproductive traits) took place in March 2015. We found that the size-selected fish slowly started to recover but are not experiencing as high reproductive success as our control line. We would further need to conduct a fully standardized, 210 days long growth experiment (similar than that we conducted after five generations of selection). Realistically, this could start in autumn 2015. The manuscript disseminating the phenotypic reversibility is likely to be submitted early next year.

Despite I have given talks describing some of our findings at the Molecular Ecology –meeting in Turku (Finland), The Finnish Ecology Meeting in Joensuu (Finland), at the University of Tartu (Estonia, invited talk) and at the University of Helsinki (invited talk), all of the unpublished results are highly confidential and not to be published or reported in the internet before published in journals the manuscripts are submitted to.

Thus far, I have received 8 000 EUR and spent approximately 1 100 EUR for the ICES Annual Science Conference and 2 000 EUR for phenotypic recovery data collection at the IGB, Berlin. The remaining money budgeted to mobility and traveling will be used to attend to two conferences: one in Lillehammer, Norway in 15. – 17.6.2015 (EIFAAC, International Symposium on Recreational Fisheries) and one in Lausanne, Switzerland in August 10. – 14.8.2015 (2015 European Society for Evolutionary Biology (ESEB) Congress). Abstracts describing the above mentioned results of the molecular mechanisms and reversibility of fisheries-induced evolution have been accepted as an oral presentation in both of the conferences.