Final report of a project funded by the OECD Co-operative Research Programme

Name:	Jiri Hulcr, PhD
Title:	Death of spruce in Central Europe: disaster or opportunity?
Host institution:	Czech University of Life Sciences and the Czech Academy of Sciences
Host collaborator:	Miroslav Svoboda, PhD
Fellowship dates:	17 August 2020 to 4 January 2021
Consent:	I agree with the posting of this report on the Co-operative Research Programme's website.

Research objectives

Spruce – the main European timber commodity – is dying across Central Europe. The reason is an outbreak of the spruce bark beetle, triggered by climatic changes and fueled by the plantation forests management. The situation has become highly politicized; what is missing is empirical evidence of the outcomes of different management styles.

My project used molecular biodiversity assessment to test the environmental impact of two different responses to the beetle outbreak: salvage logging versus natural stand decay and regeneration. I tested whether the two approaches resulted in significantly different insect biodiversity, endangered species, and bark beetle natural enemies.

My work has bridged three institutions: the University of Florida in the US where I work, the Czech University of Life Sciences, and the Czech Academy of Sciences.

Importance of the research project

Forestry industries in the OECD member countries contribute billions of Euros annually to the global economy and provide millions of jobs. In addition, forests are exceptional among commodities in the massive non-monetary functions they provide in every OECD state, including water management, carbon storage, non-timber commodities, biodiversity conservation, and wellness for citizens.

The management approaches compared in my project embody two different societal perspectives on forests: resource-use focus versus sustainability focus. In Czechia, the political debate has pitted many societal sectors against one another: the forestry industry is struggling to maintain its business tradition while it failed to adapt the forests to the new climate. This lack of adaptation is criticised by the academic community, nature conservation non-profits and by the European Union.

My data are clarifying the differential impact of the two philosophies on forest biodiversity.

Were the objectives achieved?

Most of the project has been finished. I am now at the stage of turning the insect DNA into data.

What has been done

With the guidance of Dr. Svoboda from CULS, I installed a network of insect collecting devices across replicates of the two forest management systems in the summer of 2020. At each of the sites, I installed six replicates of two types of trapping devices: flight-intercept trap and pitfall trap. They were sampled biweekly for three weeks. In total, 225 samples were collected. In the lab, each sample was thoroughly homogenized and complete DNA extracted from a subsample of each homogenate. A specific insect "DNA barcode" was amplified from the samples. The DNA was purified and quantified.

Current status

I am now in the process of turning the amplified DNA into libraries for Illumina sequencing. The kit that I purchased from Roche has not performed well. I am currently attempting the library generation for the third time, while improving the methodology. Such challenges are not unusual in cutting-edge molecular ecology.

Major achievements

1) Our main discovery was that salvage logging does not necessarily decrease insect biodiversity. On the contrary - according to our preliminary data, there seem to be more insect species and greater abundance in the logged localities, than in the naturally regenerated ones. The problem is that these abundant insects are common species typical for meadows. In other words, salvage logging removes the forest ecosystem and replaces it with a savanna ecosystem.

2) The second mst significant achievement was that I was able to communicate modern forest ecology concept to the forestry community in Czechia, as well as to broader audiences through media. Below are a few selected outputs. Many of them were inspired by my discussions with the host, Dr. Miroslav Svoboda. (Although I clearly stated that OECD was the source of my support, neither newspaper included it.)
   - What happens in the forest after a bark beetle outbreak? https://denikn.cz/526938/co-se-deje-s-lesem-po-kurovcove-kalamite-vedec-ziskal-odpoved-z-rozmixovanych-brouku/
   - Land owners, and nature, should decide the fate of forests: https://denikn.cz/451326/musime-se-rozhodnout-co-od-lesa-chceme-nechme-volnou-ruku-vlastnikum-ale-i-prirode/
   - Bark beetles are amazing creatures. We don't need to fear them if we plant the right forests: https://zpravy.aktualne.cz/zahranici/kurovec-je-uzasny-tvor-rika-vedec/r~84a28ca4fceb11ea80e60cc47ab5f122/

Follow-up work

Once the DNA libraries are finished (possibly as soon as this week), they will be sequenced on Illumina MiSeq in collaboration with my second host lab at the Czech Academy of Sciences. With the community DNA profiles at hand, I will be able to describe the impact of the different management on insect diversity at each of the hypotheses.

The ultimate product of my work will be two outputs:

1) A peer-reviewed research article.
2) An article in popular forestry magazine interpreting my results for the broader forestry community, forestry policy makers, and conservation practitioners.
3) A presentation at the IUFRO conference in Prague: Biological invasions in forests: trade, ecology and management. (IUFRO – International Union of Forestry Research Organizations) on September 13, 2021 (I am the invited keynote speaker).

How might the results of my research be important for helping develop forestry policies?

Depending on which hypothesis is supported by the data, I will be able to comment on the suitability of the two management approaches for different forest management objectives. For example, if my preliminary observations are true (natural stand disintegration supports less insect abundance but more valuable, true forest species, while logging replaced the entire ecosystem), then this management approach (natural disintegration and regeneration) is warranted in stands where environmental protection is the objective, such as in National Parks.

Relevance to OECD

In central Europe, the spruce beetle epidemic has grown into one of the greatest political issues, crossing national borders and dominating the news. The outcomes of the project are being distributed to stakeholders in government administrations, university entomologists, conservation non-profits, and forestry practitioners. Support by the OECD is acknowledged in all the outputs (however, not all publishers choose to reprint it).

Satisfaction

Did your fellowship conform to your expectations?
It exceeded my expectation. I really appreciate the freedom it gave me in conducting my research.

Will the OECD Co-operative Research Programme fellowship increase directly or indirectly your career opportunities? Please specify.
Absolutely. I would not be able to devote myself to this project with such ease of mind, without the support. I would not be able to gather all the professional connections and support that I was able to get. Every time I mentioned that I am supported by the OECD, it instantly increased my credibility at collaborating institutions.

Did you encounter any practical problems?
Yes, but that is not unusual in field research. For example, we had to re-think the deployment of my traps (running the experiment across the entire country proved to be unrealistic, it was hard to manage even within one National Park). The trouble with the DNA library is vexing, but the lab where I am working has succeeded in this previously, and I am confident we can figure out the problem.

Please suggest any improvements in the Fellowship Programme.
Greater support, more scientists, more international collaboration!!! In these times of limited interactions and separation of people within their own opinion communities, it is more important than ever to allow scientists to operate across borders.

Advertising the Co-operative Research Programme

How did you learn about the Co-operative Research Programme?
From a colleague.

What would you suggest to make it more "visible"?
Communicate directly to University administrators (deans, etc.). They are looking for similar opportunities for their faculty members.

Are there any issues you would like to record?
None.

Jiri Hulcr

Prague, February 24, 2021