

Phillip H. Purdy

Theme I. MANAGING NATURAL CAPITAL FOR THE FUTURE

Title: Acquisition of Primordial Germ Cell (PGC) Technologies to Enable Secure Preservation and Reliable Utilization of Chicken Genetic Resources

Host institution: The Roslin Institute, University of Edinburgh

Host collaborator: Dr. Michael McGrew

Dates of the fellowship: September 3, 2022 – October 29, 2022

I consent to the posting of this report on the Co-operative Research Programme's website.

1. What were the objectives of the research project? Why is the research project important?

This research project contained two objectives. The first was to acquire training and skills specific to the acquisition, preservation, and utilization of chicken primordial germ cells (PGCs), and the related knockout chicken technologies. The second goal was to adapt the acquisition and preservation components to a gene bank/repository setting, specifically, the National Animal Germplasm Program (NAGP) which is the national repository for the United States Department of Agriculture. The value of this research is that it will facilitate a rapid preservation and conservation of chicken germplasm and genetics by the NAGP. Moreover, the technologies acquired from this research will also be transferred to the poultry community (technology transfer activities, i.e. training sessions) and likewise used to maintain chicken biodiversity by commercial, research, and heritage breed producers.

2. Were the objectives of the fellowship achieved?

The objectives of the fellowship were substantially met. The training and skills were acquired and transfer of the technologies to the US poultry producer community are scheduled to begin with a single producer in December of 2022. However, we expanded the scope of the research from the original proposal that was submitted in 2019. Consequently, additional experiments are being conducted at the Roslin Institute and NAGP laboratories. We do not anticipate problems in completing the research and other activities.

3. What were the major achievements of the fellowship?

Acquisition of training and related skills – these technology transfer activities were the basis for this fellowship and enabled the research related to the PGCs. Moreover, acquisition of these skills enabled the NAGP to immediately begin collecting and preserving chicken germplasm upon my return.

Initiation of research on 1) use of PGCs and 2) remote analysis of rooster sperm motility – while the research is still underway, we anticipate completing it shortly. Originally, the PGC component was the primary research goal, however, the scientists at the Roslin Institute also had interest in my skillset with sperm analysis, thus significantly expanding the scope of our collaborations.

Establishment of research and mission operational relationships – going forward we will continue to collaborate on the PGC research, adaptation of the PGC technologies for genebanking, and creation of systems for remote analysis of rooster (and other species) sperm analysis.

4. Will there be any follow-up work?

We anticipate at least 2 publications as a product of this research and collaboration. One will be on the PGC aspects and a second will be on the rooster sperm motility analyses. These should be submitted to referred journals within the next 6 to 8 months.

We also anticipate that our research collaboration will continue, and that novel products and processes will result. In addition, we anticipate that multiple technology transfer sessions with chicken producers will also occur as a result of this collaboration.

5. How might the results of your research project be important for helping develop regional, national or international agro-food, fisheries or forestry policies and, or practices, or be beneficial for society?

Successful acquisition and development of these techniques will allow a more effective genetic conservation of chicken populations for USDA's National Animal Germplasm Program's stakeholders. When applied to research populations the approach will allow routine cryopreservation of a line to enable a secure preservation of the genetics, and its reconstitution, thereby reducing costs associated with maintaining chicken populations not currently being utilized by research. At the industry level elite populations can be more effectively conserved for future use in the event of disease outbreaks and genetic missteps (e.g. avian influenza and woody breast syndrome, respectively). In summary, this research is the transfer of technologies to address an industry-wide need, and further the development of this system that will enable efficient, effective, secure, high through-put preservation and utilization of chicken germplasm in the form of PGCs by the USDA, commercial and private producers, and the poultry research community (nationally and internationally).

6. Research relevance to the objectives of the CRP and the CRP research theme:

The technology transfer and research activities included in this proposal address multiple aspects of the CRP Aims and the Theme objectives. It is even important to highlight that in the Call for Applications the overview specifically states that "applications are particularly welcome" that focus on "resilience and risk management" as well as "plant and animal breeding to enhance sustainable productivity growth and resilience to climatic events". More specifically, the research described within this Fellowship Application is within the purview of Theme I, Managing Natural Capital for the Future, because it states that "this theme is about how to manage natural capital by making secure the availability and managing the quality of natural resources". The application of these technologies to US and international chicken lines/populations means that the NAGP will be able to create a secure, genetically diverse collection of all chicken breeds and lines (research or commercial) within the US, offer guidance on the implementation and use of these technologies to our customers (commercial, academic, private producers) and other countries, and use these technologies as needed to recreate populations or expand genetics following such things as disease outbreaks or if specific research lines, which were previously preserved, are needed in the future.

Moreover, Theme II, Managing Risks in a Connected World, addresses 'the need for increased biosecurity as a means to subvert emerging diseases' such as avian influenza. Again, implementation of this collaborative research and application of the results as we described means that the US will be able to expand our own, and support other countries, commercial operations, universities, etc., in their development of secure collections of chicken genetic resources, in the form of PGCs, and use these resources to overcome devastating situations, thus preserving and then utilizing diverse germplasm.

Furthermore, Theme III, Transformation Technologies and Innovation is focused on 'novel and innovative technologies that achieve a step change'. In this instance, the research component of this fellowship specifically addresses this Theme because the experiments

describe here explore aspects of the procedures that will increase the utility of the technologies. As stated, the results of this research should result in a “step change” that increases the value of these PGC technologies.

7. Satisfaction

My fellowship exceeded the high expectations I had for the experience. While the facilities at the Roslin Institute are of the highest quality, and the location and country are likewise exceptional, it was the people that I was lucky to work with that made the experience. Everyone was very patient, accommodating, supportive, intelligent, and generally just wonderful to be around. That combination of the people and environment made this experience productive and highly enjoyable. Moreover, because of those qualities of the experience, I look forward to continuing and developing our future collaborations.

The Co-operative Research Programme fellowships are certainly looked favourably upon by the USDA, by I cannot say for certain if it will directly or indirectly advance my career opportunities. In truth, that was never a consideration from my perspective when I applied for this fellowship. Instead, this opportunity was pursued purely in order that I might gain the skills to increase the capacity of my laboratory. In that regard, the efficacy and efficiency of the techniques that I know possess have elevated the capacity of the laboratory and when fully employed will increase the biosecurity of the NAGP poultry collection – the true value of this opportunity.

No practical problems were encountered.

8. Advertising the Co-operative Research Programme

I learned of the Programme from a scientist who was a visitor in my laboratory for 3 months after receiving funding for his fellowship from OECD. While word of mouth is a tremendous means of publicizing the Programme, perhaps encouraging professional societies to post links to the OECD funding website would be beneficial – it would be a win/win for both the society and the Programme.