

NATURAL ENVIRONMENT RESEARCH COUNCIL

SCIENCE AND INNOVATION PROGRAMMES

POST GENOMICS & PROTEOMICS FUNDING MEETING

SCIENCE AND IMPLEMENTATION PLAN

Programme Funding and Implementation

The Natural Environment Research Council (NERC) Post Genomics and Proteomics (PG&P) research programme is funded by the NERC at £12M over c. 5 years. It is envisaged that approximately £1.2M of these funds will be set aside to ensure the effective development and implementation of a data management plan to ensure the long-term accessibility of NERC genomic and molecular data.

The PG&P programme will focus on the application of integrated genomic and/or proteomic approaches to answering environmental questions of strategic importance to NERC and the UK. It was agreed by NERC that the PG&P programme would build on the strategic investments made by the NERC Environmental Genomics programme, but its scientific and programme objectives would be delivered through a new Steering Committee. It is anticipated that the PG&P programme will have two announcements of opportunity that will fund proposals with a maximum duration of three years. A joint fellowship announcement with the Environment Agency is also anticipated under the PG&P programme.

Development of the Scientific Programme

The PG&P directed science programme was formed as a result of the Office of Science and Technology Spending Review in 2002. To provide the NERC-based science community with an opportunity to develop the scientific objectives of the PG&P programme, an open web-based consultation was undertaken by NERC in Spring 2003. This consultation identified several areas of research that could be addressed in the new programme using an integrated genomics approach, which were strategically important to NERC and the UK. An independent Advisory Committee, including members from the academic and stakeholder community, met in August 2003 to determine the themes of the first announcement of opportunity under the PG&P programme. Four priority areas where NERC-funded post-genomic science could have a significant international impact were identified for the first announcement of opportunity. Where possible, the Advisory Committee wanted the research community to access and add value to existing ecological data resources. This first Announcement of Opportunity was published in October 2003 with a closing date of the 17th February 2004. The four themes identified by the Advisory Committee together with an outline budget are described below.

1. Integrating post-genomics and proteomics to study host-parasite interactions in aquatic and terrestrial vertebrate hosts

Parasitism is a major force in both ecology and evolution. Virtually every species of aquatic (freshwater and marine) and terrestrial animal has the potential to be infected by a wide range of viruses, bacteria, protozoa and helminths. Within the PG&P programme, NERC invited proposals offering integrated genomic approaches (for example, research networks) to study host-parasite ecology and evolution. A maximum of ~£2.5M was allocated to support this

theme. The key challenges requested under this call were to quantify the effects of infection processes within individuals on population dynamics and, conversely, the effects of population dynamics on infection processes within individuals. Proposals were restricted to infections of vertebrate populations that

- Integrated post-genomics & proteomics into fish health & disease research.
- Examined parasite diversity and host genetic diversity in free-living ruminants, avians and rodents.

2. What makes species, populations and taxa resistant or vulnerable to environmental change and environmental impact?

All organisms are stressed by abiotic factors. These factors may be a consequence of climate change, habitat destruction, or pollution incidents that result from the manufacturing and/ or use of chemicals. The way in which individuals and populations respond to these challenges can be markedly different. Some populations may adapt to these stressors and continue to exist, whereas some populations may be sensitive and not survive. It is also clear that natural variation within a single population can result in a wide variety of tolerance to abiotic stress with some individuals being more sensitive to a particular stress than others. NERC made available a maximum of ~£3M to investigate the impact of abiotic stress in two specific areas. NERC also encouraged proposals to exploit existing long-term data sets to maximise the predictive value that measurements of molecular adaptation may have in a broader ecological context, particularly with respect to assessing natural variation. The two areas that NERC identified for funding under this programme were:

- Plant responses to abiotic stress at range margins.
- Molecular ecotoxicology in aquatic vertebrate populations.

A joint call for a research fellow between NERC and the EA is anticipated under the molecular ecotoxicology theme; however this call is not to be restricted to aquatic vertebrate populations.

3. Nutrient flux and biogeochemistry

Although nutrient fluxes in aquatic and terrestrial environments are reasonably well understood from a physicochemical perspective, many of the (micro)organisms involved in the major biogeochemical cycles are poorly characterised. Standard biogeochemical measurements provide information on the accumulated activity of all the organisms present in a population but do not provide any knowledge of the dynamics of organisms and pathways that contribute to nutrient flux. The application of a meta-genomic approach, coupled with measurements of biodiversity, to study all the genes and proteins in an aquatic or terrestrial microbial assemblage has the potential to vastly improve our knowledge of the biogeochemical cycles that underpin sustainable ecosystems. NERC made available a maximum of ~£2.5M for highly focused studies to demonstrate the value of integrating meta-genomics, proteomics and diversity/ activity assessments, with traditional measures of nutrient flux, in order to study one or more of the biogeochemical cycles in detail.

4. Environmental regulation of the proteome

Epigenetic modifications provide several different mechanisms that alter genome expression without changing the DNA sequence. It is likely that much of the phenotypic variation

between individuals and species is based on non-protein coding sequences and a genomic approach to study epigenetic changes in response to environmental stimuli may identify important new levels of regulation of gene expression. NERC invited proposals that evaluated the importance of microRNA (miRNA) mediated gene expression for immediate phenotypic adaptations to environmental change. NERC's objective within this theme was to consolidate on the earlier investments made in the NERC Environmental Genomics programme. Approximately £1M was allocated against this theme.

Subsequent Announcements

It is anticipated that there will be a second announcement of opportunity under the PG&P Programme. The PG&P Steering Committee will identify the specific themes of this announcement of opportunity after the first funding allocation has been made.

Procurement of the Scientific Programme

The scientific objectives of the PG&P programme will be delivered through a number of NERC funding mechanisms:

Standard Research Grants

The first Announcement of Opportunity for PG&P encouraged large, integrated awards to support focussed, coordinated and collaborative research. It is anticipated that Standard Research grants employing skilled PDRAs of up to a maximum duration of 3 years will be the major route for funding under the first Announcement of Opportunity under the PG&P programme.

Tied Studentships

It is anticipated that several tied studentships will be aligned to the Standard Research Grants funded under the PG&P Programme.

Fellowships

A Joint NERC/ Environment Agency Fellowship will be funded through the PG&P Programme to investigate the application integration of post-genomic science to a specific aspect of ecotoxicology. Representatives from the PG&P Steering Committee and the Environment Agency will be involved in the review and interview process for this fellowship.

Standard and CASE Studentships

The Steering Committee and Science Coordinator will explore the potential for joint Studentships with other RCUK and the user community.

Assessment of Proposals and Assessment Criteria

To assist the PG&P Steering Committee in the scientific assessment of research proposals submitted against the announcement of opportunity, the Steering Committee will be supplemented with additional scientific experts to form a Moderating Panel. Two members of the moderating panel will be asked to introduce each proposal in turn. The primary introducer will provide a brief overview of the proposal, summary of the referees' reports, an assessment of the applicant's responses to the referees' comments, and a provisional science excellence grade (alpha-1-5, β or Reject). Moderating Panel members will be asked to note the strengths and weaknesses of the application and comment on whether the resource requests contained

in the proposal are justified. The provisional science excellence grade should reflect a Member's own assessment of the application.

After all the proposals have been graded with respect to their scientific excellence the supplementary members of the Moderating Panel will leave so that the PG&P Steering Committee can assess the proposals against the Science Plan for PG&P and the announcement of opportunity.

Programme Deliverables

The performance targets of the PG&P programme are:

- to attain the scientific objectives stated above, through an integrated programme based on interdisciplinary collaborations, an international perspective and cross-research council linkages;
- to demonstrate to the wider environmental community, in particular environmental regulators and the industrial user community, the potential application of post-genomic technologies to ecotoxicology and parasite management;
- to provide specific fora to communicate the science and applications of post-genomic techniques to publicly funded stakeholders;
- to build upon NERC's existing developments in environmental genomic data management for archiving, collating, analysing and mining of genomic data;
- to develop appropriate cross-research council linkages, particularly with EPSRC and BBSRC;
- to provide appropriate high quality training opportunities to develop national expertise in the application of post-genomic-based technologies.
- to explore cost-effective options for large-scale sequencing efforts;

Training and Community Development

The PG&P Steering Committee recognise that training will form an important part of the PG&P Programme, in particular:

- the application of proteomics to environmental samples, and
- developments and opportunities in data management, data analysis and the improvement of theory.

National and International Collaborations

Joint proposals between research groups with complementary expertise, and with involvement of industry and other stakeholders, are strongly encouraged within directed science programmes, to stimulate technology transfer and linkages between fundamental and applied science.

National collaborations have already been identified through the joint fellowship with the Environment Agency. Other national and international collaborations already delivered or envisaged through the PG&P programme include the following:

- *An international dimension to the Advisory Panel with international scientists from including European representatives providing technical and strategic input into the PG&P scientific objectives.* Written comments were also provided from programme managers in the National Science Foundation to ensure that the work envisaged was competitive on an international scale and not duplicating work already in progress.
- *The continuation of the Science Coordinators existing activities with the OECD, WHO and ECVAM.* These are addressing regulatory perspectives of toxico- and ecotoxicogenomics and animal welfare issues.
- A potential joint workshop with the National Science Foundation.

Knowledge Transfer

The term knowledge transfer (KT) covers the processes by which knowledge, expertise and skilled people transfer between the NERC science base (universities and research institutes) and its user community. Through knowledge transfer, NERC science contributes to the economic competitiveness of the UK, effectiveness of public services and policy, and quality of life. The PG&P knowledge transfer plan has highlighted a number of completed and ongoing KT activities for the PG&P programme.

- The science coordinator appointed to the PG&P programme is from the stakeholder community with established contacts with national and international policy makers and industrial scientists.
- Expressions of interest received through the community consultation required the NERC science community to identify the strategic importance of their research from a scientific and user perspective.
- The Advisory Panel convened to assess the expressions of interest received through the community consultation had the direct participation of the user community with representatives from DEFRA, the Environment Agency and industry. Written comments were provided from ECETOC on behalf of the EU Chemical Industry.
- The PG&P Programme has acquired funding for a joint fellowship with the Environment Agency. The NERC Environmental Genomics Programme initiated this joint fellowship opportunity.
- The PG&P Programme will hold at least two joint co-funded workshops with the user community.
- The PG&P Programme will identify the SBRI funding opportunities to appropriate SME's seeking to applied post-genomic science.
- The PG&P Programme will sponsor relevant conference sessions to raise the profile of NERC's investment in post-genomic science.
- The PG&P Programme will target its end of programme events towards particular stakeholders.
- Places will be made available at all training events organised by PG&P for members of the stakeholder community.

Data Management Plan

It is NERC policy that research programmes ensure the long-term availability of data collected by award holders to maximise the application and exploitation of their results. All data and reports submitted under the programme must be made available in an electronic format (Future NERC science). This will maximise ease of future retrieval and exploitation. In most cases, NERC Designated Data Centres are used, both for quality control and archiving, with costs covered from central programme funds. After a period of sole access by PIs for publication preparation, such data are made available to other programme participants and the wider community.

As with the Environmental Genomics programme the PG&P programme has the potential for large amounts of data to be generated. The collation, archiving, storage and mining of these data may require the data management systems that have been developed through the Environmental Genomics programme. In line with NERC policy a provisional sum of £1.2m (10% of the programme budget) has been allocated for data management in PG&P. NERC requested that all research proposals submitted against the announcement of opportunity be adequately resourced with respect to data analysis and bioinformatics. NERC also required that the standards for microarray experiments published by the MicroArray Gene Expression Data (MGED) Society must be strictly adhered to.

The PG&P Steering Committee agreed that the developmental work and solutions provided by the EGTDC under the Environmental genomics programme will assist the PG&P programme in the management and analysis of both expressed sequence tag (EST) data and transcriptomics data. The MIAME/ ENV and metadata catalogue initiatives to ensure the capture of metadata to a level that facilitates future exploitation by NERC scientists at a level suitable for most ecological studies conducted by NERC scientists was also recognised as important. As such the PG&P programme will continue to build on the transcriptomic and EST work of the EGTDC. In addition to the existing activities the PG&P Steering Committee has identified three additional areas that must be addressed:

- the storage and analysis of proteomic data and its integration with other omic and environmental metadata;
- the Metagenomic datasets that will be generated through the nutrient flux and biogeochemistry call; and
- data describing natural variability within and between populations.

In order to advise the PG&P Steering Committee on how to address these emerging issues, it was agreed by the PG&P Steering Committee that a data subcommittee would be established to develop a data management plan that would address the complete data management requirements of PG&P. Dr Susanna Sansone from the European Bioinformatics Institute will chair this committee. The draft data management and implementation plan will be circulated to the PG&P Steering Committee by 15th October 2004 for comment and approval.

Biological Resource

In addition to the electronic data generated in the PG&P Programme scientific and strategic value can be attached to the biological resource generated by the PG&P programme (for example, EST clone sets). The Science Coordinator will work with the PG&P Steering Committee and the Steering Committee's of other directed programmes to identify

appropriate mechanisms to ensure the long-term availability of strategically important biological material.

Evaluation

OST has requested that an evaluation plan is drawn up by the Steering Committee at the outset of the PG&P programme. This evaluation plan must cover both administrative and technical issues.

Ownership and Exploitation of Intellectual Property (IP)

Ownership of IP and IP Rights arising from NERC awards lies with the grant holding body (university, NERC Research Centre or other NERC-approved institution). Whilst all recipients of NERC funding must endeavour to ensure that the outcomes of their research are used to the advantage of the UK, NERC retains the right, for a limited period, to exploit IP in partnership with grant recipient organisations to the benefit of the UK and the organisations. This is to avoid circumstances where fragmentation of IP would reduce the likelihood of exploitation.

Many possibilities exist for the commercial exploitation of discoveries. Workshops, involving end-users, such as industry, environmental regulators, NGOs, conservation scientists and IP companies, will be held to discuss mutually beneficial means of maximising benefit from novel discoveries.

Programme Management

The PG&P **Programme Administrator** has responsibility for all aspects of the day-to-day programme administration and for enquiries concerning the programme. Contact information: Mr Will Thomas, NERC Polaris House, North Star Avenue, Swindon SN2 1EU; e-mail: wpht@nerc.ac.uk; tel: 01793 411698; fax: 01793 411545.

The PG&P **Science Co-ordinator** assists the Steering Committee in the co-ordinated implementation of the programme's science objectives, through liaison with award holders and other bodies. Contact information for Science Coordinator: Dr Jason Snape, Brixham Environmental Laboratory, AstraZeneca, Freshwater Quarry, Brixham, South Devon, TQ5 8BA; e-mail: jason.snape@brixham.astrazeneca.com; tel: 01803 882882; fax: 01803 882974.