

# **Evaluation of BBSRC Genes and Developmental Biology Committee Responsive Mode Portfolio**

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This document represents the conclusions of a Review Panel of experts in  
genetics and developmental biology.

The views expressed are those of the members of the Panel.

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## EXECUTIVE SUMMARY AND KEY CONCLUSIONS

This document sets out the views of a specialist Review Panel convened to provide an independent evaluation of the research supported in responsive mode through the BBSRC Genes and Developmental Biology Committee (GDB) since the Committee's inception in September 1994. The objectives of the evaluation were to assess the quality of the research supported and to identify major outcomes arising from it; to consider whether the GDB committee is currently funding the most appropriate areas of UK bioscience; and to identify ways to build on successes and address identified gaps and issues.

The Panel's analysis was based on the results of questionnaire surveys of a sample of 170 current and past grantholders, 17 current and past GDB committee members, and eight other UK funding organisations; and on the final reports that had been submitted for 141 sample completed grants.

The evaluation covered five specific areas: Research outputs and achievements; Balance and coverage of the portfolio; Interaction with industry; Public engagement; and Ultimate (longer-term) impacts.

### Research outputs and achievements

The research outputs were generally good: the majority of grants had produced papers in well respected journals; a good number of new contacts and collaborations had been developed; almost half of the sample PIs had received further funding to continue or develop the research supported by the grant; and a range of novel products, processes, tools and technologies had been developed.

Overall, the quality of research funded through the GDB Committee over the past ten years has been mainly good, particularly given the preponderance of relatively short (three year), small (supporting one research assistant) projects funded, and there were some outstanding examples of outputs and achievements. However, the Panel identified this model of funding as a major constraint on the quality of research outputs and the development of research careers. In addition, there were some concerns relating to research careers, and the impact of career instability on the maintenance of the UK research skills base, which should be addressed.

#### Key conclusions

The impact of research supported through GDB could be increased by moving to a funding model which encourages and rewards the continuity and stability of research and research groups (i.e. increasing support for longer and larger grants).

BBSRC, possibly working through Research Councils UK (RCUK), should continue to identify ways to contribute to improving job security, benefits and career prospects for research staff.

### Balance and coverage of the portfolio

The remit of GDB is well defined and the coverage of the portfolio has been, and still is, generally appropriate, although there is an apparent gap in support for research using and developing bioinformatic tools within GDB's remit.

There is some overlap between the remits of GDB with those of other research councils, government departments and charities, but this is seen to be beneficial to researchers by ensuring that all areas are adequately funded. The current level of cross-council communication might limit the perception and success of interdisciplinary research in the future, however, and BBSRC should take steps to ensure that effective communication between research councils is maintained.

## Key conclusions

BBSRC should investigate the apparent gap in support for the development of bioinformatic tools for research within GDB's remit. Should this gap be real, the Council should take steps either to review its policy for support of bioinformatics research through all committees, or to encourage more applications to GDB in this area.

BBSRC should remain committed to cross-council communication to facilitate interdisciplinary research.

Priority Areas (PAs) could play a useful role in enabling Committees to encourage applications in particular areas of science, but do not appear to be well understood by the GDB community. The range of subjects selected as PAs is too broad and should be more focused.

Key conclusion: BBSRC should consider the relevance, breadth, and clarity of Priority Areas within the GDB remit.

## Interaction with industry

The level of interaction between the sample GDB grantholders and industry is low, but acceptable, as it reflects the basic nature of the GDB remit and the fact that GDB is unlikely to be considered, by the scientific community, as an industrially-focused committee. Industrial interaction might be constrained by administration issues within research institutions, and because this type of interaction is difficult to combine with the pressures of rapid publication.

Key conclusion: BBSRC should seek to promote further contacts and collaborations between GDB grantholders and industry, when appropriate. Specifically, liaising with university administrators on technology transfer could be very beneficial in some circumstances.

## Public engagement

There appears to be a low level of activity in this area by GDB grantholders, even though BBSRC places importance on this. It is possible that some PIs do not feel adequately trained in this area and would appreciate further training and support from BBSRC.

Key conclusion: BBSRC should continue to seek opportunities to encourage and facilitate bioscientists to engage with the public. This could include dedicated financial support, dissemination of examples of best practise, consultation with experts from other organisations, and assessing the amount of time available for such activities.

## Ultimate impacts

The sample GDB grants made a range of direct contributions to the public good such as human health and the environment. The BBSRC is a key funder of genetics and developmental biology and supports some areas for which there are few or no other funders e.g. plant developmental genetics.

## Generic issues

A number of generic issues were raised:

- There is significant variation in how well final reports are written, resulting in difficulties in assessing research outputs accurately
- A college referee system could be used to limit the number of references requested from each assessor each year, increase the time given to assess grants and provide a financial incentive
- A balance between the number of longer, larger, and three year grants is necessary. This should provide stability and security to big research groups whilst still supporting new investigators.

Key conclusion: The Panel endorses the attempts of BBSRC to increase the number of longer and larger grants provided through the GDB committee. Allowing the length of the grant to reflect the needs of the science and the research group would be beneficial and should ensure that an appropriate balance between longer and larger grants and three year, one RA grants is maintained.

## CHAPTER 1. BACKGROUND

### Introduction

1. The Biotechnology and Biological Sciences Research Council is one of eight Research Councils sponsored through the UK Government's Office of Science and Innovation (OSI). Its principal aim is to foster a world-class biological science community in the UK. The mission of BBSRC is to fund internationally competitive research; to provide training in the biosciences; to encourage opportunities for knowledge transfer and innovation; and to engage the public and other stakeholders in dialogue on issues of scientific interest.
2. BBSRC supports research in a number of ways, including research grants, studentships, fellowships, and Core Strategic Grants to BBSRC-sponsored research institutes. In the financial year 2005/06, 38% of BBSRC research funding was spent via the organisation's 'responsive mode' scheme, whereby research grants are awarded to unsolicited high quality research proposals from eligible applicants in any area relevant to the Council's mission.
3. For organisational purposes, BBSRC remit is divided into seven key areas, each covered by a Research Committee: Agri-Food; Animal Sciences; Biochemistry and Cell Biology; Biomolecular Sciences; Engineering and Biological Systems; Genes and Developmental Biology; and Plant and Microbial Sciences.
4. This document sets out the views of the specialist independent Panel convened to provide an independent scientific evaluation of the Genes and Developmental Biology Committee (GDB) responsive mode portfolio.

### Evaluation context

5. Evaluation is of growing importance to BBSRC and, with its emphasis on evidence-based decision making, to the UK Government. Evaluation plays a central role in:
  - justifying BBSRC funding allocation and contributing to the Evidence Base that all Councils are required to submit to OSI for Spending Review negotiations
  - informing internal funding decisions, providing evidence of progress and achievement, and facilitating the development of a strategic overview for future funding decisions
  - enabling BBSRC to account to government, the general public, the scientific community, and other stakeholders for the funds it allocates
  - helping BBSRC to improve its policy and practice, through informing policy decisions and the design of new schemes, programmes and processes; and through identifying good practice, lessons learned, and ways to improve processes.
6. Formal evaluation of research is currently conducted at a number of levels in BBSRC:

Grant	<ul style="list-style-type: none"><li>• Evaluation of final reports from individual grants</li></ul>
Scheme	<ul style="list-style-type: none"><li>• Evaluation of the responsive mode scheme, evaluating the portfolio of each Research Committee in turn</li><li>• Evaluation of Research Initiatives (time-limited research funding in strategically significant areas), 2-3 years after the grants have ended</li></ul>
Institution	<ul style="list-style-type: none"><li>• Institute Assessment Exercise, conducted every four to five years at BBSRC-sponsored Research Institutes</li></ul>

7. BBSRC recently published its Evaluation Strategy outlining the Council's approach to evaluation and methodology used ([www.bbsrc.ac.uk/about/pub/reports/eval\\_strat\\_01\\_02\\_06.pdf](http://www.bbsrc.ac.uk/about/pub/reports/eval_strat_01_02_06.pdf)). The BBSRC responsive mode portfolio is evaluated by Research

Committee area on a rolling basis whereby two Committee portfolios are evaluated every year. Following a pilot evaluation of the Biomolecular Sciences Committee, GDB is the third Committee to be evaluated. The responsive mode portfolios previously evaluated are Animal Sciences (completed 2005), and Biochemistry and Cell Biology (completed 2006).

8. The evaluation covered research supported in responsive mode through the GDB Committee and assessed since 1996. The objectives of the evaluation were to:
  - assess the quality and international standing of research funded through GDB
  - identify the major outputs and, where possible, outcomes of GDB responsive portfolio over the past 10 years
  - identify strengths, weaknesses and gaps in the GDB remit, the way it is structured, and the influence of initiatives and priority areas
  - in consultation with the research community and other relevant funding bodies (government and non-government), assess whether GDB is currently funding the most appropriate areas of UK bioscience
  - identify ways to build on successes, and ways to address identified gaps and issues.
  
9. BBSRC evaluations are evidence-based, and conducted by an independent Review Panel comprising scientists not closely involved with BBSRC, but who between them have expertise across the GDB remit. They were asked to provide an independent scientific evaluation of the evidence presented:
  - 141 sample final reports (representing 57% of all GDB responsive mode grants that had been completed and graded at the time)
  - Questionnaires returned by 100 PIs of completed grants (representing 40% of all completed and graded GDB responsive mode grants) and 70 current PIs (36% of all current GDB responsive mode grants that had at the time been underway for more than a year)
  - Questionnaires returned by 17 current and former GDB Committee members
  - Questionnaires returned by eight other government and non-government funding bodies relevant to GDB's remit.

The sample final reports and PIs were chosen randomly from the point of view of the science, but in a structured way to be representative of the years and final report grades achieved.
  
10. Further information on responsive mode funding in BBSRC, the evaluation objectives and methodology, and the GDB Committee is included at Appendix 2 (page 28).

## CHAPTER 2. RESEARCH OUTPUTS AND ACHIEVEMENTS

### Research quality

11. The responsive mode research funded by the GDB Committee is almost entirely basic research, which explores and tests fundamental biological ideas and for which there would not necessarily be any immediate application. In recent years the pattern of funding through GDB has typically been for grants lasting three years supporting a single research assistant. In the Panel's view, such a portfolio should be producing a significant amount of at least nationally competitive research outputs, with some outstanding results. Given the inherently risky nature of basic research, the Panel would also expect some grants to fail, and regards such failure as a necessary element of any dynamic and productive basic research system. In assessing the output from GDB-funded grants, therefore, the Panel distinguished between grants which were ambitious but failed to deliver against some objectives, and those which led to no more than, at best, pedestrian results.
12. To assess the quality of the research the Panel reviewed 141 sample final reports, which represented 57% of all GDB grants completed and graded since September 1996. 100 of these reports were updated with output information received from PIs who returned questionnaires. The analysis of the research quality and outputs was limited by the information provided in the final reports, which was of variable quality in terms of how well they had been written and the detail provided.
13. The Panel noted that 79% of the final reports of GDB responsive mode grants since September 1996 had been graded A or B by Committee members at the time (final reports are submitted three months after the end of the grant, and peer reviewed and graded on a scale of A to D<sup>1</sup> by Committee members). Moreover in their questionnaire responses, 78% of the sample PIs felt that their grant had been (or was likely to be) successful. However, this level of quality was not reflected in the sample of final reports reviewed by every Panel member. While some Panel members found much to commend, including a number of outstanding final reports and outputs, others saw reports which were, at best, solid, incremental contributions to the research base.
14. Overall the panel concluded that the research supported by GDB was mainly good and in line with expectations, given the pattern of support. There were moreover some excellent examples of outputs and achievements (see paragraph 16). However, the Panel identified some grants which had produced relatively little. While acknowledging that some failures would be bound to arise, and that some PIs had problems with the recruitment or retention of staff (discussed later in this Chapter), the Panel felt that some grants should not, perhaps, have been funded in the first place. It also felt that the 'tail' of under-achieving grants was rather longer than might have been expected.
15. To improve the level of outputs, and therefore the potential quality and impact of the science, BBSRC should reconsider the balance between its support for longer and larger grants, and its support for the more traditional three year award. Both forms of support are valuable, but increasing the proportion of longer, larger grants funded would allow some research groups to concentrate on more ambitious programmes of

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<sup>1</sup> A: very high class work that has produced results of considerable scientific importance in a cost effective way, and met all or almost all of the agreed or related key objectives

B: work that has added significantly to knowledge in the field and met the majority of its agreed or related key objectives

C: Work that has fallen short of the contribution to knowledge or cost effectiveness expected from the original proposal even though it may have met some or all of its agreed or related key objectives

D: Work that has not added significantly to knowledge in the field and/or has failed to address the agreed or related objectives.

research and to develop any newly emerging ideas in a more secure funding environment.

The impact of research supported through GDB could be significantly improved by moving to a funding model which encourages and rewards the continuity and stability of research and research groups (i.e. increasing support for longer and larger grants).

## Highlights

16. A number of grants were identified by the Panel as having produced outstanding research outputs. These are described below (other notable grants are included at Appendix 5).

### **How are neural stem cells maintained?**

The aims of the research were: to determine the roles of Notch and other known signalling pathways in preventing differentiation and/or promoting proliferation of the pNB stem cells; and to identify novel genes responsible for implementing the stem cell programme in these cells. There have been several key scientific advances made; the most significant of which is that Notch activity does not prevent differentiation or promote proliferation of the pNB stem cells. This grant resulted in 6 refereed publications.

### **Significance of a non-coding endogenous antisense frequency transcript for circadian clock function in *Neurospora crassa***

This project studied the possible role of antisense transcripts on circadian rhythms in *Neurospora*. Strains were constructed in which expression of the AS *frq* RNA has been altered. The data are the first to link antisense RNA with a circadian phenotype and provide a new example of a cellular process regulated by non-coding antisense RNA. This grant resulted in one refereed publication (in *Nature*).

### **Comparative genomics of *Antirrhinum* and *Arabidopsis* as a model for analysing plant gene function**

The aim of this project was to test the degree to which chromosome structure of *Arabidopsis*, and by implication, the functions of genes, is shared with a distant relative, *Antirrhinum*. The project had two specific aims: to use a limited selection of *Antirrhinum* chromosome fragments to test how much chromosome structure and function is shared between the two species; and to map all eight chromosomes of *Antirrhinum* onto the chromosomes of *Arabidopsis*, to compare the structure and function of the chromosomes on a global, but coarser, scale. Both aspects of the project were successful but gave unexpected results: the library of chromosome fragments from *Antirrhinum* suggested surprisingly low similarity to the chromosomes of *Arabidopsis*. This grant resulted in 5 refereed publications, and in the development of an *Antirrhinum* BAC Library.

### **Molecular and functional analysis of the mutant mouse *shaker-with-syndactylism***

This research used positional cloning to identify two key genes associated with different aspects of this mouse mutant phenotype. They showed that the Na-K-Cl co-transporter gene, *Slc2a2* is important in inner ear development, causing deafness when mutated, and that the mutation of the fibrillin-2 gene causes syndactyly. This grant resulted in 3 refereed publications, and the PI carried out several public engagement activities, including a poster presentation at the House of Commons.

### **Structure and function of picornavirus cis-acting replication elements (CRE)**

This research characterised the structure and function of an RNA sequence that is critical for the replication of picornavirus. The results and generated reagents and know-how have commercial potential as they could be developed into screening tools to search for inhibitors of viral replication. The grant resulted in 3 refereed publications, productive international collaborations, and follow-on funding from MRC of £1M over 5 years.

### **Inferring the distribution of fitness effects of new mutations from DNA sequence data**

The project aimed to develop a general method to estimate the distribution of fitness effects of mutations across the genome (i.e. advantageous, neutral or near-neutral, deleterious). They showed that their original method could not work - disappointing though a useful result - and changed tack somewhat to develop a series of more targeted techniques. One allowed them to calculate the fraction of amino acid substitutions brought about by selection (45% in *Drosophila*) and another the genomic rate of deleterious mutations. The latter estimates are important as they severely undermine a leading theory of the evolution of sex. The grant resulted in impressive outputs, including 7 refereed publications (2 in *Nature*; one in *Science*).

### **Molecular analysis of the novel but widely disseminated active partition system of multidrug resistance plasmid TP228**

The research resulted in the detailed characterisation of the ParFG plasmid partitioning system in *E. coli*. An impressive range of technologies was deployed to characterise the system including protein chemistry, analytical ultracentrifugation, electron microscopy, determination of protein structure by NMR and genetics. The grant resulted in 6 refereed publications and several sequences being lodged in public access databases. Follow-on funding was secured from BBSRC.

### **Genetic and cellular control of growth in *C. elegans* and relatives**

This project studied the genetic basis of growth control in *C. elegans*, and the cellular basis of body size evolution in related nematodes. A screen of body size mutants led to novel genes being investigated, indicating that very complex pathways are involved. The research achieved its initial aims and the PI was inspired to pursue spin-off projects which led to striking results regarding nematode species' variable cell numbers and also regarding germline signalling for growth repression. The grant represents insights into fundamental growth processes in an important model organism, and has led to 7 refereed publications (2 in PNAS; one *Nature* brief communication). The PI has promoted evolution and development to the public, through writing in literary publications and presenting a Royal Institution Lecture, which received considerable press coverage.

### **Comparative genomics of the genus *Saccharomyces***

The aim of this project was to understand whole-genome evolution in terms of the network of relationships between a closely related group of species, and to make the results available through a website and online database. Their view of genome evolution contrasts with that developed from other model organisms such as *Drosophila* and indicates that there are many different modes of genome evolution across the different taxa. Their analysis of closely-related species of *Saccharomyces* was published in *Nature*, which inspired several other complementary studies around the world. Two other BBSRC projects have arisen from the project, and 8 refereed publications have been published (2 in *Nature*).

### **Nottingham Arabidopsis Stock Centre: provision of key *Arabidopsis thaliana* genetic resources to the research community**

This team was funded to maintain the services of the Nottingham *Arabidopsis* Stock Centre, the European counterpart of ABRC in Ohio. They met the major objective of attaining 20% cost recovery, and provided 100,000 stocks to 86 countries worldwide, thereby facilitating research, publication and commercialisation in one of the most successful single organism communities in the biological sciences. The grant has resulted in one refereed publication and two book chapters, as well as a substantial, well-used website. The team has carried out an impressive number of public engagement activities, including media interactions; the development and distribution of a schools kit for *Arabidopsis* research; and participation in an annual Plant Sciences teachers and students demonstration day.

### **Fundamental molecular evolutionary processes of genes and genomes**

This group studied patterns of evolution at synonymously variable or silent sites among different genes and across species. The major findings were: (i) that a significant fraction of amino acid replacements can be neutral with respect to fitness; (ii) *Giardia lamblia* shows a more pronounced variation in the extent of selected codon usage than any other species; (iii)

in mammals, although neighbouring genes exhibit significant similarity with respect to G+C content at silent sites and rates of synonymous substitution, these phenomena were not correlated, suggesting two distinct underlying mutational causes; (iv) in a set of highly conserved prokaryotic and eukaryotic gene products, most codon switches probably reflect simultaneous double mutations; and (v) in *Saccharomyces cerevisiae*, shorter chromosomes are more G+C rich, possibly reflecting a mutational bias generated by their relatively higher rate of recombination. The grant has resulted in 5 refereed papers (one in *Science*).

### **Molecular genetic analysis of the *Drosophila* Trk-related receptor *Dror* and its signalling cascade**

The original aims of this grant were based on genetic anomaly, but changed direction. It has led to important and fundamental findings concerning the functions of JNK and PTEN. The studies have clearly defined, for the first time, the *in vivo* mechanisms by which PTEN can act as a tumour suppressor in higher organisms, and have provided the basis for identifying and testing key functional motifs in PTEN and for dissecting the PTEN signalling cascade in a genetically amenable organism. This grant resulted in 3 refereed publications and the production of mutant and transgenic flies that have been distributed to 20 other laboratories.

## **Research outputs**

17. The Panel considered a number of types of short- to medium-term research output:
- Publications
  - Trained people, new skills
  - New collaborations, further funding
  - New products, processes, tools and technologies, intellectual property, spin-out companies
  - Contribution to the reduction, refinement and replacement of animals in research.

Longer-term outcomes arising from the research supported through GDB are discussed in Chapter 6 (page 21).

### Publications

18. Bearing in mind the caution with which all data on publications must be interpreted, the Panel felt that the level of publications reported by sample PIs as having arisen from the research supported by the grant was good, with a median of three peer-reviewed publications per grant for sample completed grants<sup>2</sup>. Many publications were in highly respected journals in the field, and the Panel noted that 18% of the reported publications were in journals with an Impact Factor greater than 10, including a number in high profile general journals (e.g. *Nature*, *Proceedings of the National Academy of Sciences*). Some Panel members felt that it would also have been helpful to see the number of citations.

### Trained people, new skills

19. One of the important outputs from BBSRC responsive mode funding is an increased level of trained and skilled staff within the biosciences research community, with many being of international quality. It is also important that a sufficient level of these skills and know-how are retained and developed further within the academic research base, through effective career structures.
20. The Panel was encouraged that 54% of PIs reported that the GDB grant had supported their wider research aims by strengthening the skills base of their group.

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<sup>2</sup> The median is used because the distribution of papers per grant is left-skewed (the majority of grants lead to the publication of 0-6 papers, but a small proportion resulted in larger numbers of papers, with a maximum of 16). The average per grant was 3.2 for completed grants and 2.1 for current grants.

Nevertheless, it was concerned about career prospects for some newly trained staff. The Panel noted that 47% of those PIs who indicated that their grant had been less successful than anticipated said that this was due to the difficulty of recruiting and retaining staff, which it believed further underlined the structural career difficulties faced by research assistants employed on grants. While recognising the need for flexibility to maintain dynamism, the Panel felt that action was needed to ensure that career prospects for the most able research staff were attractive and stable.

21. 13% of the RAs on the sample grants had been employed as a Named Researcher (an RA already working in the laboratory and included on the application). The Panel welcomed the Named Researcher system, and suggested that BBSRC should encourage a greater level of involvement in grant preparation among postdoctoral researchers; more of them should be writing their own applications for funding, or at least be closely involved in the application process.
22. In terms of career development for the most able, the Panel identified junior research fellowships as an important mechanism for allowing postdocs to develop their ideas and questioned whether BBSRC funds a sufficient number of fellows.
23. EPSRC Platform Grants were cited as a good model for funding, as the award is made to a research group rather than an individual, so can provide more stability for the group, and support researchers for transition periods early in their careers.
24. Although principal investigators on grants may also be, and often are, BBSRC-approved PhD student supervisors, PhD students cannot be funded on BBSRC research grants. The Panel suggested that this policy might usefully be revisited, as funding PhD students on grants could provide an additional source of suitably trained staff for employment as RAs on future grants.

BBSRC, possibly working through Research Councils UK (RCUK), should continue to identify ways to contribute to improving job security, benefits and career prospects for research staff.

#### New collaborations, further funding

25. More than half of the sample PIs reported new or improved academic contacts as a result of the research supported by the grant, with 35% reporting new UK collaborations and (an overlapping) 35% reporting new overseas collaborations. Some PIs also reported new industrial contacts and collaborations, which are discussed further in Chapter 4 (page 17).
26. 47% of the PIs of sample completed grants had received further funding to continue or develop the research supported by the grant. 18% had secured further funding through GDB and 8% through other BBSRC committees.

#### New products, processes, tools and technologies, intellectual property, and spin-out companies

27. Almost half of the PIs returning questionnaires reported new products, processes, tools or technologies that had or could result from the work supported by the grant, including sequence information, protocols and methods, biological materials, chromosome libraries, software, and databases. Most of these outputs have been made freely available and, as would be expected from GDB's remit, most of the reported users of these outputs were other researchers. Small numbers of the sample PIs reported having secured intellectual property (mostly in the form of patents) as a result of the work supported by the grant, or reported that they were likely to apply in the near future. No spin-out companies were reported as having

been established from these grants. Industrial interactions are discussed further in Chapter 4 (page 17).

#### Contribution to the reduction, refinement and replacement of animals in research

28. More than a third of sample committee members felt that the research supported by the GDB committee contributed generally to the reduction, refinement and replacement of animals used in experiments (the '3Rs'). Specific examples include:
- Adaptation of an avian cell line (QNR/d) in the study of circadian clock mechanisms such as synchronisation, protein-protein interaction, and gene regulation. It is envisaged that this cell line will provide a tool in circadian research and may replace (or reduce) the use of primary avian cells such as the pineal gland and retina in future experimentation
  - Creation of single cell molecular techniques and human preimplantation embryo libraries reduce the use of animals and human embryos in embryonic growth and differentiation
  - Development of *in vitro* models for the microdissection of adult hair follicle cells to investigate induction of gene expression. These models reduced the number of animals used in experiments.
29. The Panel felt that the focus on the 3Rs is a recent and political development. As a result it may not be appropriate to make strong judgements on grants that were awarded prior to the recent emphasis. It might be possible that, although PIs recognise the importance of the 3Rs, they do not highlight their contributions.

## CHAPTER 3. BALANCE AND COVERAGE OF THE PORTFOLIO

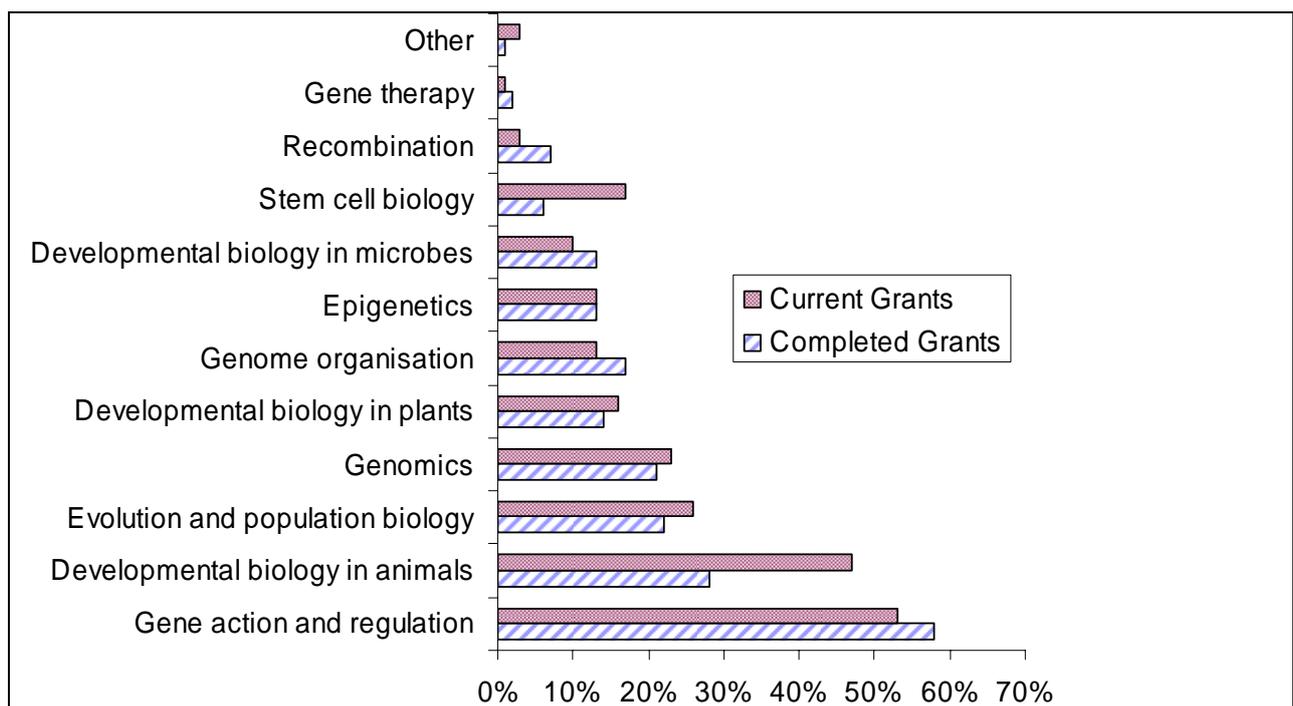
### Overview

30. The Panel agreed that the GDB committee remit is, and continues to be, appropriate. The surveyed committee members were generally happy with the remit, noting that it is very broad. The PI survey elicited few comments on this, except that the remit was sufficiently broad and general to enable it to concentrate on supporting the highest quality research. These views are supported by the fact that 95% of the sample PIs reported that they had not significantly had to change the direction of their research to fit into the GDB remit. An important feature of the GDB remit is that it supports a number of areas of science where there is no other funding available in the UK; 23% of sample PIs commented that the GDB grant had provided funding for activities that other bodies would not fund, for example in plant developmental genetics.

### Coverage of the portfolio

31. The coverage of the GDB portfolio was also considered to be appropriate to its remit and there appeared to be no major gaps in the areas funded. The figure below provides a rough illustration of the coverage of the portfolio, as indicated by the areas of expertise selected by sample PIs in their questionnaires.

*Areas of expertise indicated by sample PIs*  
(many respondents ticked multiple categories)



32. Although the focus of the evaluation was on the responsive mode funding through GDB, the Panel felt strongly that BBSRC should be congratulated on the success of the Stem Cell Initiative, which falls within the remit of the GDB committee.
33. 70% of the sample PIs felt that their area was well supported by the committee; only 7% felt it was not well supported. 71% of the sample committee members commented that the portfolio of research supported by the GDB committee was appropriate and more or less covered the committee remit.
34. The Panel noted an apparent lack of support within GDB's remit for research using and developing bioinformatic tools. However, it was recognised that separate

Bioinformatics initiatives had been in place over the time period being reviewed, within which most of the bioinformatics grants had been funded. It was clear to the Panel that the majority of those grants funded via GDB had used bioinformatic tools rather than carrying out the basic research underpinning the development of those tools. The Panel recommended that BBSRC should take steps to encourage and support more research to develop focused tools for the GDB community, and felt that bioinformaticians should be encouraged to participate in interdisciplinary research projects.

35. The surveyed committee members commented that there appears to be some overlap between the remit of GDB and some of the other BBSRC committees. However, the Panel's view was that some overlap was healthy for the UK research base as a whole.

BBSRC should investigate the apparent gap in support for the development of bioinformatic tools for research within GDB's remit. Should this gap be real, the Council should take steps either to review its policy for support of bioinformatics research through all committees, or to encourage more applications to GDB in this area.

### Overlap with other funders

36. A number of other UK funding bodies support research in areas that overlap with the GDB remit, including government departments, other research councils, and charities. When surveyed, these organisations appeared to be generally satisfied that the GDB remit is clearly defined. The Panel agreed with the views of other funders and surveyed committee members that some overlap can be beneficial as it gives researchers a number of options and ensures that there are no gaps in support for research in this area.
37. Areas of interface with the other research councils are monitored, and grant applications outside the BBSRC remit are redirected to the appropriate council. There are formal funding arrangements already in place with both NERC and with EPSRC (via the Life Sciences Interface). In the questionnaire responses, the other research councils were reasonably satisfied that the boundaries between the councils are clearly defined, although EPSRC commented that it would be helpful to improve the levels of communication between GDB and LSI, to ensure that all interdisciplinary proposals are dealt with properly. The Panel felt that with the increasing emphasis on interdisciplinary research, it is important that BBSRC remains committed to making communication between Councils more effective in the future. For example, there was a degree of uncertainty between GDB and NERC in biodiversity informatics which should be resolved.

BBSRC should remain committed to cross-council communication to facilitate interdisciplinary research.

### Priority Areas

38. The Panel was undecided about the merits of the Priority Areas (PAs). The main observation was that too many subjects were included as priorities, they were too broad, and should be more clearly defined. This view was supported to an extent by the surveyed committee members, 24% of whom expressed concerns relating to PAs. The minor role played by PAs in the assessment process<sup>3</sup> was felt to be

<sup>3</sup> PAs are intended to encourage PIs to submit applications in certain specific areas within the Committee remit (for example to address important gaps in the portfolio or to promote new/developing areas of science), rather than to have a major influence on the peer review. Scientific excellence remains the most important criterion in the appraisal of applications. The other criteria of strategic relevance (which includes fit to PAs), prosperity &

appropriate, as these areas should not be promoted to the detriment of support for the best science through responsive mode, especially as research initiatives are used by BBSRC as a mechanism for providing targeted support where it is clearly needed.

39. There appeared to be a negative perception of PAs among the GDB community, as reported in the questionnaire returns, which BBSRC should address. It is possible that the word 'priority' implies a greater level of significance than is actually the case and it is clear that some in the community find the terms confusing or misleading.

BBSRC should consider the relevance, breadth, and clarity of Priority Areas within the GDB remit.

### **Interdisciplinary research**

40. The Panel agreed that interdisciplinary research should be encouraged and felt that, in particular, research proposals involving bioinformaticians should be considered. In a recent study of interdisciplinarity in BBSRC responsive mode grants, GDB ranked third out of the BBSRC committees, with 18 interdisciplinary grants being funded on 1 April 2004. This was 6% of all BBSRC interdisciplinary grants. It should be noted that the measure of interdisciplinarity used (joint awards between PIs in different departments, plus awards to PIs in non-bioscience departments) will be an underestimate of total interdisciplinary effort.

### **International comparison**

41. Given the scope of this evaluation, it has not been feasible to generate specific internationally comparative data for genes and developmental biology research. However, the UK ranks very highly on the international stage in terms of the quality of its bioscience research as shown in the Office of Science and Innovation's Public Service Agreement target metrics 2005. The UK ranked second (after the USA) for its share of citations in the biosciences for 1995-2004; and was ahead of the USA, in citation impact (ratio of citations to publications). The UK also had the lowest proportion of uncited papers for biosciences for 1999-2004 amongst the G8 countries. In addition, the Panel felt that GDB trained staff are well respected in other countries and as a result many can compete for international positions.
42. The Panel member from Germany gave some brief comments on the perception in Germany of UK research in genetics and developmental biology. Generally, UK research in the biosciences is respected for its funding of basic, underpinning research, which is perceived to provide good value for money. The BBSRC is well known as a leading UK funder, although the GDB committee specifically is not necessarily known.

## CHAPTER 4. INTERACTION WITH INDUSTRY

43. The level of interaction with industry in the sample grants is low. However, this is acceptable and partly to be expected due to the basic nature of the research supported through GDB. It is important to note that knowledge transfer and interactions with industry occur at a number of other levels (for example specialist networks, direct funding of research by industry) that are not included in this study on research grants.
44. The most important contributions that GDB supported research makes to industry are likely to be longer-term, and hence more difficult to measure and attribute:
- the basic research supported through GDB forms the 'bedrock' of knowledge from which industry can conduct more applied research
  - GDB-supported research provides industry with a continued supply of scientists trained in GDB research methods: the private sector was the first destination for 10% of the RAs employed on the sample grants.
45. There was limited initial investment by industry in the sample grants: only 3% of sample PIs reported having had co-funding or in-kind support from industry at the start of the grant. By way of comparison, 6% of sample ASC PIs and 4% of BCB PIs reported industrial support at the outset of their grant.
46. The level of interaction and the potential for collaboration, however, appears to be slightly higher once the research has been conducted:
- 10% of sample PIs reported new or improved contacts with UK industry as a result of the research supported by the grant, and 9% with overseas industry
  - 7% of sample PIs reported new collaborations with UK industry, and 2% with overseas industry.
- The BBSRC Industrial Partnership Award (where 10% of the grant is provided by an industrial sponsor) is designed to encourage industrial investment at the outset and addresses this issue to some extent. The LINK Programmes which used to be run in conjunction with DTI were thought to have been effective and the Panel was disappointed that this funding is no longer available. Other government departments still participate in this scheme, and BBSRC still support stand-alone LINK projects.
47. It is likely that the scientific community expects GDB to focus predominantly on basic bioscience, and that PIs target more applied and industrially relevant grant applications to more medically oriented funders. If this is the case the interaction between GDB grantholders and industry will be limited.
48. Technology transfer offices within academic institutions represent a critical link between academia and industry but, in some institutions, these offices can be under-resourced and hence limit interactions. Specifically, lack of experience can make it difficult for universities realistically to judge potential outputs and expectations of any technologies developed. It could be beneficial for BBSRC to liaise with technology transfer offices and provide assistance if necessary.
49. The academic community's need to publish can work against the development of industrial interactions: PIs might feel under pressure to publish results rather than spend time developing findings into industrially relevant solutions, particularly within the current climate of the Research Assessment Exercise. A change in publication and employment culture may result in more industrial outputs, but this cannot be the sole responsibility of BBSRC. BBSRC can best make a difference through continuing to facilitate interactions between universities and industry.
50. Working with industry to help develop higher quality products and services more quickly and efficiently can be of benefit to PIs and is routinely done by the National Institutes of Health in the United States. The advantage is that some products/services can be provided quicker, cheaper, and of higher quality. The

priorities of industry, however, are different from those of academia and the working relationship with industry needs careful consideration to avoid potential pitfalls.

BBSRC should seek to promote further contacts and collaborations between GDB grantholders and industry when appropriate. Specifically, liaising with university administrators on technology transfer could be very beneficial in some circumstances.

## CHAPTER 5. PUBLIC ENGAGEMENT

51. It is a condition of BBSRC grant funding that PIs (or a member of their group) spend one to two days per year on public engagement activities, and they are expected to report progress in the final report. However, the Panel noted that, although public engagement was included at all six levels of the GDB logic chart, this level of commitment was not reflected in the activities reported. Moreover, the Panel was concerned that PIs were expected to achieve these objectives in only one or two days a year.
52. The Panel was nevertheless pleased to note from the questionnaires and final reports that over half of the sample PIs had reported public engagement activities over the 10 year period being sampled. The most frequently reported activities were presentations and events (e.g. school activities, presentations to the general public, exhibitions, open days) and media interactions (e.g. newspaper and magazine articles, radio and television interviews). There was no discernable pattern in terms of the nature of the project and the type of public engagement activity employed. Target audiences ranged from the national media and Parliament, to the Women's Guild.
53. A recent study by the BBSRC External Relations Unit found that 82% of the GDB final reports returned between June and September 2005 reported having carried out at least some public engagement activities, suggesting a genuine level of activity in this area, and an improvement over the earlier years of the period under review in this evaluation, potentially as a result of growing emphasis by BBSRC. 82% was above the BBSRC average across all Committees (76%).
54. BBSRC has increased awareness of the importance of public engagement amongst the bioscience community. However, a number of issues and barriers remain: the Panel agreed that the PIs did not appear to have a clear understanding of what BBSRC means by 'public engagement' as opposed to 'informing the public' and, more generally, what the Council expects of them as grantholders.
55. It was recognised that PIs do not always have the expertise and support needed to undertake these activities. It can be difficult, for example, to attract media interest in basic biology, and it is often not easy to make this area of bioscience accessible to the public. Beyond these problems, some PIs are concerned that the media could misrepresent the science, a particular issue for those working with animals. There is a lack of immediate incentive for PIs to devote effort to this area because, unlike writing papers or grant applications, there is no obvious reward for putting time into public engagement activities or penalty for not doing so.
56. The Panel agreed that at present the public engagement activities of projects do not match the ambitions of the logic chart, but recognised that PIs are in a difficult situation. Apart from the general statement regarding the maintenance of public confidence, they appear to have little guidance on what they are expected to achieve through their public engagement activities, the purposes of different types of public engagement, and where to find various kinds of support.
57. Ultimately, the Panel felt that public engagement is a priority for BBSRC but not for PIs. To reverse this BBSRC should consider:
  - refining or limiting the purpose and function of public engagement activities within the remit of the GDB committee
  - consultation with external specialists, including the Wellcome Trust, the Royal Society and social scientists on how these functions can more readily be achieved
  - allocation of increased resources and modes of support to achieve these objectives, such as training and incentives for PIs
  - identifying and sharing good dissemination practice within existing GDB projects (human embryonic stem cell researchers, for example, have had a lot of practice

in thinking through the politics of public engagement), and across other BBSRC committees.

BBSRC should continue to seek opportunities to encourage and facilitate bioscientists to engage with the public. This could include dedicated financial support, dissemination of examples of best practise, consultation with experts from other organisations, and assessing the amount of time available for such activities.

## CHAPTER 6. ULTIMATE IMPACTS

### Introduction

58. Ultimate impacts relate to the overall objectives of BBSRC as an organisation and are generally expected to arise in the longer-term. The logic chart identifies the following 'ultimate' impacts (relating to the objectives expressed in the BBSRC 10-year vision) that might arise from GDB responsive mode research (Figure 1, Appendix 2):
- the UK maintaining its international standing in genes and developmental biology research
  - research findings are used for the 'public good', e.g. medical research, biotechnology, government policy
  - income to the research community and to 'UK plc', e.g. from new technologies, intellectual property
  - BBSRC maintaining its role as a key funder of genes and developmental biology research in the UK
  - public confidence in UK genes and developmental biology research is maintained.
59. These impacts are clearly difficult to measure and even more difficult to attribute. However, it is particularly important that they are evaluated because they relate to the overall objectives of the organisation; they help to answer the question 'how effectively is BBSRC doing its job?'
60. Income to the research community and UK plc, and the international standing of the UK in genes and developmental biology research (as measured by the quality of UK research in this area) are discussed in Chapters 4 (page 17) and 2 (page 8), respectively.

### Research findings used for the public good

61. As an important component of the BBSRC portfolio of fundamental research, GDB research has high intrinsic value, and constitutes a public good in itself, as it helps to maintain a healthy bioscience research base in the UK, without which few related achievements would be realised. More specifically, some of the sample PIs identified direct contributions to the public good that the research supported by the grant had made (or could potentially make). Examples included:
- a potential anti-cancer drug for childhood brain cancer sufferers
  - increased knowledge of the evolution of drug resistant and virulent *Staphylococcus aureus* (MRSA), with the potential to predict emergence of drug resistant strains in the future
  - a molecular phylogeny that provides the framework for taxonomy of the social amoebae. This is an important tool for global mapping of their biodiversity and for estimating the impact of modern society on biodiversity
  - knowledge of the mutation rate for deleterious mutations which is of fundamental significance for conservation biology
  - identification and characterisation of a mechanism (shared by many animal and human pathogenic viruses) for the initiation of replication
  - better insight into plasticity of stem cells
  - contributions to basic knowledge about the mechanisms of development of the vertebral column. This is likely to inform future stem cell/tissue engineering strategies for treating degenerative disease of the human intervertebral disc.
62. The contributions to the 3Rs discussed in Chapter 2 (page 8) are also relevant here, helping the UK research community to move towards using fewer animals in research, in line with government policy.

## **The role of BBSRC as a key funder of GDB research**

63. The large and increasing number of applications received by GDB is evidence of the health of this research community in the UK. BBSRC is clearly an important funder of GDB research particularly as transient fashions are not allowed to dominate the portfolio. However, as discussed in Chapter 7, a move to improve the continuity of research funding (through funding significantly more longer and larger grants) could notably increase the impact of BBSRC as a funder of research in the GDB area.
64. The Panel noted that GDB funds some areas of research that do not have alternative funders. One such area of particular importance is plant developmental genetics, where basic research has proven to be of great significance, and applicable to many other biological disciplines such as the discovery of siRNA.

## **Public confidence in UK GDB research**

65. The public can draw confidence from the fact that GDB-supported research is peer reviewed and funded only when judged to be of sufficiently high quality. There are no particular issues with GDB's remit or portfolio in this respect.
66. Public engagement can increase public confidence in GDB research and, as discussed in Chapter 5 (page 19), over half of PIs reported completing this type of activity. Selected examples are shown below:
  - a presentation to staff and pupils of all the local secondary schools. This led to two pupils being supported (Nuffield/SGM) to conduct summer placements in the university
  - House of Commons presentation by research student
  - lecture on 'Human Cloning' at the local Science Café
  - webcast with the National History Museum.The Panel agreed that BBSRC should continue to encourage public engagement and take an increased role in its facilitation.

## CHAPTER 7. GENERIC ISSUES

67. A number of general issues relating to BBSRC grant administration processes and support for the UK biosciences arose in the surveys and during the Panel meetings. These findings will be considered by the appropriate BBSRC body in conjunction with the results of other current responsive mode portfolio evaluations. The main points are summarised here.
68. The Panel was pleased to note that all of the surveyed Committee members said that the Committee works very well as a team, and that there is robust discussion of difficult cases. As with all funding bodies relying on peer review, the effectiveness of the Committee is limited by difficulties in obtaining sufficient and useful input from referees. The Panel suggested that efforts should be made to improve the number and quality of referees' comments. This might be achieved by setting up a college system, where referees are paid for carrying out an agreed number of reviews each year. It was also suggested that referees should be given more time to assess grants and should be approached in advance to check whether or not they are able to carry out the assessment.
69. In the questionnaires, PIs and Committee members mainly commented that the processes are good or satisfactory, and that it is helpful to be able to respond to referees' comments before the Committee meeting. The most common negative comments were that the process is too slow, and that better feedback should be given for unsuccessful applications.
70. The Panel agreed that more longer and larger grants should be funded (e.g. for up to 5 years and supporting more than one RA). Although three year grants with one RA are of value and have their place, in supporting smaller groups, new investigators, allowing the piloting of new approaches or ideas, and providing continuity between larger grants, the Panel agreed that there were many advantages in funding longer, larger grants. They enable researchers to investigate more complex problems and to take more risks, for example exploring interdisciplinary approaches.
71. Despite BBSRC's encouragement for PIs to apply for longer and larger grants, there has been a significant decline in the proportion of grants awarded for longer than three years, and no real increase in the number of large grants awarded. In 2005, for example, only 4% of the responsive mode grants awarded by BBSRC were for longer than three years, compared with 31% in 2001. There is no clear reason for this decline, although there does appear to be a feeling in the community that longer and larger grants have a lower chance of success, so PIs are therefore not submitting these types of application in large numbers. In fact, the opposite appears to be true, as data show that the success rates of applications for longer and larger grants are higher than those for three year, one RA, grants. One reason for this might be that PIs are able to submit outline proposals for these grants in advance of the full application, so they are able to fine-tune them before the formal submission.
72. BBSRC is commended for having recently launched the Longer Larger Grants Scheme<sup>4</sup>, and is strongly encouraged to take more proactive and structural steps towards facilitating continuity and stability in larger research groups, enabling the recruitment, retention and career development of high quality research staff. As BBSRC grants appear to be seen by some PIs as top-up grants to other sources of funding, longer term funding might also encourage more 'loyalty' towards BBSRC amongst those PIs, and would give more career security for staff on the grant.

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<sup>4</sup> [www.bbsrc.ac.uk/science/areas/crosscommittee/multidisciplinary\\_programmes.html](http://www.bbsrc.ac.uk/science/areas/crosscommittee/multidisciplinary_programmes.html).

The Panel endorses the attempts by BBSRC to increase the number of longer and larger grants provided through the GDB committee. Allowing the length of the grant to reflect the needs of the science and the research group would be beneficial, and should ensure that an appropriate balance between longer and larger grants and three year, one RA grants is maintained.

73. In addition to its general points on staff and career development in Chapter 2 (page 8), and the role of Priority Areas in Chapter 3 (page 15), the Panel also noted that:
- studentships linked to grants would be very beneficial
  - there was significant variation in how well the final reports had been written, and in how outputs (particularly publications) had been reported, leading to difficulties and, potentially, unfairness in the evaluation of the reports. The Panel was pleased to hear that more specific guidelines are now in place for completion of these forms in electronic format.

## CHAPTER 8. CONCLUSIONS

74. The GDB Committee supports high quality science which forms an important scientific base. The Panel felt that the remit is strong, broad and appropriate and that significant structural change is not required.
75. Some of the research presented was considered as 'top class' but it was also the opinion of the Panel that some low quality work had been funded. However, the risk inherent in this field should be recognised and thus failure of some grants expected. It is essential for the progression of this area that the GDB Committee should continue to fund grants that could have uncertainties such as young investigators or high risk hypotheses.
76. The trained scientists and strong scientific base that is produced by GDB funded research enables the UK to maintain its position of strong international competitiveness in this area. As a result a number of other countries look to the UK for expertise in fundamental biological sciences.
77. The Panel identified a number of generic issues:
- there was support for the Longer, Larger Grants Scheme and acknowledgement that BBSRC should address the issues of job security and career prospects for research staff.
  - the Panel expressed concerns over the refereeing process. Although they agreed with the overall principle they felt that a minimum of two referees should review each application. The Panel felt that incentives should be provided to referees to encourage participation and that scheduling could be improved
  - the current final reporting format does not enable BBSRC to track the staff participating in the research, so it is difficult to evaluate staff shortages, publications or training received. Reformatting to include personnel information and a simpler and more specific description of scientific content, such as an abstract, would be beneficial