APPENDICES

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APPENDIX 1

PANEL MEMBERSHIP

Steve Brown (Chair – meeting 1), MRC Mammalian Genetics Unit, Harwell

David Ish-Horowicz (Chair – meeting 2), Cancer Research UK

Teresa Attwood, Faculty of Life Sciences, University of Manchester

Dolores Cahill, Dublin Molecular Medicine Centre

Tony Carr, MRC Genome Damage and Stability Centre, University of Sussex

Lloyd Czaplewski, Prolysis Limited

Amanda Fisher, MRC Clinical Sciences Centre, Imperial College

Charles Godfray, Department of Zoology, University of Oxford
(formerly at NERC Centre for Population Biology, Imperial College)

Nick Goldman, European Bioinformatics Institute, Hinxton

Catherine Kidner, Institute of Molecular Plant Sciences, University of Edinburgh and
Royal Botanic Gardens, Edinburgh

Brian Salter, Institute of Health, University of East Anglia

Tom Strachan, Institute of Human Genetics, University of Newcastle

Diethard Tautz, Institute for Genetics, Cologne

Fiona Watt, Cancer Research UK

ACKNOWLEDGEMENTS

The Panel would like to thank all of the respondents who gave their time to contribute to this evaluation. This includes Principal Investigators, current and former GDB Committee members, and other funding organisations.

APPENDIX 2

EVALUATION CONTEXT AND METHODOLOGY

Responsive mode funding in BBSRC

1. Responsive mode grant applications are welcomed from eligible researchers at UK universities, BBSRC-sponsored Research Institutes, and a number of other Research Institutes. All responsive mode applications accepted by BBSRC are subject to peer review through the seven Research Committees. Despite increases in the amount of funding available, competition for responsive mode grants has been particularly intense in recent years, with approximately 25% of applications funded in recent rounds.

2. BBSRC operates a number of research grants schemes within responsive mode, aimed at fostering collaboration with industry (e.g. Industrial Partnership Awards), and at assisting researchers at an early stage in their careers to obtain their first research grant (the New Investigator Scheme).

3. All Principal Investigators (PIs) on grants are required to submit a final scientific report within three months of completion of the grant. They are asked to report on progress against scientific objectives, and to list publications and other outputs arising directly from the research supported by the grant. Final reports are peer reviewed and graded by two current or former Committee members, or by other specialist advisers.

Evaluation objectives and methodology

4. This evaluation covered research supported in responsive mode through the BBSRC Genes and Developmental Biology Committee (GDB) since 1996. This includes research conducted at universities and responsive mode grants to BBSRC-sponsored Research Institutes. The research supported through Core Strategic Grants to the Institutes is evaluated every four years in the BBSRC Institute Assessment Exercise. Thus, although some of this research falls within GDB's remit, it was not included in this evaluation.

   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's responsive portfolio over the past 10 years
   - Identify strengths, weaknesses and gaps in GDB's 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.

5. The evaluation comprised a number of surveys, followed by a review of findings. The work was co-ordinated by the BBSRC Evaluation and Policy Unit, in consultation with the Genes and Developmental Biology Branch. A logic chart was used to guide the design of the evaluation (Figure 1, page 33). This chart represents diagrammatically the objectives and desired impacts of the BBSRC responsive mode, and places the scheme in its wider context, showing its links to the longer-term aims of the organisation.

Surveys

6. Information was gathered from a range of sources:

- **Completed grantholders:** 247 GDB responsive mode grants were completed and graded from 1996 to mid 2005. A structured sample of more than half of these was taken, comprising 141 grants drawn from all of the years covered, and encompassing a representative proportion of final report grades. A questionnaire (Appendix 3) covering a range of topics including success of the grant, outputs, outcomes, views on the coverage of the portfolio, and views on the operation of the Committee was sent to the Principal Investigators (PIs) of the sample grants.

- **Current grantholders:** A structured sample of half the current grants that have been active for more than a year was taken, comprising 96 grants ranging from those at the end of their first year to almost completed grants. A questionnaire very similar to that sent to completed grantholders was sent to each PI.

- **Committee members:** Current and past Committee members (those serving over the last five years) were sent a questionnaire (Appendix 3) covering topics such as coverage of the portfolio, GDB's achievements, and views on the Committee and BBSRC administration.

- **Other relevant UK funding bodies:** A separate questionnaire (Appendix 3) was sent to other funding bodies with an interest in genes and developmental biology research in the UK, namely: Cancer Research UK, the Department for Environment, Food and Rural Affairs (Defra), the Department of Health, the Department of Trade and Industry, the Engineering and Physical Sciences Research Council (EPSRC), the Economic and Social Research Council (ESRC), the Medical Research Council (MRC), the Natural Environment Research Council (NERC), the Scottish Executive Environment and Rural Affairs Department (SEERAD), and the Wellcome Trust. The questionnaire covered potential overlap or gaps between remits, research priorities in genes and developmental biology research, and views on the appropriate niches for the two organisations.

- **BBSRC data:** Relevant data were collated, including the final reports submitted by the sample PIs, and information from the BBSRC grants databases.

7. Unsuccessful applicants were not included in the surveys because the focus of the evaluation was on the science supported through GDB; moreover because the majority of BBSRC's grantholders have had applications rejected as well as funded, these grantholders were likely to include issues relating to unsuccessful applications in their responses. The comments included in the questionnaires showed this to be the case.

Review of findings

8. The findings of the surveys were collated and analysed, and are presented in Appendix 6. The role of the Panel was to provide an independent scientific evaluation of the data presented, focusing on the scientific aspects of the portfolio. The detailed process aspects covered in the surveys (i.e. issues that are common to all of the Research Committees) will be combined with the process-related responses from other responsive mode evaluations and reviewed by the BBSRC Strategy Board. It should also be noted that financial and efficiency aspects are reviewed regularly as part of the BBSRC internal audit procedures.

9. The Review Panel comprised independent experts who are not closely involved with BBSRC, but who are nevertheless familiar with the research in this area, and who between them have expertise across GDB's remit. The Panel included one member from industry, and two international members.

10. The Panel met for two sessions. To facilitate the analysis, the three 'impact' lines of the logic chart were divided into five subject areas:

- Research outputs and achievements
- Balance and coverage of the portfolio
- Interaction with industry
- Public engagement
- Ultimate impacts.

11. This report will be presented to the BBSRC Strategy Board, which is responsible for analysing the report and acting on it as appropriate. The report will also be made public on the BBSRC website, and circulated to all those who returned questionnaires.

Constraints

12. The survey data presented in this report relate to the samples described above. The samples of completed and current grants represent a random cross-section of the science supported through GDB and, due to the excellent response rate, cover 40% of completed grants and 36% of current grants. Nevertheless, it should be borne in mind that they are samples, a point which is especially pertinent to the analysis of portfolio coverage.

The Genes and Developmental Biology Committee

13. The BBSRC Genes and Developmental Biology Committee (GDB) was established in 1994 following the creation of BBSRC from a re-organisation of the Research Councils. The Committee's first responsive mode round took place in September 1994. The table below contains summary data on the BBSRC responsive mode funding through GDB over the past five years.

Year	2001/02	2002/03	2003/04	2004/05	2005/06[$]
GDB spend - responsive mode (£ million)	13.6	15.1	17.1	19.1	19.9
GDB spend – total* (£ million)	36.3	40.1	46.9	49.9	57.9[+]
No. GDB responsive mode grants awarded	77	81	77	67	57

* Including initiatives, studentships, Core Strategic Grants to Institutes, other types of grant
[$] The 05/06 figures are affected by the move to Full Economic Costing in September 2005
[+] Estimate

14. The science funded by the GDB committee under responsive mode is defined by its remit, which is the overarching definition of the scientific responsibility of the Committee and is not generally subject to change or modification. The GDB Committee supports research which seeks to establish fundamental principles of genetics and gene function in all organisms, or which seeks to understand developmental mechanisms in animals, plants and model microbes including fungi. The remit includes:

- genetics of developmental processes including differentiation
- morphogenesis and comparative developmental biology
- stem cell biology
- genetics of ageing
- genomics including sequence analysis and genome organisation
- quantitative genetics
- behaviour of genes in populations
- evolutionary genetics
- molecular evolution including diversity and phylogeny
- forced evolution
- fundamental studies of gene regulation, expression and action

- genetics of the cell cycle and recombination
- gene therapy.

Note that the GDB Committee supports research into the function/s of viral/non-viral vectors in modification of gene expression. It does not support studies in vector developments/design/ engineering which researchers may find more applicable to the EBS Committee remit.

Themes

15. The Committee's role is to support high quality basic and strategic research across the breadth of its remit. That remit is very broad and the Committee has developed a themed description of its main activities to help the scientific and user communities to understand the major areas in which it operates. The themes are intended to be illustrative rather than exclusive:

    - Genome Analysis
    - Developmental Biology
    - Gene Action and Regulation
    - Cell Cycle and Recombination
    - Evolution and Population Biology.

    Unlike other BBSRC Research Committees, GDB's themes have not previously had accompanying explanatory text. However, the Committee is currently developing text for each theme.

16. To illustrate the distribution of the portfolio amongst the themes, the table below shows the value of GDB responsive mode grants live on 1 January 2005:

Theme	**Spend**
Developmental Biology	£19 million (31%)
Genome Analysis	£15 million (26%)
Gene Action and Regulation	£14 million (24%)
Evolution and Population Biology	£7 million (11%)
Cell Cycle and Recombination	£5 million (8%)

Priority Areas

17. Within GDB's remit there are specific areas of science, called Priority Areas, which are areas where the Committee particularly wishes to encourage applications, for example to address important gaps in the Committee's portfolio or to promote new/developing areas of science. Priority areas are modified and/or removed over time as their objectives are achieved. GDB currently has the following Priority Areas:

    - Post/Functional Genomics
    - Stem Cell Biology
    - Comparative and Evolutionary Genomics
    - Evolutionary Developmental Biology
    - Genetics of Ageing
    - Gene Function Analysis in Developmental Biology
    - Biodiversity Informatics.

18. BBSRC recognises that research is becoming increasingly multi- and inter-disciplinary and that some research areas are important to all Committees. As a result, nine Cross-Committee Priority Areas were announced between 2001 and 2004. An application in a Cross-Committee Priority Area is given the same status as one in a Committee Priority Area.

19. Applications under any of these Priority Areas may potentially fall within GDB's remit, but in practice applications are generally only received in the Priority Areas marked*:

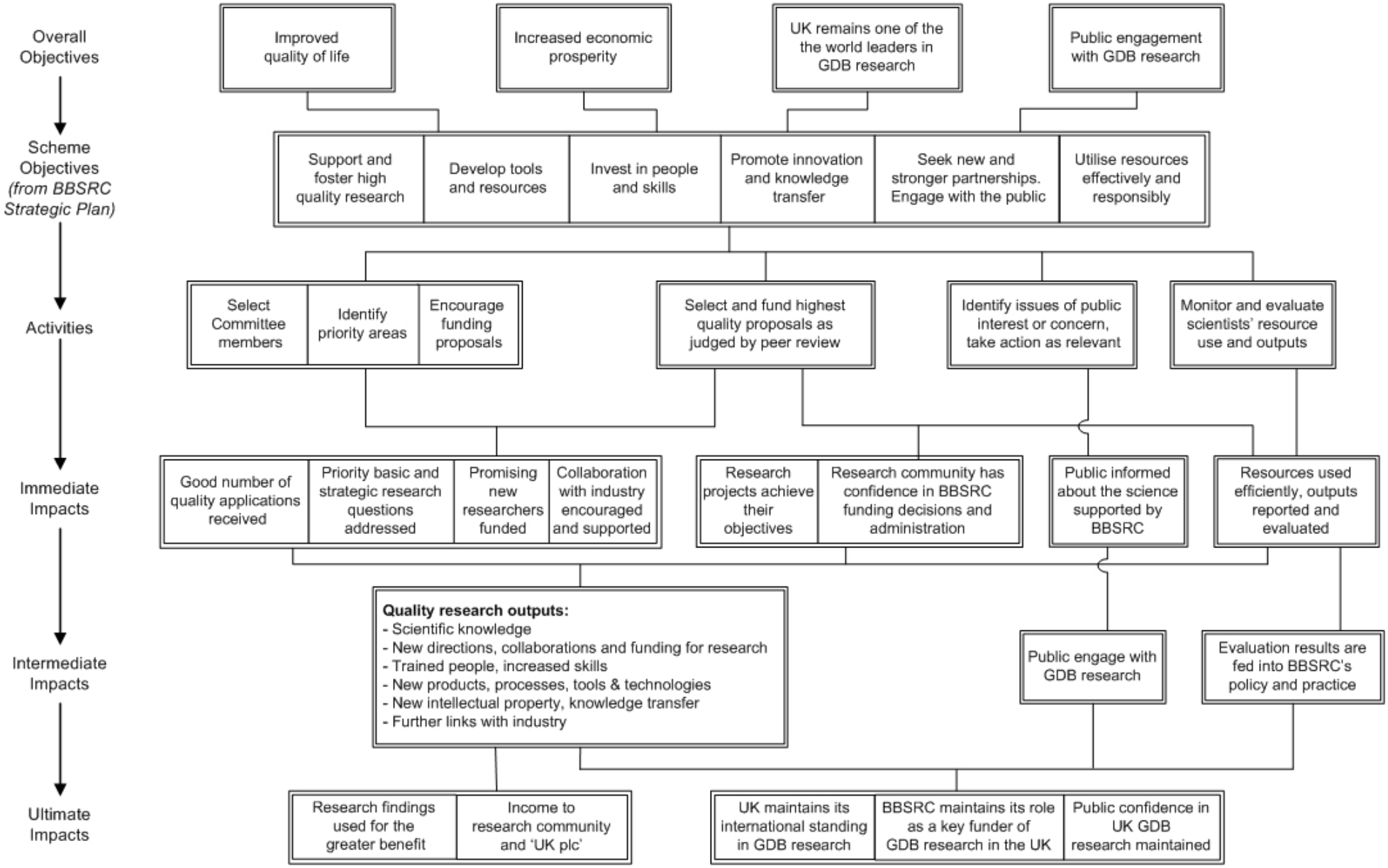
- Bioinformatics and e-science*
- Biology of the Transmissible Spongiform Encephalopathies
- Biophysics
- Bioscience engineering
- Developing alternative methods to replace, reduce or refine animal experiments*
- Drug resistance and alternatives to chemotherapeutics*
- Multidisciplinary programmes in the BBSRC remit
- Technology development*
- Theoretical biology.

Research Initiatives and Programmes

20. BBSRC also runs Research Initiatives and Programmes, which provide time-limited research funding in areas identified as strategically significant. These are evaluated separately by BBSRC, and hence do not form part of this evaluation. However, they comprise important background information, as the science supported in initiatives often becomes an important area in responsive mode after the initiative has ended. The grants supported through the Integrated Epigenetics, and Comparative Development and Evolution initiatives were included in this evaluation as these initiatives were assessed by the GDB Committee through responsive mode.

FIGURE 1

Logic Chart for Genes and Developmental Biology Committee Responsive Mode Funding



APPENDIX 3

QUESTIONNAIRES

Genes and Development Biology Portfolio Evaluation 2005
Survey of Completed Grants

*Please complete as many questions as possible and relevant, and return to Fiona Goff, preferably by email, by **14th December.** An electronic version of this questionnaire will be sent to you in the next few days. If completing by hand, please feel free to continue your answers on a separate sheet.*

Fiona Goff, Research Evaluation Manager
fiona.goff@bbsrc.ac.uk
BBSRC, Polaris House, North Star Avenue, Swindon SN2 1UH
Tel 01793 414678, Fax 01793 414674

Name:

Grant No:

Grant Title:

Research

1. Did the project have any **co-funding** or **in-kind** support at the outset?

a. IPA (Industrial Partnership Award)	
b. LINK Programme	
c. Other *(please specify)*	
d. No	

Comments/details:

2. When applying for the grant did you need to alter the direction of your research to fit within the **remit** of the Genes and Developmental Biology Committee (GDB)? (please tick one and comment if you wish)

4 (significantly)	**3**	**2**	**1** (not at all)

Comments:

3. Was it difficult to recruit staff to undertake this research, or did you have major staff issues (e.g. staff leaving) during the grant?

YES / NO / N/A (named researcher)

Do any of these statements describe your experience with recruitment for this grant? (please tick one or more and comment if you wish)

I had to accept someone with significantly less experience than was needed	
I had to delay the start of the grant (e.g. I needed to re-advertise, I was waiting for visa clearance for an overseas candidate)	
It was difficult to find someone with the necessary qualifications and experience	
Staff left or temporarily stopped work during the grant, so I had to re-recruit	
There were no suitable UK candidates	
I was lucky this time, recruitment is usually difficult	

Comments:

4. How closely did the skills of your Research Assistant match the needs of the project? (please tick one and comment if you wish)

4 (close match)	**3**	**2**	**1** (significant training was required)

If you ticked 2 or 1, which skills were lacking or weaker than required?

Comments:

5. Did this grant support your wider research aims? (please tick one or more boxes and comment if you wish)

a. Enabled extension of my research into new areas	
b. Helped me to establish my lab	
c. Helped me to win other grants	
d. Helped to publicise the importance of my field of research	
e. Provided funding for activities that other bodies would not fund	
f. Strengthened the skill base of the group (e.g. techniques, cross-disciplinary skills)	
g. Strengthened the standing of my research group in the field	
h. Other *(please specify)*	
i. Did not support my wider research aims	

Comments:

6. How successful was the project supported by this grant in meeting its objectives? (please tick one and comment if you wish)

4 (very successful)	**3**	**2**	**1** (not successful)

If you ticked 1 or 2, were the reasons for this related to:

Experimental/methodological/technical issues	
Lack of resources, e.g. funding, equipment	
Staff e.g. difficulties in retaining staff	
Changes to the objectives of the research due to new information or after initial findings	
Unrealistic project objectives	

Comments:

Publications

7. Have you adopted a publishing strategy for your research? (please tick one or more and comment if you wish)

Submit the most important results to the highest profile general journals (e.g. Nature, Science, PNAS), submit the rest to respected journals in the subject area	
Target the most respected journals in the area of science	
Target journals where I can get the results published quickly	
Target journals that do not have high page rates	
Other (*please specify*)	

Comments:

8. Is your publishing strategy influenced by having to produce a final scientific report for BBSRC within 3 months of completion?
   YES / NO

Comments:

9. Please provide details of all refereed publications arising as a direct result of this grant (continue on separate sheet if necessary)

How many of these papers had co-authors based in industry or based overseas?

Industry: Overseas:

Staff

10. Please provide details of all staff employed on the grant

Position (please tick one)			% time spent on grant	Period of apptmt (months)	First destination*		For RAs, was this their first postdoc position?
RA1A (PDRA)	Tech-nician	Other (please specify)			UK	Over seas	

* Please indicate category in appropriate column: a – remained in my lab, b - permanent academic elsewhere, c - fixed-term academic elsewhere, d - further training (excl. teaching), e - teaching or teacher training, f - private sector, industry or commerce, g - government or other public sector, h - other employment, i - not employed

11. Were there any student projects associated with this grant? (please indicate no. projects)

PhD: Masters: Undergraduate:

Further funding

12. Have you received further funding to continue or develop the work funded by this grant? If yes, please provide details

YES / NO

Funder (BBSRC Committee/other funding body)	Grant ref (for BBSRC grants) Value (£), no. years (other funding bodies)

If you did not receive further funding through the GDB Committee, why not? (please tick one or more and comment if you wish)

I applied to GDB but my proposal was not funded	
The area of science was not covered by the GDB remit	
Funding is more accessible from other sources (e.g. through other BBSRC Committees, other funding bodies) *(please specify)*	
I already had funding from other sources *(please specify)*	
My research priorities have changed	
Other *(please specify)*	

Comments:

Research outputs

13. Did/could any novel products, processes, resources, tools or technologies result from this grant? (e.g. reagents, sequences, software). If yes, please provide details where relevant

YES / NO

Description	
Who are the (potential) users? For what purpose do (or will) they use it?	
How was/will it be made accessible to others?	
Is it potentially commercially exploitable?	
What impact has it had on researchers and on the community as a whole?	

14. Have you or your colleagues applied, or are you likely to apply, for any **patents, licences** or other form of **intellectual property** rights as a result of the research supported by this grant? If yes, please provide details

YES / NO / LIKELY TO APPLY

Type of IP	Has it been licensed to other companies?	If so, has the licence yielded any income? (please give details with dates)

15. Have you or your colleagues established any **Spin-out** companies from the research supported by this grant? If yes, please provide details

YES / NO

Company name	Area of activity	Date established	Trading/ dormant	Turnover		No. staff
				FY	Value	

16. Did the research supported by this grant help to establish or strengthen contacts or collaboration with other academic groups or with industry?

New or improved **academic contacts** - *if cross-disciplinary, please specify discipline*	UK	
	Overseas	
New or improved **contacts with other organisations** (e.g. industry, charity, government department) - *please specify type of organisation*	UK	
	Overseas	
New formal **academic research collaboration** (e.g. joint publication, joint funding application) - *if cross-disciplinary, please specify discipline*	UK	
	Overseas	
New formal **research collaboration with other organisations** (e.g. industry, charity, government department) - *please specify type of organisation*	UK	
	Overseas	

Comments/details:

17. Did the research supported by this grant result in outcomes of benefit to the 'public good'? (please tick one or more and give details where appropriate)

Human health	
Animal health and welfare	
Environment	
Contribution to the formulation of government policy	
Other	

18. Did any other outcomes arise from the research supported by this grant? (please tick one or more and provide details where appropriate)

Contribution to the reduction, refinement and replacement of animals in experiments		
Contributions to public awareness or science in society debates	Publicity in the general non-scientific media	
	Schools activities	
	Public dialogue	
Other		

19. To what extent did regulatory procedures and ethical issues impact on the progress of the research?

4 (significantly)	**3**	**2**	**1** (not at all)

Please provide details:

General

20. What is your area of research? (tick one or more areas)

1. Developmental biology in animals		7. Gene therapy	
2. Developmental biology in microbes		8. Genome organisation	
3. Developmental biology in plants		9. Genomics	
4. Epigenetics		10. Recombination	
5. Evolution and population biology		11. Stem cell biology	
6. Gene action and regulation			

21. Do you think this/these area(s) is/are well supported by the GDB Committee? (please tick one and comment if you wish)

4 (very well)	**3**	**2**	**1** (not at all well)

Comments:

Are there any scientific areas within its remit that the Committee should be funding but isn't at present? (for details of the current portfolio, go to www.bbsrc.ac.uk/science/areas/gdb.html).

22. Do you have any comments on the operation of the GDB Committee (e.g. remit, themes, Priority Areas)?

23. Do you have any comments on BBSRC's grant application/administration process?

24. Was the scope and format of your application affected by your perception of BBSRC's funding schemes and policies, or the structure of the application form?

4 (significantly)	3	2	1 (not at all)

Comments:

25. Have you acted as a referee for a BBSRC grant? YES / NO

If yes, do you have any comments on the refereeing process (e.g. quality, helpfulness of referees' comments)? How could BBSRC increase the number and quality of referees' comments?

26. Do you have any other comments relevant to this evaluation?

Thank you, your contribution is much appreciated.

Genes and Developmental Biology Committee Portfolio Evaluation 2005
Survey of Current and Past Committee Members

*Please return to Fiona Goff, preferably by email, by **14th July.** If completing by hand, please feel free to continue your answers on a separate sheet.*

Mrs Fiona Goff, Research Evaluation Manager
fiona.goff@bbsrc.ac.uk
BBSRC, Polaris House, North Star Avenue, Swindon SN2 1UH
Tel 01793 414678, Fax 01793 414674

Name:

Organisation:

Portfolio

1. What are your views on the coverage of the research supported through the Genes and Developmental Biology Committee (GDB)? *e.g. is it appropriate, are there any particular areas/communities missing?*

2. How does the GDB portfolio compare with other UK funders of research in this area? *e.g. is there overlap? Are there gaps in coverage?*

3. Have any areas/opportunities been missed in recent years? Why were they missed?

4. How helpful are the Committee Themes and Priority Areas? *(for current Themes and Priority Areas, see http://www.bbsrc.ac.uk/science/areas/gdb.html)*

Achievements

5. What are the Committee's key achievements over the past few years in terms of the support it has given to the genes and developmental biology community? In other words, what difference has the Committee made?

6. Who are the end users of GDB-supported research, tools and resources (including databases), and what are the long-term outcomes?

7. How well has the research supported by GDB contributed to the reduction, refinement and replacement of animals in experiments?

4 (very well)	**3**	**2**	**1 (poorly)**

Comments:

Industry

8. Please comment on the relationship between GDB-supported research and industry, e.g. is it getting better or worse, how important is it?

Extra questions for industrial members

9. What is your perception of genes and developmental biology research in the UK? Does your company want to do this type of research here?

10. Does your company collaborate with BBSRC-funded researchers? If not, why?

11. How easy is it to collaborate with BBSRC-funded researchers? How could we encourage more contact and collaboration?

Process and Management

12. Does the Committee work well as a team in reaching conclusions?

13. What do you think about the way Committee meetings are structured? How could they be improved?

14. Do you have any comments on the fact that many grants are not discussed at Committee meetings?

15. What do you think of the state of refereeing? How could it be improved?

16. Do you have any other comments on the Committee or the grant appraisal process (including the rank ordering process)?

17. What do you think of the final report grade system? How could it be improved?

18. What are your views on BBSRC's management of the grant appraisal process and management of the Committee?

Other

19. What do you think are the most important functions of the Committee? Do you have any comments on its role within BBSRC as a whole?

20. Do you have any other comments relevant to this evaluation?

Thank you, your contribution is much appreciated.

Genes and Developmental Biology Portfolio Evaluation 2006
Survey of UK Funders

*Please answer as many questions as you can, and return to Fiona Goff, preferably by email, by **1st March.** If completing by hand, please feel free to continue your answers on a separate sheet.*

Fiona Goff, Research Evaluation Manager
fiona.goff@bbsrc.ac.uk
BBSRC, Polaris House, North Star Avenue, Swindon SN2 1UH
Tel 01793 414678, Fax 01793 414674

Name:
Job title:
Organisation:

Remit (please refer to enclosed background information)

1. How does the Genes and Developmental Biology (GDB) Committee's remit compare with your remit in this scientific area? E.g. areas of overlap, gaps

2. What do you think of the GDB's remit and themes as described in the enclosed document? Does this remit adequately cover what you understand to be BBSRC's responsibilities in the GDB area?

3. Do our current priorities (see enclosed document) reflect your perception of the key research needs (as they relate to BBSRC's remit) in the area?

4. Are the boundaries between our two organisation's remits and responsibilities in this area clearly defined? Do you have any concerns about the clarity of the interface?

Coverage and resources

5. Are there any areas within (or potentially within) GDB's remit that you receive many proposals for but cannot fund?

6. Are there areas relevant to your organisation within GDB's remit that need more support in the UK? Conversely, are there areas where support is less crucial? E.g. where there are many potential funders or where you feel the science is less important to the UK

7. If you have the data to hand, what was your annual budget in the GDB area (or sub area), and/or how many grants did you support in the last financial year?

Area	**Budget**		**No. grants**	
	Amount	Year	No.	Year(s)

Funding processes

8. At present, the majority of BBSRC's responsive mode grants involve academic research and are 3 years in length, supporting one postdoctoral Research Assistant. Is this typical of the type of funding provided by your organisation? Do you have any comments on this?

9. How could funding organisations work together to better serve the GDB research community? Are there any barriers to joint working between your organisation and BBSRC in this area?

10. Do you have any other comments relevant to this evaluation?

Thank you, your contribution is much appreciated.

APPENDIX 4

LIST OF SAMPLE GRANTS

Completed grants

Grant code	Title	Principal Investigator
G10929	Molecular genetics of capitulum development in Senecio	Abbott R J
G07094	Plant DNA methyltransferases: processing, modulation and function	Adams RLP
G07591	Constructing an expression map of *Toxoplasma gondii*	Ajioka J
G08600	In vitro and in vivo nucleosome positioning on the ovine B-lactoglobulin gene	Allan J
G11827	Essential and redundant roles of a PP1 isoform	Alphey LS
G11549	Functional analysis of highly conserved unidentified reading frames in the *E. coli* genome	Andrews SC
G12966	An investigation into the genetic control of chromosome behaviour during meiosis I in *Saccharomyces cerevisiae*	Aragon-Alcaide L
G09923	Studies on the translocation mechanism of telomerase	Balasubramanian S
G09617	A novel approach to the analysis of human genomic variation investigating heterogeneity of both mutation and recombination.	Balding D J
G12760	Characterisation of genes maintaining the floral state in Impatiens	Battey NH
G09314	Eukaryote gene number estimation by a genomic sequence sampling strategy	Bird A
G11730	The regulation and function of fimE in the phase variation of type 1 fimbriae in *E. coli*	Blomfield IC
G09615	Coordination of cell division in the Arabidopsis root meristem	Bougourd SM
G10980	How are neural stem cells maintained?	Bray S J
G13767	Functional heterogenity within transposable element families	Brookfield JFY
G15327	An extensive chicken EST database to allow efficient functional genomics in chick embryos and DT40 cells	Brown W
G06544	Molecular architecture of *Escherichia coli* FNR protein	Busby SJW
G08620	Morphogenetic signalling by desmosomal glycoproteins in epidermal development	Byrne C R
G13824	Regulation of the circadian-clock associated gene LHY in response to light-signals in *Arabidopsis thaliana*	Carre IA
G08759	The genomic mutation rate for detrimental alleles in Drosophila	Charlesworth B
G12109	Studies of the roles of the JAK2 protein tyrosine kinase in cellular survival decisions	Clarke A
G12106	Significance of a non-coding endogenous antisense frequency transcript for circadian clock function in *Neurospora crassa*	Crosthwaite S
G13375	Molecular mechanisms controlling fin muscle formation	Currie P D
G11137	Neurotrophic factor requirements of cranial motoneurons	Davies AM
G13280	Comparative genomics of Antirrhinum and Arabidopsis as a model for analysing plant gene function	Davies B
G11639	The role of gap junction-mediated intercellular communication in Drosophila	Davies J A
G11906	Investigation of the role of the human *FEN1* gene in genomic instability using inducible ribozyme gene ablation	Davies KE
G06722	Molecular studies on FtsK, a highly conserved cell division	Dewar S J

Grant code	Title	Principal Investigator
	and putative DNA mobilising protein	
G06311	Maintenance of liver cell phenotype: characterisation of signalling factors which regulate differentiation of isolated hepatocytes	Dickson A
G11908	Molecular and functional analysis of the mutant mouse, shaker- with-syndactylism	Dixon M
G11681	Structure and function of picornavirus cis-acting replication elements (CRE)	Evans DJ
G10138	Inferring the distribution of fitness effects of new mutations from DNA sequence data	Eyre-Walker A
G10794	Provision of resources to exploit a bovine whole genome radiation hybrid cell panel to aid the identification of candidate genes for genetically mapped traits	Farr C
G11725	Population bottlenecks, changes in genetic variance and inbreeding depression in fruitflies	Fowler K
G09544	Cell autonomy in Arabidopsis	Furner IJ
G11838	Transdifferentiation of visceral endoderm in the mouse	Gardner R
G09616	A novel approach to the analysis of human genome variations investigating heterogeneity of both mutation and recombination.	Giannelli F
G07924	Arabidopsis thaliana GATA binding proteins: a functional analysis	Gilmartin P
G13018	The role of the ML1 gene in epidermal cell specification in Antirrhinum majus	Glover B J
G12839	Determining the role of Spo11p and DSB formation in signalling the onset of meiotic chromosome pairing	Goldman Ash
G14076	Understanding and exploiting relationships between molecular evolution and protein structure	Goldman N
G11728	Analysis of TTH1 a K+ transporter that is required for root hair development	Grabov A
G09571	Post-transcriptional regulation of HPV 16 late gene expression in response to epithelial cell differentiation	Graham SV
G08606	Role of TTG1 in epidermal cell differentiation in Arabidopsis	Gray J
G06940	Molecular analysis of TIP2: a gene that controls cell shape in root hairs and pollen tubes of Arabidopsis	Grierson CS
G06890	Structure-function relationships of a novel, developmentally regulated CCAAT box transcription factor	Guille M
G07109	Role of the eph-related tyrosine kinase receptors in the determination and axon pathfinding of cranial motor neurons	Guthrie S C
G04869	Control of developmental genes expression in Dictyostelium	Hames BD
G12064	Do cytokines uncouple cell cycle arrest and DNA repair in hepatocytes following DNA damage?	Harrison DJ
G07878	Transcriptional repression and cell fate determination-in vivo analysis of the groucho gene of Drosophila	Hartley D A
G13032	Molecular analysis of the novel but widely-disseminated active partition system of multidrug resistance plasmid TP228	Hayes F
G10882	A genetic study of the biological functions of platelet derived growth factor A	Heath JK
G07945	Evolution of RNA-sequence, structure and function	Higgs P
G08646	Genetic analysis of quantitative traits	Hill WG
G07803	Single molecule mechanics of DNA transcription by RNA polymerase	Hoggett JG
G11719	The origin of animals: a molecular genetic approach	Holland P
G13278	Comparative genomics of Antirrhinum and Arabidopsis as a model for analysing plant gene function	Hudson A

Grant code	Title	Principal Investigator
G12140	Isolation and functional characterisation of novel T-box genes in the zebrafish (*D. rerio*)	Ingham P
G09240	Metabolic engineering of recombinant protein sialylation in animal cells by co-expression of CMP-NeuAC synthetase and transporter genes	James D C
G10146	In vitro evolution of RNA ligands: understanding the process and exploiting the products	James WS
G14018	Characterisation of prohibitin-protein interactions and their effect upon replicative senescence in yeast	Jamieson DJ
G13510	Mutations affecting Ac transpositional activity in Arabidopsis	Jarvis RP
G05552	Glycosylation of immunoglobulin domains: studies on control and functional significance	Jefferis R
G08319	Molecular cytogenetic (FISH) analysis of meiotic chromosome pairing in *Arabidopsis thaliana*	Jones GH
G12163	Functional analysis of highly conserved unidentified reading frames in the *E. coli* genome	Kell D
G07389	Heat flux as an on-line process control variable to optimise growth and product fidelity in recombinant animal cells	Kemp RD
G11720	Segmentation and morphogenesis of the vertebral column in the zebrafish embryo	Keynes R
G06016	The structure and assembly of retrotransposon virus-like particles	Kingsman AJ
G08291	Characterisation of *Bsd1* gene action during photosynthetic development in grasses	Langdale J
G08637	The genetic and cellular control of growth in C. elegans and relatives	Leroi A M
G01466	Galls of Cynipid wasps: a model system to study plant development	Lichtenstein CP
G11414	Molecular genetics of axialisation in the Arabidopsis embryo and seedling	Lindsey K
G09710	Novel ageing in *Caenorhabditis elegans*.	Lithgow G D
G07782	Identification of mutants defective in light and / or plastid signalling to nuclear photosynthetic gene expression in Arabidopsis	Lopez Juez E
G10415	Comparative genomics of the genus Saccharomyces	Louis EJ
G07749	Inhibition of apoptosis in Rb deficient haematopoietic progenitors in vivo by tissue - specific expression of Bcl-XL	Macleod K F
G09530	Enzymes, signalling and cell determination in the chick embryo: sites of synthesis of the morphogen retinoic acid.	Maden M
G11745	Genomic mapping of reproductive isolation in the larch budmoth	Mallet J
G12044	Roles of Celsr proteins in development of the avian brain	Mason I
G06054	Exploring the function of a novel *Wnt* gene through tissue-specific gene targeting	Mason J
G11834	Deletion and functional analysis of previously uncharacterised open reading frames on the chromosome of *E. coli* K12	Masters M
G10114	Co-ordination of nuclear and kinetoplast gene expression during trypanosome differentiation	Matthews K
X08267	Nottingham Arabidopsis Stock Centre: provision of key Arabidopsis thaliana genetic resources to the research community	May ST
G11425	The ubiquitin/26sproteasome system in development and ageing in the nervous system	Mayer RJ
G06882	Genetic and biochemical analysis of mechanisms regulating RNA stability in vivo	McDowall KJ

Grant code	Title	Principal Investigator
G10107	Regulation of gene transcription during meiosis in the fission yeast *Schizosaccharomyces pombe*	McInerny CJ
G13035	An investigation of dosage compensation in chickens	McQueen H A
G08756	Investigation of the molecular mechanism of genetic regulation by thiamine in yeast	Meacock PA
G09505	Identification of genes involved in haematopoietic stem cell differentiation during embryonic development of the mouse	Medvinsky A
G06125	A genetic analysis of translation initiation at an IRES in *Schizosaccharomyces pombe*	Mellor EJC
G04732	Homology and promoter requirements of homology-dependent gene silencing mechanisms in plants	Meyer P
G13967	Identification of circadian clock regulators by quantitative genetics in *brassica oleracea*	Millar AJ
G12852	Trans-acting modifiers of expanded triplet repeat stability	Monckton DG
G14765	Gene expression in human development studied in oocyte preimplantation embryo primordial germ cell and EC cDNAs	Monk M
G05844	Zinc metabolism in *Escherichia coli*: molecular analysis of zin, a novel zinc inducible operon	Morby AP
G11702	Developmental and molecular analysis of doublefoot; a new gene in the sonic hedgehog signalling pathway	Morris-Kay G
G04872	Inferring process from genealogical coalescence times	Nee S
G08770	Drosophila melanogaster mRNA 3' end formation in vitro	O'Hare K
G10086	Positioning of the U5 snRNA with exon sequences during pre-mRNA splicing	O'Keefe RT
G10414	Comparative genomics of the genus Saccharomyces	Oliver S
G12115	Novel approaches towards determining the effect of histone acetylation on chromatin structure	Owen-Hughes TA
G06562	Translational regulation during early embryogenesis in *Xenopus laevis*	Pain V M
G04924	Genetic variation for fitness and its components in *Drosophila melanogaster*	Partridge L
G11429	Cell cycle and differentiation	Pears C
G10361	The roles of the Pax-6 gene in neural development: generation of conditional mutants	Price D
G08574	Molecular mechanisms controlling antler regeneration	Price JS
G04843	Developmental genetics of bundle sheath cells and their chloroplasts in Arabidopsis leaves	Pyke KA
G09538	High resolution physical and genetic map of the 6.6Mb *Pseudomonas fluorescens* SBW25 chromosome.	Rainey PB
G13151	RNA-based phylogenetic methods	Rattray M
G08469	Characterisation of the regulatory components of transcriptional activators	Reece R J
G14497	Progressive evolution in dance fly mating systems	Ritchie M
G09242	Genetic and molecular approaches towards the isolation of the pollen determinant of self incompatiblity in petunia	Robbins T P
G15054	Genetic and molecular identification of genes required for nitric oxide controlled cell proliferation	Roberts I J
G07638	A family of metal-sensors: forced evolution in cyanobacteria	Robinson NJ
G11837	Functional characterisation of a novel human stress response gene with a potential role in radioprotection	Robson T
G12030	Investigation of the molecular basis of arbuscular mycorrhiza formation using insertional mutagenesis in *Medicago truncatula*	Schultze M
G11717	Mechanism of alternative splicing at an atypical splice donor in the vertebrate fibroblast growth factor receptor genes	Screaton G
G04905	Fundamental molecular evolutionary processes of genes	Sharp P

Grant code	Title	Principal Investigator
	and genomes	
G09239	Protein-induced DNA bending by MADS-box transcription factors	Sharrocks A D
G11709	FKHL gene cluster evolution in chordates	Shimeld SM
G05986	Repressor-operator interactions in the Streptomyces temperate phage thetaC31	Smith MC
G13960	A functional genomics approach to hexose transporter function in Arabidopsis seed development and germination	Smith SM
G08463	Ribosome fates following translation termination in yeast	Stansfield I
G11778	The control and evolution of morphology by the Hox gene Ultrabithorax	Stern D L
G11706	Probing dynamic events on chromatin templates during transcription using surface plasmon resonance (SPR)	Stockley PG
G07003	Role of the Brachyury protein in mesoderm formation	Stott D
G06153	The role of the yeast WH12 in coordinating cell growth and proliferation	Sudbery PE
G13225	Molecular phylogenetics and evolution of actinopterygian fishes as inferred from mitochondrial protein coding sequences	Thomas M G
G13350	Selection, identification and analysis of mitochondrial mutants in *Arabidopsis thaliana* L.	Tobin AK
G12717	The A-domain proteins of *C. elegans*: a novel family of extracellular matrix molecules?	Tuckwell D S
G09663	Genetic and biochemical analysis of prion elimination in yeast.	Tuite M
G06623	Control of hyphal branch initiation in *Aspergillus nidulans*	Turner G
G08788	Molecular cloning of a gametophytic gene required for correct division asymmetry and cell fate in Arabidopsis	Twell D
G09234	Genetic and molecular analysis of hedgehog signalling	van den Heuvel M
G14548	Expressed sequence tags for molecular systematics	Vogler AP
G12997	Epigenetic gene silencing in the germ line	Walsh C
G07302	Increasing the amount of transgene generated translatable mRNA	Whitelaw CBA
G07826	Genetic dissection of signalling mechanisms underlying developmental fate assignment in insect epithelia	Whittle J R
G10842	Analysis of the signal transduction pathways that regulate transcription directed by a complex promoter of Dictyostelium	Williams J G
G04907	Molecular genetic analysis of the Drosophila Trk-related receptor Dror and its signalling cascade	Wilson C
G13580	Statistical and computational improvements to molecular phylogenetic estimation	Yang Z

Current grants for which questionnaires were returned

Grant code	Title	Principal Investigator
G17918	The genetic control of the undifferentiated phenotype of human embryonic stem cells	Andrews P
G19755	Identification of TGF-beta signalling targets in Drosophila on a genome-wide scale	Ashe HL
G18657	Neurogenic placode evolution: development of the chick paratympanic organ and dogfish spiracular organ	Baker C
G18889	The GARNet metabolite profiling service	Beale MH
BBS/B/13462	Chicken genome annotation and analysis	Birney J F
G18737	TGFb signalling during dorsal closure in Drosophila melanogaster	Bloor J
G20421	Use of frog oocyte and egg extracts to reprogramme nuclear function in mammalian cells	Blow J
G18782	The rate of molecular evolution during adaptive radiations: implications for the molecular clock	Bromham L
G15993	A post-genomic approach to phylogeny reconstruction and the evolution of metabolic diversity in yeasts	Burt A
G18887	Transcriptome and bioinformatics resource provision for the Streptomyces coelicolor A3(2) community	Chater KF
G18273	The chick pinealocyte and melatonin synthesis: a clock-output and clock-input model system	Chong N
G16919	Functional characterisation of the Arabidopsis transcriptional regulator LEUNIG	Conlan RS
BBS/B/0661X	Analysis of the role of Tolloid metalloproteases in vertebrate development	Dale L
G18622	Characterisation of SDE5, an Arabidopsis protein required for RNA silencing	Dalmay T
G15996	Molecular determination of the epigenetic basis of vernalization	Dean C
BBS/B/04498	Role of ROOT HAIR DEFECTIVE2 in cell growth	Dolan L
G20322	In silico discovery of functional single nucleotid polymorphisms	Edwards K
G16891	Genomic microarrays to examine chromosome rearrangement and evolution	Edwards P
G17920	A transgenic approach to investigate the developmental role of an evolutionarily conserved RNA binding protein	Elliot DJ
G17530	Genetic consequences of island colonisation in the model organism *Brachyderes rugatus*	Emerson B
BBS/B/09007	The role of RNA localisation in I Factor transposition	Finnegan DJ
G15583	Regulation of embryonic stem cell differentian: the role of stem cell factor and its receptor, c-Kit	Forrester L
G19864	Dynamics of chromosome pairing during plant meiosis: the role of Asy1 an Arabidopsis protein essential for synapsis	Franklin FCH
G18775	Novel technology to identify and study sequence elements involved in long-range, gene regulatory interactions in vivo	Fraser P
G19459	Immunoglobulin-like neural adhesion molecules in the control of neuronal progenitor proliferation and differentiation	Furley AJW
G18139	Differential gene exchange across a steep selection gradient: a genomic analysis	Grahame JW
BBS/B/10846	The mechanism of target mRNA degradation in post-transcriptional gene silencing in plants	Grierson D

Grant code	Title	Principal Investigator
BBS/B/07306	Improving cross-kingdom techniques for siRNA detection and their specific application to x-chromosome inactivation	Hamilton A
BBS/B/12083	The TNF receptor family in cutaneous development and pattering	Headon D
G17511	The role of the PAS protein VVD in light and clock signal transduction in Neurospora crassa	Heintzen C
BBS/B/09716	Recombineering *Caenorhabditis elegans* reporter gene fusions	Hope I
BBS/B/13497	Chicken genome annotation and analysis	Hubbard S
BB/C003500/1	Do minisatellites play a primary role in meiotic chromosome pairing?	Hulten M
G15592	A genetic analysis of links between nuclear structure and function in vertebrate cells	Jackson D
G18988	Determining the molecular and cellular basis of hair follicle induction	Jahoda C
BBS/B/09074	The genetic architecture of adaptive radiation in *Heliconius melpomene*	Jiggins CD
G15940	The biological role of a novel sigma factor, sigma n, in the mycelial prokaryote *Streptomyces coelicolor*	Kelemen G
G17474	Genetic analysis of factors preventing foreign DNA acquisition by *Staphylococcus aureus*	Lindsay J
G18986	Definition of the mouse CNS axon regeneration transcriptome and proteome	Logan A
G18653	DNA topoisomerase VI, anarchael enzyme with a role in cell-size control, cell cycle and endoreduplication in Arabidopsis	Maxwell A
BBS/B/11699	The creation of mouse models to study the role of the Wilms' Tumour suppressor gene (WT1) in muscle development	Miles CG
COD 16934	Evolution of vertebrate middle ear development	Milner A
G17536	Investigation of beta-catenin/Lef-1 regulation and function during myogenic specification in chick embryos	Munsterberg A
G16929/2	Investigation of the role of a 5'-3' exoribonuclease of Drosophila and *C. elegans* development	Newbury S
BBS/B/04951	Functional characterization of an essential conserved cell cycle gene involved in the metaphase to anaphase transition	Panaretou B
G16857	The role of emx genes in the development of the cerebral cortex	Parnavelas J G
BBS/B/06512	The role of the expression of beta-catenin and gamma-catenin in postmitotic neurons in the formation of spinal motor circuitry	Price S R
BB/C508050/1	Evolution of regulatory networks controlling vein patterning in Dipteran wings	Ray R
BBS/B/04234	Function and regulation of genes activated in floral organ primordia by the homeotic gene AGAMOUS	Sablowski RW
BB/C507053/1	Mechanism of transcription complex displacement by a transcription-repair coupling factor	Savery N J
COD 16760	The development evolution of fruiting body size and pattern in social amoebae	Schaap P
G17549	Evolution and maintenance of variation in reproductive behaviour in wild great tits	Sheldon BC
G15381	Stem cell potency	Smith A
G18886	Transcriptome and bioinformatics resource provision for the	Smith CP

Grant code	Title	Principal Investigator
	Streptomyces coelicolor A3(2) community	
COD 16764	Tbx20 orthologues and the generation of morphological diversity	Sowden JC
G18743	The transcriptional response to different levels Drosophila mef2 in muscle differentiation	Taylor MV
BB/C50 9866/1	The evolution and development of Xenoturbella, a newly recognised phylum of deuterostome	Telford M J
COD 15494	Molecular and genetic bases of adult neurogenesis in budding ascidians	Thorndyke M C
COD 16765	Control of leaf shape in Arabidopsis relative *Cardamine hirsuta*	Tsiantis M
G18086	The role of PTEN, and its relationship with Stat3, in mammary gland development	Watson C
BBS/B/0 8043	Histone modifications at chromatin boundary elements	West A
G19428	Development and evolution of anteroposterior asymmetry in the fish inner ear	Whitfield TT
G18385	Assembling the tree of life : supertree methods for comparative biology	Wilkinson M
G18276	Creation of high resolution comparative and physical maps of the bovine genome	Williams JL
G19181	Characterisation of novel genes affecting neuronal and axonal patterning in the developing Zebrafish brain	Wilson S W
COD 16763	Tbx20 orthologues and the generation of morphological diversity	Woollard ACS
G16883	Linked gene flow methods for linkage disequilibrium mapping	Woolliams JA
BBS/B/0 6164	Using human embryonic stem cells to model developmental programming by nutrient-epigenetic interactions	Young LE
G16920	Role of Par genes in early mouse development	Zernicka-Goetz M

APPENDIX 5

OTHER NOTABLE GRANTS IDENTIFIED BY PANEL

Functional analysis of highly conserved unidentified reading frames in the *E. coli* genome
This group produced 45 conserved URF mutants and pinpointed potential essential genes and genes required for good growth. Overall, the project provided a comprehensive and unique data set for the provision of clues on gene function. Perhaps more importantly, it established the method of metabolic footprinting as a novel, powerful and convenient method for functional genomics. The grant led directly to two refereed publications and has stimulated many others.

Molecular architecture of *Escherichia coli* FNR protein
This is a superb example of the dissection of FNR protein-protein interactions at the molecular level. This research was possible due to a productive collaboration between groups at Sheffield and Birmingham and demonstrates what long term investment into groups can achieve through the generation of expertise and reagents. This project resulted in 6 refereed publications, and is also notable for its presentations to lay audiences and its strength in training young scientists. Follow-on funding was secured from GDB.

Determining the role of Spo11p and DSB formation in signalling the onset of meiotic chromosome pairing
Using a model system, this work made significant contributions to our understanding of meiotic recombination, a key process in fertility. The cytological work was particularly important because the data corrected a published view of the impact of Spo11 on chromosome pairing. This grant resulted in one refereed publication.

Role of *TTG1* in epidermal cell differentiation in *Arabidopsis*
The *TTG1* locus is a key regulator in epidermal patterning, and its cloning had been long-awaited. The action of TTG1 was shown to be dependent on a paralog, GL3, which controlled its subcellular localisation. They expanded this work from the model species to the ornamental stock (*Matthiola icana*). This grant resulted in 2 refereed publications and a book; and the use of the TTG1 gene was patented.

Molecular analysis of *TIP2*: a gene that controls cell shape in root hairs and pollen tubes of *Arabidopsis*
This grant resulted in the cloning of an S-acyltransferase, revealing a role for lipidation in the regulation of cell growth. During the project a new method of screening BACs for complementing genes was devised and made available through the *Arabidopsis* stock centres. Four refereed publications resulted from the grant.

Characterisation of *Bsd1* gene action during photosynthetic development in grasses
This research defined the GARP family as plant specific transcriptional regulators. Work in this lab and by others has shown them to have fundamental roles in the regulation of plant development on an organ and cell specific level. The genomic and cDNA *BSD1* and *BSD1*-like sequences from both maize and rice have been deposited in Genbank, and further funding was secured from BBSRC. The grant resulted in 2 refereed publications.

Molecular genetics of axialisation in the Arabidopsis embryo and seedling
This work continues the characterisation of POLARIS, one of the few small peptides known to control development in plants. It describes a membrane protein to which POLARIS binds (PIP) and links POLARIS and PIP to auxin and cytokinin signaling. The group has also been heavily involved in public engagement activities, particularly the publicity surrounding the completion of the Arabidopsis genome sequence. The grant resulted in 3 refereed publications and several articles in trade journals; further funding was secured for 4 years from RDA.

Zinc metabolism in *Escherichia coli*: molecular analysis of zin, a novel zinc inducible operon
An outstanding example of project planning, clear report writing and what is achievable with a focused 24-month programme of work. This research characterised a zinc inducible operon and identified the first MerR-like regulator to respond to zinc. The grant resulted in 3 refereed publications.

Molecular mechanisms controlling antler regeneration
This research showed that it was possible to initiate the exploration of the molecular mechanisms that drive a unique regeneration phenomenon in mammals. It showed that genes that are involved in embryonic limb formation are also partially active in the annual regeneration of the bony antlers in deer, indicating that a reprogramming of embryonic pathways can lead to regeneration of adult structures. The study system is unusual and is a promising system for understanding regeneration phenomena in mammals. The grant resulted in 3 refereed publications.

Developmental genetics of bundlesheath cells and their chloroplasts in *Arabidopsis* leaves
This was the first description of a role for the bundle sheath in C3 photosynthetic plants. The grant was also associated with a high number of reviews on leaf development produced just as the field was expanding and resulted in a CASE studentship with Astra-Zeneca and a collaboration with Joanne Chory at the SALK institute. The grant resulted in 4 refereed publications.

High resolution physical and genetic map of the 6.6Mb *Pseudomonas fluorescens* SBW25 chromosome
A BAC library of the *P. fluorescens* SBW25 genome was constructed, used both for mapping and genetic analysis of SBW25 and for comparative analysis with *P. aeruginosa.* Results suggested that, while the genetic complement of these pseudomonads is similar, marked differences exist in gene order and linkage; a database was developed to allow community access to the BAC library and genomic sequence. A novel means of forcing over-expression of the gene cluster was discovered, showing that the cluster did encode a novel polymer. The grant resulted in one refereed publication, a patent application and further funding from BBSRC.

Selection, identification and analysis of mitochrondrial mutants in *Arabidopsis thaliana*
Although short, this grant succeeded beyond its objectives in identifying five mutants defective in mitochrondrial development and setting up map-based cloning for three. Public engagement by this group was notable with presentations at the Royal Society and Tomorrow's World exhibitions. The grant resulted in 2 refereed publications.

Genetic and biochemical analysis of prion elimination in yeast
This research characterised yeast prions and explored how they could be cured to establish any parallels that may be applicable to human healthcare. This research resulted in 3 refereed publications and follow-on funding from BBSRC.

Control of hyphal branch initiation in *Aspergillus nidulans*
This is an example of world-class fundamental biology that can be achieved with a focused 24-month programme. It explored the mechanisms involved in the selection and initiation of hyphal branch sites in a filamentous fungi. The work has potential commercial utility and a patent was filed with Genencor.

Molecular cloning of a gametophytic gene required for correct division asymmetry and cell fate in *Arabidopsis*
GEMINI POLLEN1 was characterised - a gene required for cytokinesis, possibly through control of the phragmoplast. Cloning showed it to be identical to *MOR1*. It is associated with microtubules throughout the cell cycle and able to bind to microtubules. The production of

antibodies for this protein will be particularly useful to cell biologists as the gene is conserved between plant and animals. Five refereed publications resulted from this grant.

APPENDIX 6

SURVEY RESULTS - CONTENTS

1. INTRODUCTION

1. This paper reports the results and analysis of the surveys conducted for the evaluation of the Genes and Developmental Biology (GDB) Committee responsive mode portfolio. To facilitate the analysis, potential impacts have been divided into five subject areas (in keeping with the logic chart, see Appendix 2, Page 33):
   a. Research outputs and achievements
   b. Balance and coverage of the portfolio
   c. Interaction with industry
   d. Public engagement
   e. High-level impacts.

2. Each section contains the survey results and data relevant to that area, followed by questions for the Panel to consider.

3. Results are drawn from the following surveys, and from the BBSRC databases:

   - **Completed grantholders: 100** out of **141** questionnaires were returned (71% response rate), representing **40%** of all completed and graded GDB responsive mode grants since 1996. The sample was random from the point of view of the science, but structured to ensure that it was representative of the whole in terms of final report grades and years started (the correlation between sample and whole is shown in Annex 1).

   - **Current grantholders: 70** out of **96** questionnaires were returned (73% response rate), which is **36%** of all current GDB responsive mode grants started between 2001 and 2004. Again, the sample was random with respect to the science, but fairly representative of the whole in terms of years in which the grants had been started.

   - **Committee members: 17** Committee members returned a questionnaire (**40%** of all members serving over the past five years), including 8 current members and 9 former members. One of the former members was based in industry.

   - **Other UK funders:** responses were received from most of the organisations contacted:
     - Research Councils: Engineering and Physical Sciences Research Council (EPSRC), Economic and Social Research Council (ESRC), Medical Research Council (MRC), Natural Environment Research Council (NERC);
     - Government departments: Department of Trade and Industry, Scottish Executive Environment and Rural Affairs Department (SEERAD); and
     - Charities: Cancer Research UK, Wellcome Trust.

     The Department of Health, and the Department for Environment, Food and Rural Affairs did not respond.

4. The questionnaire data presented in this report relate to the samples described above. While the samples were random from the point of view of the science involved, and representative in terms of years and final report grades, it should nevertheless be borne in mind that they are only samples.

5. Respondents were given options to tick in some of the questions, whereas other questions were open-ended. Response rates to open-ended questions are generally significantly lower. Open-ended questions are identified as such in the text.

6. Where relevant, the survey findings are compared with the results of the surveys conducted for the recent Animal Sciences Committee (ASC) and Biochemistry and Cell Biology Committee (BCB) Portfolio Evaluations.

2. RESEARCH OUTPUTS AND ACHIEVEMENTS

7. This section covers outputs and achievements both of the Committee and of the research supported through the Committee.

2.1 Committee's achievements

8. The majority of the surveyed Committee members identified the key role of the Committee as being to support the best UK science through ensuring the most appropriate and fair allocation of BBSRC resources. Others commented that the Committee's most important function is to evaluate grant applications fairly, objectively and openly, through peer review. All of the surveyed members said that the Committee works very well as a team, and that there is robust discussion of difficult cases.

9. When asked to identify specific achievements of the Committee over the past five years, the most common responses from the sample Committee members were that the Committee:
   - provided support in areas where there were no/few other sources of funding for UK researchers, e.g. plant science, population genetics, evolution, developmental biology
   - fostered new research areas and supported key research groups in emerging areas, e.g. genomics, stem cell research
   - maintained support for a broad range of good quality basic research in this area across all of the kingdoms.

10. The Committee's support for areas where there are no/few alternatives is reflected by the fact that **23%** of sample PIs said that the grant had provided funding for activities that other bodies would not fund.

11. The Committee's ongoing support for these areas is also a major achievement, as illustrated by the fact that **97** GDB PIs received more than five grants from BBSRC over the evaluation period, **28** of whom received more than 50% of their grants through GDB.

2.2 Increased scientific knowledge and awareness

General

12. When asked whether the grant had supported their wider research aims, **62%** of the sample PIs said it had enabled extension of their research into new areas, and **42%** said that it had helped to publicise the importance of their field of research.

Publications

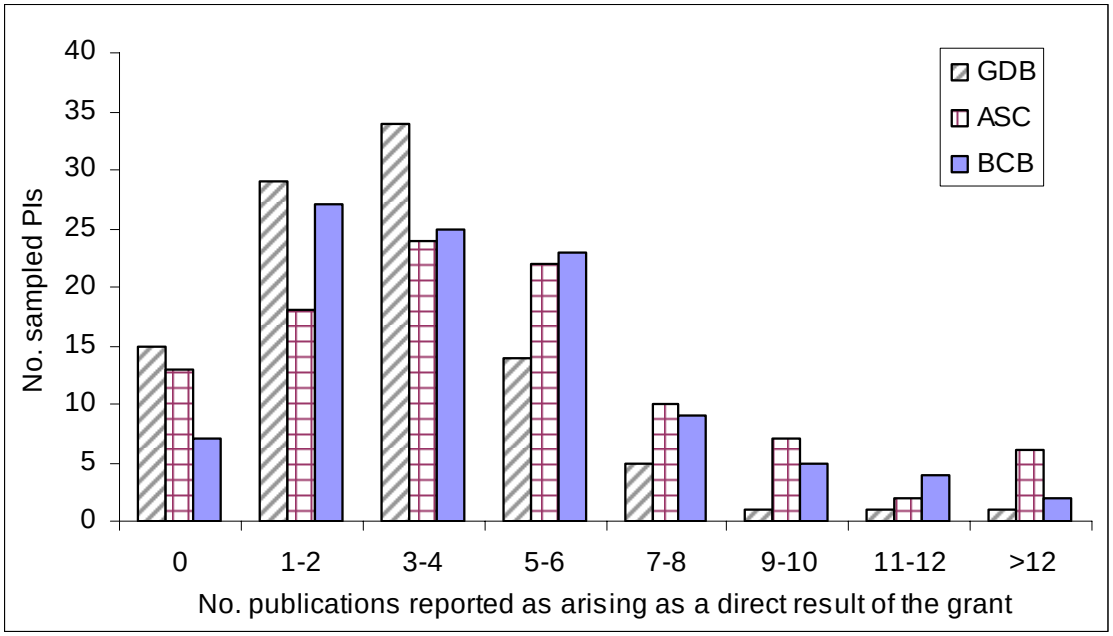
13. PIs were asked to list publications in peer reviewed journals that had arisen as a direct result of the research supported by the grant. In total (from the 170 questionnaire responses received), **455** papers had been published in **157** peer reviewed journals. Completed grants had a median[1] of **three** publications per grant. The median for current grants, as would be expected, was much lower at **one**.

14. Figure 1 shows the distribution of numbers of reported publications per grant. To provide some context, the graph also shows the results of the surveys conducted for

[1] 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 was 3.2 for completed grants and 2.1 for current grants.

the recent Animal Sciences Committee (ASC) and Biochemistry and Cell Biology Committee (BCB) Portfolio Evaluations.

Figure 1: Numbers of reported peer reviewed publications per grant (sample completed grants)

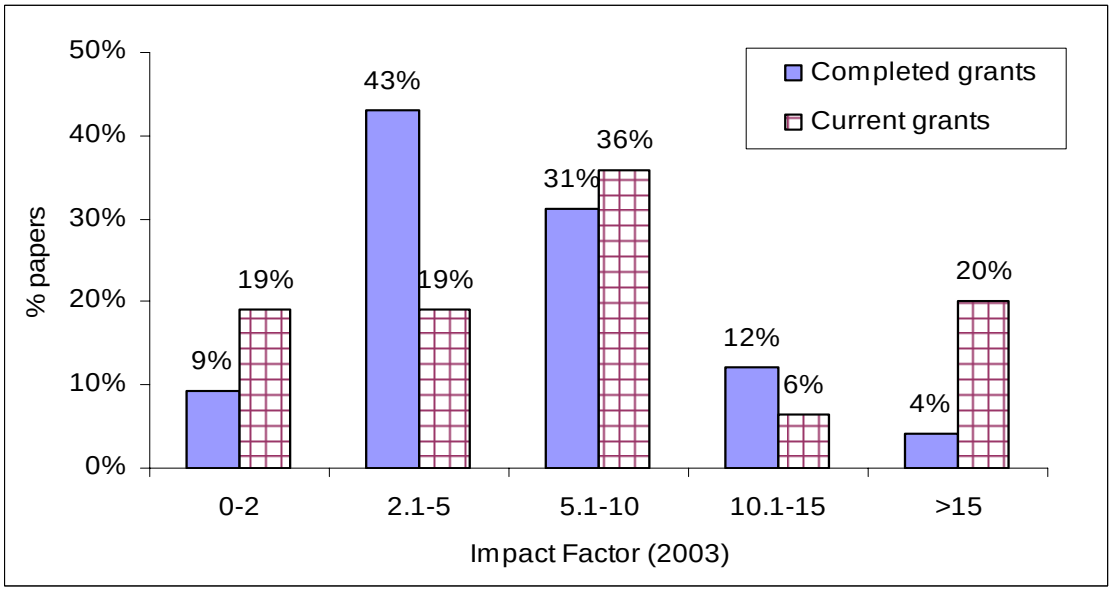


15. **18%** (82) of the reported papers had been published in journals with an Impact Factor greater than 10, including Nature (15 papers in total), Proceedings of the National Academy of Sciences USA (12), Plant Cell (9), Current Biology (9), Cell (7), and EMBO (7). This is slightly above the 16% and 15% of reported papers in the ASC and BCB surveys respectively.

16. The journals most frequently reported by the sample GDB PIs were: Journal of Biological Chemistry (17 papers), Genetics (16), Nature (15) and Development (15).

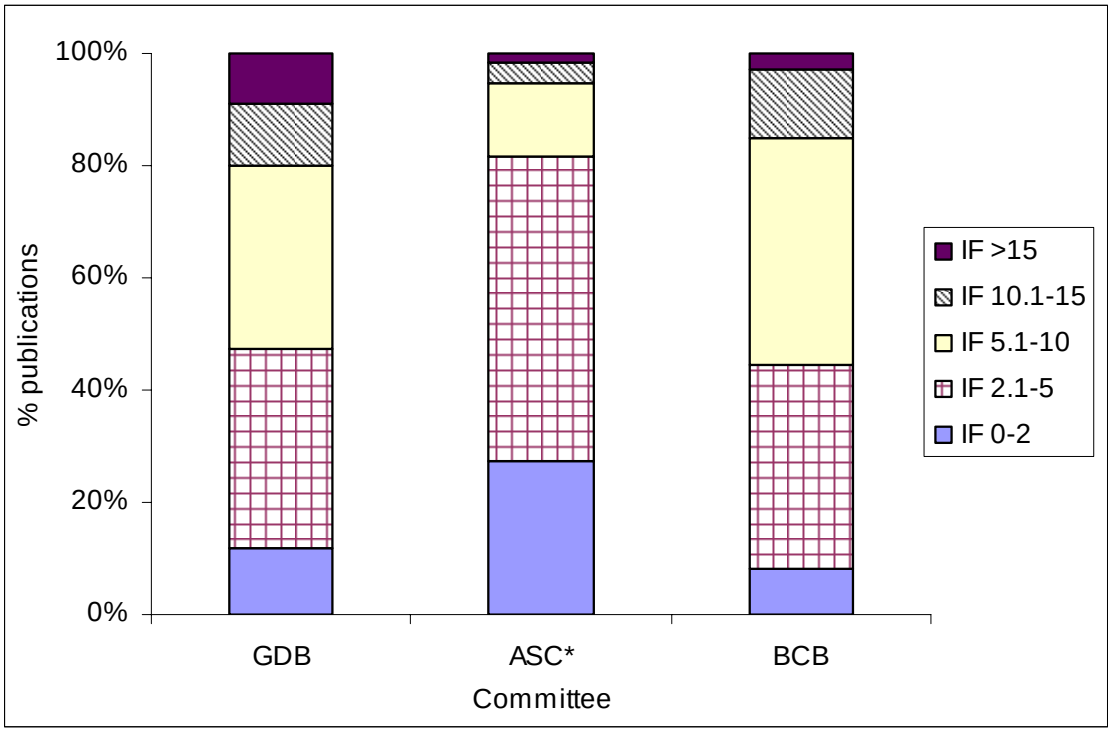
17. Figure 2 shows the distribution of papers published by the Impact Factor of the journal they were published in. The drawbacks of Impact Factors as measures of quality are well known, so these data are presented as supplementary contextual background for the Panel's discussion, and should be interpreted with care.

Figure 2: Distribution of papers by Impact Factor of journal
(journals where >1 paper was published)



18. To provide context, Figure 3 shows the data in comparison with the results of the ASC and BCB surveys.

Figure 3: Distribution of papers by Impact Factor of journal (completed and current grants, journals where >1 paper was published).



* The relatively lower Impact Factors of the journals used by researchers supported through ASC was recognised (in the ASC Portfolio Evaluation) to be a feature of the animal science research area rather than any difference in the quality of the research.

Publishing strategy

19. PIs were asked whether they had adopted a publishing strategy for their research. Of the options given, the majority (**66%**) adopt a pragmatic view, targeting the highest profile general journals with their best results, otherwise targeting the most appropriate journals for their area of science. **30%** said that they target the most respected journals for their area of science, and **9%** that they target journals where their results are published quickly (some PIs ticked multiple options).

2.3 New collaborations and further funding for research

New collaborations

20. More than half of the sample PIs said that the research funded by the grant had helped to establish or strengthen academic contacts:

Type of contact/collaboration		**Proportion of PIs**
Base (all sample PIs)		170
New or improved **academic contacts**	UK	**55%**
	Overseas	**59%**
New formal **academic research collaboration** (e.g. joint publication, joint funding application)	UK	**35%**
	Overseas	**35%**

21. **18** of the PIs indicated making a new contact or collaboration with researchers from a different discipline. A range of disciplines was cited.

Further funding

22. **47%** of the PIs of sample completed grants had received further funding to continue or develop the work supported by the grant. **18%** had received further funding from GDB.

23. When asked why they had not secured further funding through GDB, **27%** of the sample PIs said that their research priorities have changed, **20%** had applied to GDB but their proposal had not been funded, and **9%** commented that funding is more accessible from other sources. Only **2%** commented that the area of science was not covered by GDB's remit.

24. **8%** of the PIs had secured funding through other BBSRC Research Committees, including Plant and Microbial Sciences (5 PIs) and Biomolecular Sciences (2).

25. **24%** of the sample PIs had secured one or more follow on grants related to the work from another funding body, the most common being the Wellcome Trust (10 PIs).

> "In order to achieve the goals of this work the funding available via UK sources would have been inadequate, therefore the BBSRC funding was instrumental in allowing us to obtain EC funding and to make a significant contribution to the international bovine genome work..."
>
> GDB Grantholder

26. By way of context, the table below shows these figures in comparison with the results of the ASC and BCB surveys. Perhaps the most striking comparison with the ASC and BCB Committees relates to the proportion of PIs securing follow-on funding from the same Committee. Whilst 20% of the sample had applied to the GDB Committee for their next grant and had been unsuccessful, that does not necessarily mean that their research was not of an internationally competitive standard. For several years now, the GDB Committee has been unable to fund all the proposals it has rated as internationally competitive. A greater proportion of the sample (27%) indicated that their priorities had changed and this perhaps reflects the role that GDB serves in funding basic science which underpins future work of more relevance to MRC, the Wellcome Trust and NERC. It is not uncommon to see research proposals at the medical and environmental sciences interface amongst the projects that GDB assesses for which the future direction of the work would take it outside GDB's and BBSRC's remit.

	GDB	**ASC**	**BCB**
Base (sample completed grants)	100	102	103
Secured follow on funding	47%	42%	62%
Secured funding from the same Committee	18%	30%	30%
Secured funding from other BBSRC Committees	8%	2%	15%
Number of other BBSRC Committees reported	3	1	5
Secured funding from other funding bodies	24%	15%	31%
"Funding is easier to obtain from other funding sources"	9%	7%	24%
Number of other funding sources reported (including other BBSRC Committees)	16	9	16

2.4 Trained people, increased skills

Staff employed on grants

27. When asked how the grant had supported their wider research aims, **54%** of PIs ticked the option 'strengthened the skill base of my group'.

> "Technical knowledge and skills gained from the experiments in this grant have helped greatly to improve the skill base of my group and as a result have led to significant and exciting new experimental avenues into another area that is of great interest to my group."
>
> GDB Grantholder

28. PIs of completed grants were asked for details of the staff employed on their grant. **92%** had employed one RA, **4%** had employed two. **4%** of the grants had only supported a research technician position.

29. Of the RAs, **91%** of the positions were RA1A, the remainder RA1B. Almost all of the RAs had been contracted full time for the period of the grant.

30. **43%** of the RAs employed on the sampled grants were on their first postdoc (12 grants had a change of RA part way through, so the total number of RAs employed on the sample grants is 112). This figure may be considered to be fairly high, and indicative either of an expanding sector, or a high turnover of RAs.

31. **13%** of the RAs had been employed as a Named Researcher - an RA already working in the laboratory who is included on the application, and whose employment is part of the grant award. By way of comparison, 29% of the RAs employed on the sample ASC grants were Named Researchers (the question was not asked in the BCB survey).

32. The Named Researcher data can be cross-referenced with the data on first postdocs to gain an insight on the employment of RAs:

	First postdoc	**Not first postdoc**	**Total**
Base (no. RAs recruited)	48	64	**112**
Recruited	40%	47%	**87%**
Named Researcher	3%	10%	**13%***
Total	**43%**	**57%**	**100%**

*16% of the sample PIs of completed grants reported a Named Researcher.

33. **54%** of the sample grants supported research technicians, generally for the full 3 years but in a part time role (contracted on the grant for an average of **56%** of the time).

34. **12%** of the sample completed grants had a change of RA during the grant. This compares with RA changes in 12% of the sample ASC grants and 27% of the sample BCB grants. Staff issues such as this, and the impact that they have on the success of grants are discussed further in section 2.8.

35. PIs were also asked for the first destination of the staff employed on the grant:

First destination	RA	Research technician
Base (staff for whom first destination information was given)	*86*	*32*
Fixed-term academic elsewhere	33%	25%
Remained in my lab	21%	44%
Permanent academic elsewhere	10%	6%
Private sector, industry or commerce	10%	16%
Further training (excl. teaching)	9%	0
Government or other public sector	7%	3%
Other employment	6%	6%
Teaching or teacher training	1%	0
Not employed	2%	0

36. The proportion of RAs moving into the private sector, industry or commerce (10%) is very similar to the 10% and 16% reported in both the ASC and BCB surveys respectively.

Researchers at an early stage in their careers

37. GDB awarded **19%** of the BBSRC New Investigator[2] grants over the last five years, higher than the overall proportion of responsive mode grants awarded by GDB (**14%**).

> "This was my first project grant as an independent researcher and it was hugely important for me. It enabled me to develop my research profile and also taught me skills such as project management."
> "For someone trying to start up their own lab, BBSRC support was invaluable. It gave more flexibility than charitable funding, which in the case of this grant was essential".
>
> GDB Grantholders

38. **53%** of the PIs of sample completed grants reported that student projects had been associated with the grant:

	PhD	Masters	Undergrad	Overall
Sample grants with associated projects	40%	14%	37%	**53%**
Number of projects reported	49	26	98	**173**

2.5 New products, processes, tools and technologies

39. **48%** of PIs reported new products, processes, tools or technologies that had or could result from the work supported by the grant. By way of comparison, 27% and 47% of sample PIs reported such outputs in the ASC and BCB surveys respectively.

40. These outputs were wide ranging, and encompassed both tools and resources. In particular, the PIs reported having produced sequence information, protocols and methods, biological materials (e.g. mutant lines, antibodies), chromosome libraries, software and databases.

[2] The New Investigator scheme aims to assist researchers at an early stage in their careers to obtain their first research grants.

41. As would be expected from GDB's remit, the reported users of these outputs were mostly other researchers. Some of the outputs were useful for specific groups, others much more widely. Four of the PIs of sample completed grants (**4%**) reported industry as being the user of their output.

42. It is encouraging to note that the majority of these outputs have been made freely available, mostly through websites, published articles, published databases and conference presentations. The biological materials were more limited, and were usually made available on request, with a few made available only to collaborators.

43. PIs were also asked about the impact that the output had had. Not surprisingly, the outputs reported by current grantholders had generally had little impact as yet. Amongst the completed grants, some of the outputs had had global impact. The group that produced an improved *Streptomyces coelicolor* database, for example, reported that the database is 'used by many researchers internationally every day'. Others had been very useful to specific groups working in more specialised areas.

2.6 New intellectual property, spin out companies

44. Seven (**4%**) 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. A further 6 (**4%**) reported that they were likely to apply in the near future. Two of the PIs reporting patents (**1%** of the sample PIs) had licensed their intellectual property, one of which had led to the generation of income. In comparison, six PIs (4%) and 19 PIs (11%) in the ASC and BCB surveys respectively reported having secured intellectual property, and a further five (3%) in both surveys reported that they were likely to apply.

45. No spin out companies were reported as having been established from the research supported by the grant. In comparison, 2% of PIs reported having established spin out companies in both the ASC and BCB surveys.

2.7 Contribution to the reduction, refinement and replacement of animals in experiments

46. **35%** of the sample Committee members felt that research supported by GDB had contributed to the '3Rs'. The remainder said that they did not know or felt unable to comment. Three added that the Committee carefully considers the issue of animal use in experiments when assessing grant applications.

47. When asked whether any other outcomes arose from the research supported by this grant, **8%** of PIs ticked the option 'contribution to the reduction, refinement and replacement of animals in experiments', compared with 21% and 6% of PIs sampled in the ASC and BCB surveys respectively.

2.8 Performance of grants

48. This section examines how well PIs were able to achieve the scientific objectives set out in their proposals, and investigates the explanations given for projects that had made slower progress.

49. There are two sources of overview data on grant performance: final report grades, and PI responses to the question 'was the project supported by this grant successful in meeting its objectives?' Although the data from these two sources cannot be directly compared, the results are broadly comparable, and show that the majority of projects did achieve their objectives:

- **79%** of GDB grants completed and graded in the period of this study were graded A or B for their final reports (on a scale of A to D[3])
- **74%** of the PIs of the sample completed grants and **83%** of the PIs of sample current grants felt that their project had been or was likely to be successful (some of the current grantholders added that it was too early to tell)

There is no obvious trend in either measure over time.

50. The PIs who identified that their projects had been less successful were asked why. Many ticked multiple options:

Reason	**Proportion of:**	
	PIs indicating that their grants had been less successful	all sample PIs
Base	36	170
Experimental/methodological issues	67%	14%
Staff issues e.g. difficulties in recruiting and retaining staff	47%	10%
The objectives of the research changed due to new information or after initial findings	31%	7%
Unrealistic objectives	17%	4%
Lack of resources e.g. funding, equipment	17%	4%

Skills and staff issues

51. **37%** of the sample PIs reported difficulties in recruiting research staff, or major staff issues during the grant. Of the remainder, **41%** reported no difficulties, and **19%** had a Named Researcher on their application and therefore not had to recruit.

52. PIs were also asked whether a number of statements about recruitment described their experience. Many PIs ticked multiple options:

	Completed	**Current**	**Total**
Base (all sample PIs)	*100*	*70*	***170***
Staff left or temporarily stopped work during the grant, so I had to re-recruit	27%	29%	**28%**
It was difficult to find someone with the necessary qualifications and experience	30%	23%	**27%**
I had to accept someone with significantly less experience than was needed	20%	19%	**19%**
I had to delay the start of the grant (e.g. I needed to re-advertise, I was waiting for visa clearance for an overseas candidate)	15%	24%	**19%**
There were no suitable UK candidates	16%	24%	**19%**
I was lucky this time, recruitment is usually difficult	18%	14%	**16%**

[3] A is defined as 'very high class work that has produced results of considerably scientific importance in a cost effective way, and met all or almost all of the agreed or related key objectives.'
D is defined as 'work that has not added significantly to knowledge in the field and/or has failed to address the agreed or related objectives.'

53. Although the dataset is fairly small, analysing the data by the discipline of the PI (see paragraph 70 for explanation of how PIs were divided into disciplines) shows that more than a third of PIs in the fields of developmental biology in animals; developmental biology in microbes; and gene action and regulation reported difficulties in recruiting research staff.

54. PIs were asked to rank how closely the skills of their RA matched the needs of the project. **58%** of PIs reported that the recruited RA was a good or excellent match to the required skills (this analysis excludes the 19% of grants that had Named Researchers). By way of comparison, this figure was **73%** for the ASC survey (the question was not asked in the BCB survey).

	4 (close match)	**3**	**2**	**1** (significant training required)
Completed grants	17%	40%	24%	18%
Current grants	21%	38%	28%	13%
Total	**19%**	**39%**	**26%**	**16%**

55. These results can also be broken down by research area. More than a third of the PIs ticked 2 or 1 in the categories developmental biology in animals; developmental biology in microbes; epigenetics; stem cell biology; genome organisation; and gene action and regulation.

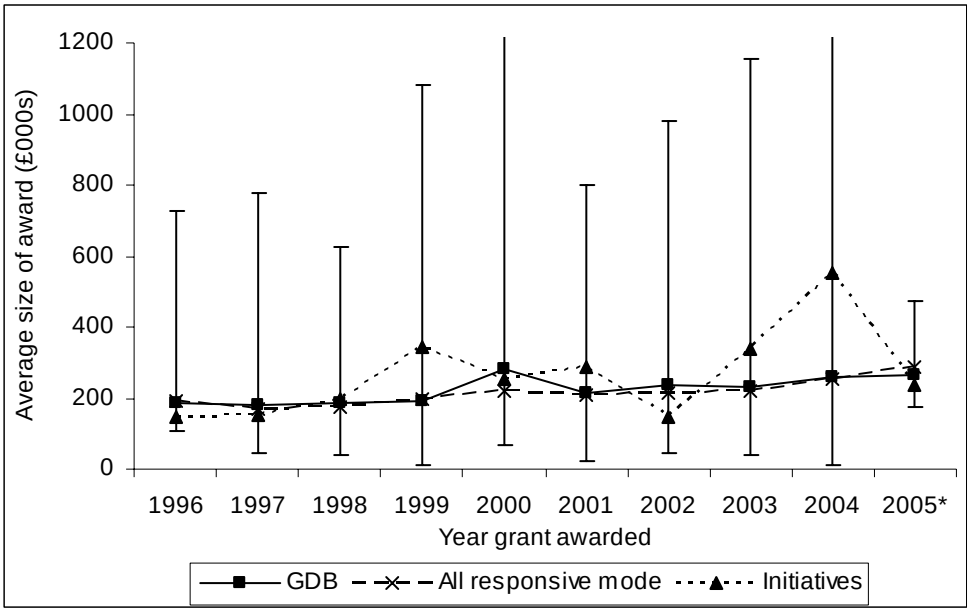
56. A number of the PIs ticking 2 or 1 identified the skills that were lacking or weaker than required. Broadly, these span techniques, knowledge areas, and transferable/ management skills.

Size and length of grants

57. The average size of GDB responsive mode grants awarded in the spring and autumn 2005 rounds (pre-FEC) was £278,000, slightly lower than the BBSRC average of £290,000. BBSRC responsive mode grants have risen slightly in size over the past few years, rising on average by 6% per year (i.e. above inflation) (Figure 4). The trend for GDB is very similar to that for BBSRC responsive mode grants overall.

58. This rate of increase in size is considered to be relatively low, but is balanced by a generally more rapid increase in the size of grants funded through BBSRC's research initiatives (also shown in Figure 4), where much of the 'novel' areas of science have been funded over recent years. Many of these initiatives have been in GDB's remit. [The initiatives data fluctuates more than for responsive mode, because the size of grants varies considerably depending on the scientific area and aims of the initiative].

Figure 4: Size of award (all GDB responsive mode grants)

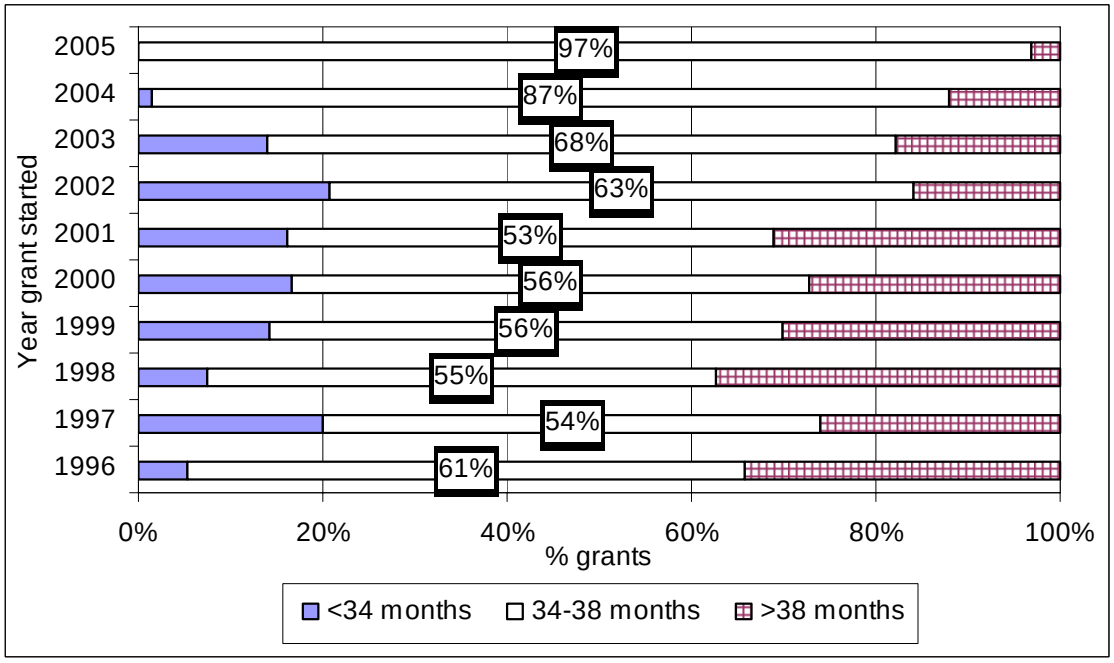


Error bars show the size of the smallest and largest GDB grants for each year

59. The GDB Committee awarded **17** large (>£500,000) responsive mode grants over the last 10 years (up to autumn 2005, pre-FEC). This represents **23%** of the large responsive mode grants awarded through responsive mode by BBSRC in the last 10 years.

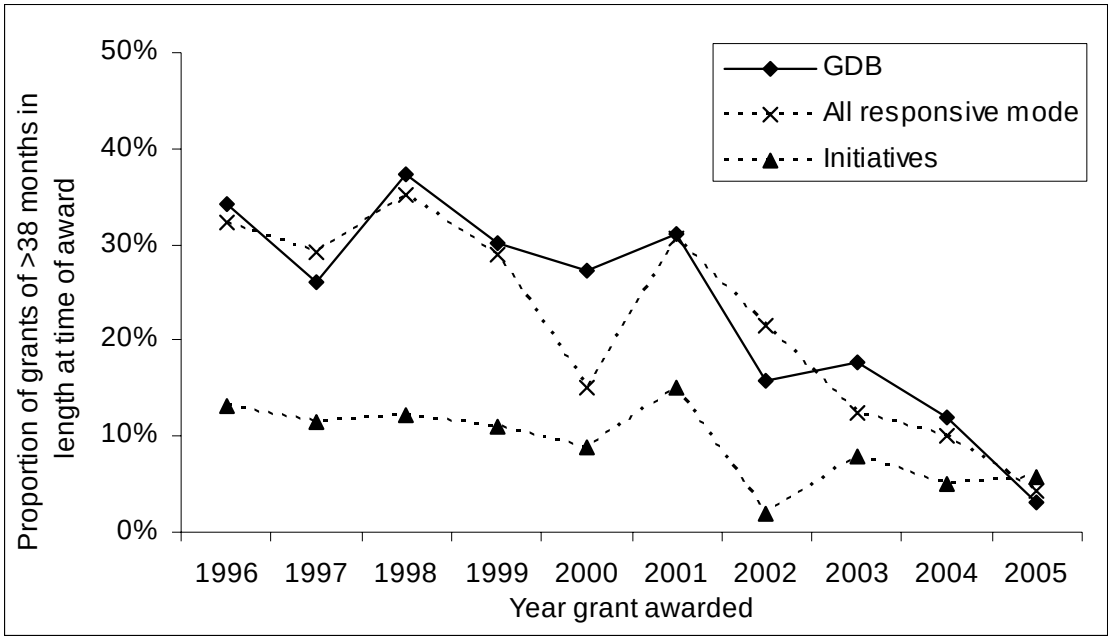
60. BBSRC has, over recent years, encouraged PIs to apply for the resources most relevant to the research (i.e. to move away from the 3-year, one Research Assistant model). The data indicate that this is starting to work in terms of grant size, but not in grant length: despite BBSRC encouragement to PIs, there has been a significant decline in recent years in the proportion of longer grants, and an apparent recent drop in the proportion of shorter grants (Figure 5). Given that BBSRC has been encouraging longer grants, this decline is a concern. It is hoped that the recent Longer and Larger Grants funding mechanism launched by BBSRC will encourage PIs to apply for these grants.

Figure 5: Approved length of all GDB responsive mode grants



61. This decline in longer grants mirrors the trend both for all responsive mode grants and research initiative grants (Figure 6).

Figure 6: Longer (>38 months) responsive mode grants as a proportion of all responsive mode grants



62. EPSRC (like BBSRC) has over the past few years been encouraging PIs to submit shorter or longer applications where this is appropriate to the research involved, and report that they are slowly starting to see a change. The majority of the other Research Councils and the charities surveyed also support longer term grants (e.g. programme grants), which tend to be for five years.

Regulatory and ethical issues

63. PIs were asked about the extent to which regulatory procedures and ethical issues had impacted on the progress of the research supported by the grant. The majority (**81%**) said that these had not impacted on their research at all, but a small number (**3%**) reported that they had had a significant impact.

64. Where procedures had had an impact, the most common reported issue was the time taken to obtain Home Office licences. Two PIs reported that the procedures regulating the use of mice were overly stringent, with one commenting that "the procedures for managing and controlling the use of mice in the proposed project were overbearing and contributed directly to my moving back to the US where such work is appropriately and ethically regulated in such a way as to promote research not hinder it".

3. BALANCE AND COVERAGE OF THE PORTFOLIO

3.1 Remit

65. When asked a general question about the functioning of the GDB Committee, the only common message was that **19%** of the sample PIs highlighted the importance of GDB's remit being broad and general to enable it to concentrate on supporting the highest quality research. There were no major comments on the Committee's remit.

66. The surveyed Committee members were generally happy with the remit, commenting that it is very broad. These comments are backed up by the fact that **95%** of PIs reported that they did not have significantly to change the direction of their research to fit their application to GDB's remit. One of the Committee's key features is that it supports a number of areas of science where there are few other funding opportunities in the UK (e.g. plant sciences, population genetics, evolution).

67. The other funders surveyed were generally satisfied that GDB's remit and its Themes are appropriate, clearly explained, and adequately cover BBSRC's responsibilities in this area. EPSRC noted that it would like to see more emphasis on systems biology research, given its relevance to GDB's remit; and ESRC questioned whether behavioural genetics should be included in GDB's remit.

68. The surveyed Committee members also noted that GDB's remit overlaps with other BBSRC Committees (especially the Plant and Microbial Sciences, and Agri-Food Committees), and with other funders including the Medical Research Council and the Wellcome Trust. The overlap between remits, and the clarity of the interface between GDB and other funding bodies are discussed at paragraphs 78-87.

3.2 Coverage

69. PIs were asked to indicate their areas of expertise against 11 areas covering GDB's remit:

Discipline area	Completed	Current	Total
Base (all sample PIs)	100	70	**170**
Gene action and regulation	58%	53%	**56%**
Developmental biology in animals	28%	47%	**36%**
Evolution and population biology	22%	26%	**24%**
Genomics	21%	23%	**22%**
Developmental biology in plants	14%	16%	**15%**
Genome organisation	17%	13%	**15%**
Epigenetics	13%	13%	**13%**
Developmental biology in microbes	13%	10%	**12%**
Stem cell biology	6%	17%	**11%**
Recombination	7%	3%	**5%**
Gene therapy	2%	1%	**2%**
Other	*1%*	*3%*	***2%***

Note: many PIs ticked multiple categories

70. To investigate trends in the portfolio over time, a rough analysis can be done with the above data, looking at the expertise of PIs of grants supported in each area over time. There has been a marked increase over time in the proportion of PIs declaring expertise in gene action and regulation; and developmental biology in animals. When considering the balance of the portfolio, it should be borne in mind that these data cover the self-declared expertise of the PIs, not necessarily the subject area of the grant.

71. **70%** of the sample PIs felt that their area of expertise is well supported by the Committee, and only **7%** felt that it is not at all well supported. This is a greater proportion than reported in both the ASC and BCB surveys, where **56%** and **68%** of PIs respectively felt that their area is well supported by the Committee. The picture is similarly positive when broken down by area of expertise, except that more than a third of the sample current PIs indicating expertise in developmental biology in plants; epigenetics; and evolution and population biology felt that their area was not well supported by the Committee.

72. **71%** of the sample Committee members commented that the portfolio of research currently supported through GDB is appropriate, and more or less covers the Committee's remit. **41%** identified particular areas as being underrepresented (in terms of research supported and applications received), but no one area received more than two mentions.

73. PIs were also asked whether there were any areas that the Committee should be covering but is not at present. **11%** of PIs identified a range of areas. The only comment made by more than one PI was that the Committee should be more open to technology development (**3%** of PIs).

3.3 Priority Areas

74. There is currently some debate within BBSRC and its Committees over the role of Priority Areas (PAs). As recognised by the surveyed Committee members, PAs are intended to encourage PIs to submit applications in certain specific areas within the Committees' remits (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 & quality of life, timeliness and promise, and cost effectiveness can contribute to the final prioritisation; in practice this is mainly used where grants of comparable scientific excellence are being prioritised.

75. PAs are changed or modified over time as their objectives are achieved; BBSRC also identifies Cross-Committee PAs in areas of relevance to more than one Committee, many of which are relevant to GDB.

76. **35%** of the surveyed Committee members commented that GDB's PAs are helpful in encouraging scientists to submit applications in particular areas. However, **24%** expressed a range of concerns relating to PAs, and **18%** stated that PAs should be reviewed and revised regularly. The only major comment on PAs by the sample PIs (when asked a general question on the functioning of the Committee) was that the remit should be kept broad and general, that funding should not be ring-fenced but allocated on the basis of scientific quality (**19%** of sample PIs).

3.4 Interdisciplinarity

77. A recent exercise aimed at getting an idea of the level of interdisciplinarity in BBSRC responsive mode grants used PIs' departments as an indicator. For the purposes of the study, interdisciplinary grants were defined as those with PIs from a life sciences department and a non-life sciences department, and those with PIs based in non life-sciences departments. This is obviously an underestimate as it does not include scientists from other disciplines who work in life sciences departments, but was a working definition to enable data to be fairly easily extracted from the BBSRC grants database. GDB ranked third out of the seven BBSRC Research Committees by this measure, with **18** 'live' interdisciplinary grants (**6%** of all BBSRC interdisciplinary grants) on 1 April 2004.

3.5 Comparison with other UK funders

78. GDB's remit overlaps with a number of other UK research funders, including Government departments, other Research Councils and charities. The table below summarises the responses from the other funders surveyed.

Funder	Areas where remits overlap	Budget in overlap area (where information given)	Comments
Research Councils			
EPSRC	Aspects of genome analysis, developmental biology, gene action, cell cycle, evolution	05/06 responsive mode: *(* see note on data below)* Genomic and post-genomic science and technologies: £11M, 14 grants; Bioinformatics: £6M, 17 grants; Developmental biology: £2M, 8 grants; Stem cell research: £2M, 4 grants	Projects relevant to both councils are co-funded, mostly with BBSRC's Engineering and Biological Systems Committee. The major overlap with GDB is in bioinformatics.
ESRC	Very little		ESRC has interests in aspects of the GDB portfolio e.g. gene environment interaction, but this is from a different perspective, so the research supported does not overlap.
MRC	MRC focuses on human health and disease. MRC's support for human health overlaps with aspects of GDB's remit.		Post-genomics, stem cell research and the ageing population are key strategic areas for MRC. There is especially close co-ordination and joint working across Research Councils in these priority areas.
NERC	Potential overlap in a number of areas: genomics including sequence analysis and genome organisation, quantitative genetics, behaviour of genes in populations, evolutionary genetics, molecular evolution including diversity and phylogeny.		Confusion may arise over the organisms to be studied, i.e. the domestic or model animal/wild animal divide.
Government departments			
DTI	Mainly stem cell biology, but DTI's focus is on applied research	Two recent calls in stem cell area: £11.5M in 2005, £6M in 2004	Boundaries and interfaces are clearly defined, e.g. co-funding through LINK programmes. DTI has launched several recent calls for collaborative R&D in stem cell biology. DTI is also seeking support from other funders for the following areas that it sees as a priority: stem cell research, especially toxicological screening; research on biomarkers as an emerging technology; and, more generally, research that is relevant to further advances in medicine but not within MRC's remit.

SEERAD	Some overlap, but SEERAD's focus is on applied research		Functional genomics, comparative and evolutionary genomics, and biodiversity informatics are key areas of interest for SEERAD.
Charities			
Cancer Research UK	Limited overlap, where the research is of specific relevance to cancer	~56% of the research grant portfolio has some overlap with the basic biological research supported by BCB and GDB.	
Wellcome Trust	Considerable overlap, but the Trust does not fund research on plants		Overlap is mostly with the Trust's Molecules Genes and Cells Committee.

*these data cannot simply be summed as it is based on a keyword search so there are potentially many duplicates between categories.

79. Other funders and the surveyed Committee members commented that areas of overlap are generally beneficial, as it ensures that there are no gaps in support for research in these areas in the UK.

80. Areas of overlap with the other Research Councils are monitored, and grant applications that are outside the BBSRC remit are redirected to the appropriate Council. It is possible for some Research Councils to co-fund research projects, and the GDB Committee has recently co-funded a number of projects with NERC in particular. There are no formal co-funding arrangements between BBSRC and MRC at present. The other Research Councils, in their questionnaire responses, were generally satisfied that the boundaries between the Councils are clearly defined and that effective communication takes place in areas of overlap.

81. NERC, however, expressed concern about the overlap between its remit and that of GDB, and the fact that boundaries are currently not clearly defined, particularly in genomics. It commented that further discussions are necessary to explore overlap, clarify interests and re-examine the co-funding process. The GDB secretariat has regular discussions with NERC on the remit of grant applications, as it appears that NERC regularly receives proposals that fall within the GDB Committee remit. Most of these appear to be in evolutionary genetics and population genetics. Proposals received by NERC which are of interest to GDB are usually considered for co-funding, while those which fall directly within the GDB remit are usually rejected and the applicants are invited to resubmit to BBSRC.

82. Discussions have taken place between the GDB secretariat and DTI, SEERAD, and the main charities supporting research relevant to GDB to ensure that the organisations are aware of each others activities in this area. Again, these organisations were generally satisfied that GDB's remit is clearly defined.

3.6 International comparison

83. While it was not feasible in the context of this evaluation to generate specific international comparison data for genes and developmental biology research, the Office of Science and Innovation recently published a number of Public Service Agreement target metrics for UK bioscience research as a whole[4]. The metrics compare the UK's performance in biosciences with other major research countries using bibliometric data from ISI National Science Indicators 2004, and show the UK to be ranked very highly for the quality of its bioscience research:
    - Share of world citations: The UK ranked 2nd (behind the USA) for its share of citations in the biosciences for 1995-2004 (the data were corrected for country size)

[4] PSA target metrics for the UK research base, Department of Trade and Industry, December 2005. www.dti.gov.uk/files/file27330.pdf

- Citation impact relative to world baselines in biosciences: The UK ranked 3rd (behind Switzerland and Singapore and, for the first time, ahead of the USA) in 'citation impact' (ratio of citations to publications) for biosciences for 2004
- Proportion of uncited papers: The UK had the lowest proportion of uncited papers (i.e. the highest proportion of cited papers) for biosciences for 1999-2004 amongst the G8 countries.

84. The BBSRC remit as a whole can be compared internationally with that of the National Science Foundation (NSF) in the USA. Indeed, the NSF's Directorate of Biological Sciences includes two divisions which have grant awarding committees broadly covering the remit of the GDB Committee. The budgets and portfolios of the relevant NSF Committees appear to be comparable and the websites for these committees include searchable grants information. The following analysis is based upon the grants information available through the NSF website. It is not intended to be an in-depth survey.

85. The NSF funds research and education in most fields of science and engineering. Within its Directorate of Biological Sciences, there are two divisions which include grant awarding committees ('clusters') broadly covering the remit of the GDB Committee. These are as follows:

a. Division of Integrative Organismal Biology (IOB)
Developmental Systems Cluster – the nature and control of those processes that comprise the life cycle of organisms

   - This area includes research on the mechanisms of gametogenesis, fertilization, embryogenesis, differentiation, pattern formation, and morphogenesis, including research on the development, regeneration, and aging of the nervous system. Genomic approaches, gene networks, integration of developmental gene pathways, and computational approaches are included. Studies that explore the evolution of developmental mechanisms are encouraged.

b. Division of Molecular and Cellular Biosciences (MCB)
Genes and Genome Systems Cluster – studies on genes and genomes in all organisms

   - This area includes studies on genomes and genetic mechanisms in all organisms, whether prokaryote, eukaryote, phage, or virus. Proposals on the structure, maintenance, expression, transfer, and stability of genetic information in DNA, RNA, and proteins and how those processes are regulated are appropriate. Areas of interest include genome organization, molecular and cellular evolution, replication, recombination, repair, and vertical and lateral transmission of heritable information. Of equal interest are the processes that mediate and regulate gene expression, such as chromatin structure, epigenetic phenomena, transcription, RNA processing, editing and degradation, and translation. The use of innovative in vivo and/or in vitro approaches, including biochemical, physiological, genetic, genomic, and/or computational methods, is encouraged, as is research at the interfaces of biology, physics, chemistry, mathematics and computer science, and engineering.

86. The total number of current grants and current spend for these two clusters is given below. For comparison, the GDB Committee's current responsive mode portfolio includes **333** grants – the actual number of projects is fewer – totalling approximately **£57M** (current **commitment**).

Developmental Systems Cluster
Number of Current Grants: 154Total Current Spend: £28M

Genes and Genome Systems Cluster
Number of Current Grants: 353Total Current Spend: £67M

87. The GDB and NSF financial data are only broadly comparable since the NSF provides current spend on grants through its website rather than total grant commitment at the time of award. The grants lists from the NSF website for the two clusters include titles and abstracts; roughly 85% of the projects would fall within the GDB Committee's themes, with most of the outliers residing in the Genes and Genome Systems Cluster and being more relevant to the BBSRC organismal committees (Plant and Microbial Sciences, and Animal Sciences).

4. INTERACTION WITH INDUSTRY

4.1 Overview

88. When asked what GDB-supported research achieves, the majority of Committee members commented that it supports a bedrock of fundamental scientific knowledge that underpins future research and future commercial application. Plant and animal breeders, and the pharmaceutical, biomedical and agricultural industries were particularly highlighted. These generally longer-term impacts are discussed further at Chapter 6. This Chapter considers the interaction between GDB-supported PIs and industry during and after the grants. The sections in Chapter 2 on intellectual property and spin-out companies (Paragraphs 44 and 45) are also relevant.

89. The sample Committee members had diverse views on the relationship between GDB-supported research and industry. 18% commented that it is very helpful having Committee members who are based in industry, and that this in itself fosters interaction between grantholders and industry. 24% felt that there is little interaction, but that this is not a problem given the basic nature of the science supported through GDB. 18% commented that there could be more interaction with industry. However, another 18% commented that this should not be pushed too hard by BBSRC as the scientists themselves make the links where there is potential for collaboration.

4.2 Support at outset

90. Five PIs (3% of the sample grants) reported having co-funding or in-kind involvement in the grant at the outset. This included one Industrial Partnership Award, one LINK Award, one PI who received funding from industry and one who was supported in kind. By way of comparison, 6% of sample ASC PIs and 4% of BCB PIs reported industrial support at the outset of their grant.

4.3 Involvement as a result of the grant

91. PIs were asked whether the grant had helped them to establish or strengthen contacts or collaborations with other organisations, e.g. industry, charities and other government departments. Of those that gave information about the type of organisation, all except two listed industry, including the pharmaceutical industry and Small and Medium Enterprises. These levels are slightly higher than those reported for industrial involvement at the outset of grants.

Type of contact/collaboration		**GDB**
Base (all sample PIs)		170
New or improved **contacts** with other organisations	UK	10%
	Overseas	9%
New formal **research collaboration** with other organisations	UK	7%
	Overseas	2%

5. PUBLIC ENGAGEMENT

92. PIs are required to conduct public engagement activities as a condition of their grant. Between the questionnaires and the final reports, **55%** of the sample completed PIs reported public engagement activities. Reported public engagement activity was lower amongst the sample current PIs (**34%**), as might be expected given that the grants are still underway. Recent analysis by the BBSRC External Relations Unit (ERU) found that **82%** of recent GDB PIs had conducted public engagement activities, well above the average for all Committees (76%)[5].

93. The most frequent reported activities were schools activities (**25%** of sample grants), and presentations to the general public including interest groups (**17%**).

[5] The study used a sample of 350 final reports returned to BBSRC between June and September 2005, covering grants finishing from 2001 onwards. 36 out of the 44 reports included genuine public engagement activities.

6. ULTIMATE IMPACTS

94. Ultimate impacts are those that relate to the overall objectives of the BBSRC as an organisation, and would generally be expected to arise in the longer-term. The logic chart used to guide the evaluation identifies the following 'ultimate' impacts (relating to the objectives expressed in the BBSRC 10-year vision) that should arise from BBSRC support for genes and developmental biology through responsive mode funding:
    - research findings are used for the 'public good', e.g. medical research, biotechnology, government policy
    - income to the research community and 'UK plc', e.g. from new technologies, intellectual property
    - the UK maintains its international standing in genes and developmental biology research
    - BBSRC maintains 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.

95. These impacts are clearly difficult to measure, and even more difficult to attribute directly to BBSRC funding. However, it is particularly important that they are evaluated because they relate to the overall objectives of the BBSRC: they help to answer the question 'how effectively is BBSRC doing its job?'

96. Some data relevant to the assessment of high-level impacts were collected in the surveys, and are presented below. Panel members are invited to consider this section's questions drawing on these data, and also on their knowledge and experience of genes and developmental biology research in the UK.

6.1 Contribution to the 'public good'

97. GDB's support for genes and developmental biology research contributes to the 'public good' in a number of ways. It:
    - supports a bedrock of fundamental scientific knowledge that underpins future research and commercial application (sometimes a long way down the line)
    - trains scientists in the rigours of basic science (many of whom go on to work in industry)
    - contributes to public engagement with science, and supports science of public interest.

98. The surveyed Committee members noted the wide range of potential applications for GDB-supported research, as summed up by one member:

> "Genetics and development are central to a wide range of applications, and hence GDB-funded research has an enormous diversity of end users ranging from breeders of agriculturally important plants and animals, to biomedical applications such as drug development and tissue engineering. Hence the long term outcomes could be anything from new domestications for non-food crops, through to new methods to drive differentiation down particular routes in vitro".
>
> GDB Committee member

99. The sample PIs were also asked to identify whether their research had contributed to the public good. **26%** felt that their research had contributed to (or had the potential to contribute to) human health, and **5%** to animal health and welfare. The majority of these impacts were additions to basic knowledge, contributing to applied benefits in the long-term.

100. There were also two examples of research that had relatively quickly led to an application: one where the research 'eventually led to a preclinical production for the treatment of nerve damage', and another which was 'ongoing research on embryo/cancer genes as candidates for possible cancer vaccine'.

101. Nine PIs (**5%**) identified contributions to environmental issues, illustrating that some of the research supported through GDB underpins applied biodiversity research, providing tools for understanding the origins of genetic diversity, and hence eventually contributing to biodiversity conservation strategies.

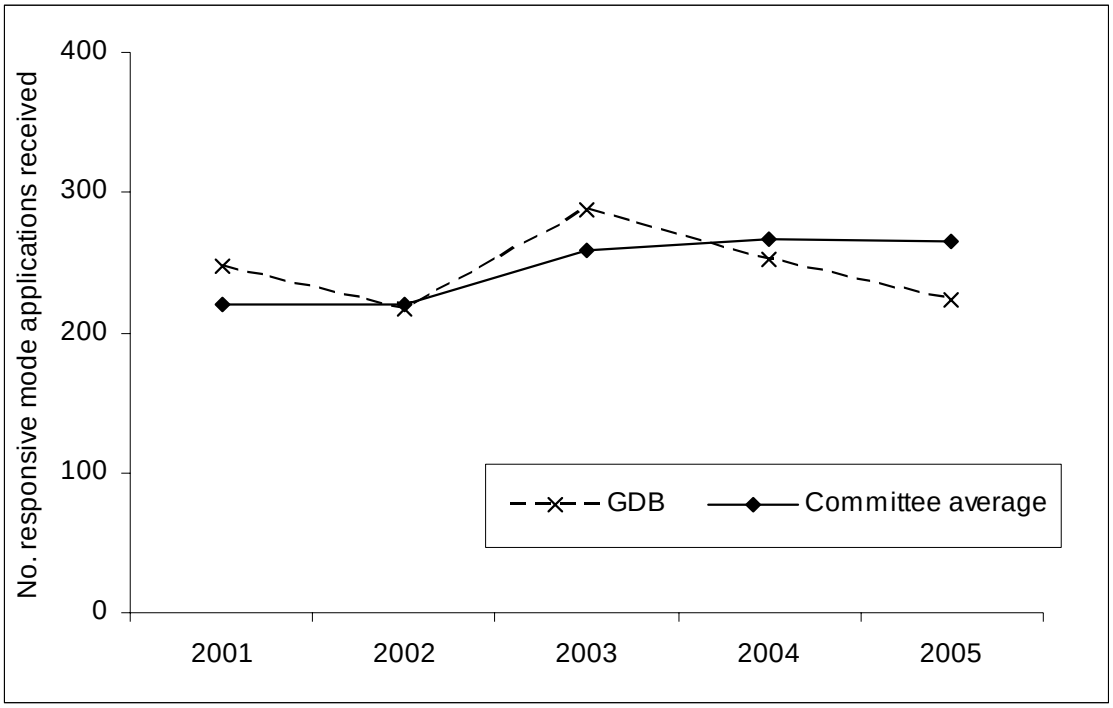
6.2 UK ranking in genes and developmental biology research

102. When asked whether the grant had supported their wider research aims, **73%** of PIs ticked the option 'strengthened the standing of my research group in the field'.

103. The BBSRC spend through GDB on responsive mode and the number of applications that the Committee receives can be used as indicators of the level of international quality genes and developmental biology research in the UK. BBSRC's spending on responsive mode research through GDB increased from **£11 million** in FY2000/01 to **£20 million** in 2005/06. Proportionally, it has stayed fairly even at around **16%** of the BBSRC responsive mode spend over the past five years.

104. The number of applications to GDB is consistently similar to the BBSRC Committee average, indicating the continued relative strength of the UK scientific community in this area (Figure 7). The number of applications rose at the end of the 1990s, but remained comparatively stable over the last five years, with **224** applications received in the spring and autumn 2005 rounds.

Figure 7: Numbers of applications to BBSRC responsive mode



105. Despite rising funding, the increasing number of applications to BBSRC and the increasing size of grants has resulted in a fall in the responsive mode success rate, from **33%** in 2001 to **25%** in 2005 (mirroring the overall figures for BBSRC).