

PANEL MEMBERSHIP

Professor Richard Morris, University of Edinburgh (Chair)

Dr Barbara Blacklaws, University of Cambridge

Dr Richard Boyd, University of Oxford

Professor Julia Buckingham, Imperial College

Professor Tony Dickinson, University of Cambridge

Professor James Stewart, University of Liverpool

Professor Monica DiLuca, University of Milan, Italy

Dr Neil Upton, Director of in vivo biology, Glaxo Smithkline, replaced for the second meeting by Professor Andy Randall, Director of Neurophysiology, GSK.

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 Animal Sciences Committee members, and other funding organisations.

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 BBSRC's Animal Sciences Committee (ASC) since the Committee's inception in 1994. 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 BBSRC's Institute Assessment Exercise. Thus, although some of this research falls within ASC's remit, it was **not** included in this evaluation.
5. The objectives of the evaluation were to:
 - Assess the quality and international standing of research funded through ASC;
 - Identify the major outputs and, where possible, outcomes of ASC's responsive portfolio over the past 10 years;
 - Identify strengths, weaknesses and gaps in the scheme, the way it is structured, the influence of initiatives and priority areas on the way that the scheme has developed, and the way in which it is administered;
 - In consultation with the research community and other relevant funding bodies (government and non-government), assess whether ASC is currently funding the most appropriate areas of UK bioscience; and
 - Identify ways to build on successes, and ways to address identified gaps and issues.

6. The evaluation began in April 2004, and comprised a number of surveys, followed by a review of findings. The work was co-ordinated by BBSRC's Evaluation and Policy Unit, in consultation with the Animal Sciences Branch. A logic chart was used to guide the design of the evaluation. This chart represents diagrammatically the objectives and desired impacts of BBSRC's responsive mode, and places the scheme in its wider context, showing its links to the longer-term aims of the organisation (Annex 2).

Surveys

7. Information was gathered from a range of sources:
 - **Completed grantholders:** A questionnaire was sent to 50% of the Principal Investigators (PIs) of all completed and graded ASC responsive mode grants (grants that started September 1994 onwards). The sampling was 'random' as regards the science (it did not take into account the nature of the research), but was structured to ensure that each of the 10 years of the Committee's operation and the full range of final report grades were included. The questionnaire covered a range of topics including success of the grant, outputs and outcomes of the research, views on the coverage of the portfolio, and views on the operation of the Committee (Annex 3).

102 responses were received (a 70% response rate), representing 35% of all the completed and graded ASC responsive mode grants. The grants for which questionnaires were returned are listed at Annex 4. The sample was considered to be representative in terms of quality because the distribution of final report grades was almost identical to the overall distribution of grades.
 - **Current grantholders:** Similarly, a structured sample of 40% of current ASC responsive mode grants that had been active for more than a year was taken, and a questionnaire sent to each PI. 69 responses were received (72% response rate), representing 29% of all current ASC responsive mode grants started between 2001 and 2004. The grants for which questionnaires were returned are listed at Annex 4.
 - **Committee members:** Current and past Committee members (those serving over the last five years) were sent a questionnaire on topics such as coverage of the portfolio, ASC's achievements, and views on the Committee and BBSRC's administration (Annex 3). Ten responses were received (36% response rate), eight from current members and two from past members. One of the responses was from an industrial member.
 - **Other relevant UK funding bodies:** A separate questionnaire was sent to other funding bodies that have an interest in animal sciences research in the UK:
 - Research Councils: Economic and Social Research Council (ESRC), Engineering and Physical Sciences Research Council (EPSRC), Medical Research Council (MRC) and Natural Environment Research Council (NERC);

- Government bodies: Department for the Environment, Food and Rural Affairs (Defra), Scottish Executive Environment and Rural Affairs Department (SEERAD);
- Charities: Cancer Research UK (CRUK) and Wellcome Trust; and
- National Centre for the Replacement, Refinement and Reduction of Animals in Research (NC3Rs).

The questionnaire covered potential overlap or gaps between remits, research priorities in the animal sciences area, and views on the appropriate ‘niches’ for the two organisations (Annex 3). Responses were received from all of the organisations apart from ESRC.

To inform the Panel’s discussion on contribution to the public good, Defra and SEERAD were also asked to comment on the extent to which ASC-supported research contributes to their departmental science strategy and research, and to the development of policy.

- **BBSRC data:** Relevant information from BBSRC’s grants databases and the final reports submitted by the PIs of sample completed grants were provided.
8. Unsuccessful applicants were not included in the surveys because the focus of the evaluation was on the science supported through ASC; 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

9. A Review Panel was convened to consider the survey results. This independent Panel was made up of scientists not closely involved with BBSRC, but who between them had expertise across ASC’s remit (see Annex 1 for Panel membership). The Panel included one member from industry and one international member, and met for two one-day sessions in October and November 2005
10. The Panel was asked to provide an independent scientific evaluation of the data presented, and to base its analysis on:
- The final reports of the sample grants for which the PI had returned a questionnaire. Each Panel member reviewed a subset of the sample final reports broadly within their area of expertise; and
 - The findings of the surveys. The survey data presented to the Panel are summarised at Annex 6.
11. The Panel’s analysis was guided by a number of questions covering the different objectives of responsive mode, as represented in the logic chart (Annex 2). To facilitate the analysis, the subject matter was divided into five subject areas:

1. Research quality and research outputs
2. Balance and coverage of the portfolio
3. Interaction with industry
4. Public engagement
5. Ultimate impacts

12. This report focuses particularly on the scientific aspects of the Panel's findings. A number of general issues related to BBSRC's programmes and grant administration processes arose in the surveys and during the Panel meetings. These findings will be presented to Strategy Board in combination with the results of other current responsive mode portfolio evaluations.

Constraints

13. 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 ASC and, due to the excellent response rate, cover 35% of completed grants and 29% 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 Animal Sciences Committee

14. BBSRC's Animal Sciences Committee (ASC) 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 BBSRC's responsive mode funding through ASC over the past four years.

ASC spend over the last four years

| Year | 2001/02 | 2002/03 | 2003/04 | 2004/05 |
|----------------------------------|---------|---------|---------|-------------------|
| ASC spend - responsive mode (£m) | 13.2 | 15.6 | 16.8 | 19.2 ⁺ |
| ASC spend - total* (£m) | 28.7 | 32.9 | 35.2 | 38.9 ⁺ |
| No. ASC responsive mode grants | 87 | 73 | 96 | 94 |

* Including initiatives, studentships, Core Strategic Grants to Institutes, other types of grant

⁺ Estimate

15. The Committee's stated aim is 'to support basic and strategic work on animal function at the level of tissues and systems'. The science that it funds in 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 current remit of the ASC is:

The Animal Sciences Committee supports basic and strategic work on animal function at the level of tissues and systems. This covers the basic and comparative physiology and behaviour of all animals (both vertebrates and invertebrates), including humans, but excludes clinical research and studies of specific human diseases. An integrative approach, applying molecular, genetic, cellular and behavioural information and technologies to understand how the whole organism functions, or elucidating how different physiological and psychological systems integrate and interact, is particularly encouraged. Thus applications are welcomed that integrate a range of disciplines and make full use of the opportunities provided by genomics in both model, and where appropriate, non-model species.

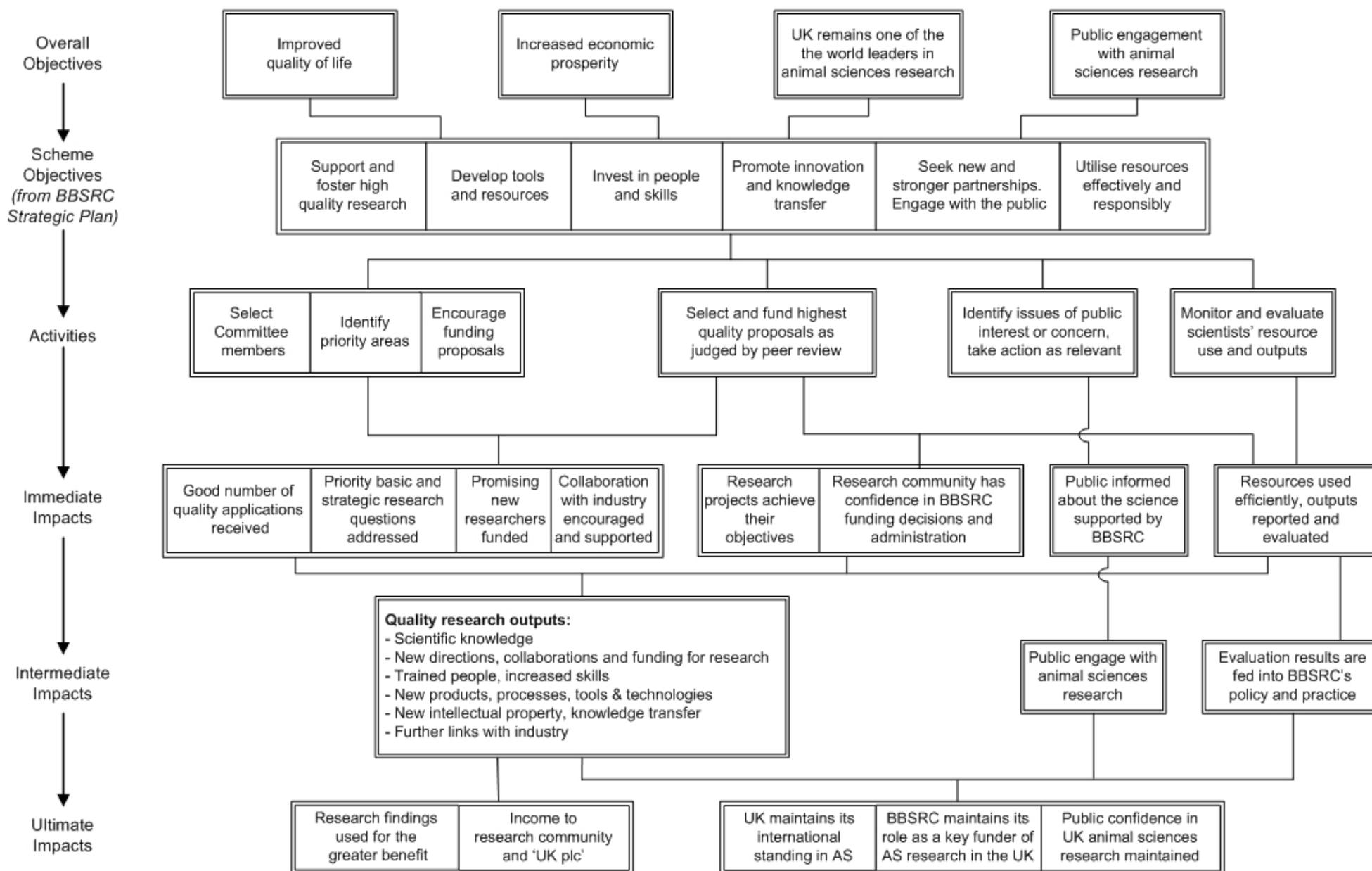
16. The ASC's remit is divided into three themes which together define the remit in greater detail. The current ASC themes are:
- Integrative Animal Physiology, covering the study of tissue function in the intact organism, including physiological disciplines (in their broadest sense) in relation to all animals, and including humans other than in a clinical context;
 - Mechanisms of Immune Function and Disease Pathogenesis, covering the study of innate and adaptive immune mechanisms of vertebrates and invertebrates and ways of manipulating these mechanisms to induce protective immunity against disease; and
 - Neuroscience and Behaviour, covering research on all fundamental aspects of nervous system functioning aimed at understanding how the brain acquires, processes and stores information.
17. The distribution of expenditure on responsive mode grants through ASC in 2004/05 was:

ASC responsive mode funding by theme (grants live at 1 January 2005)

| Theme | Spend |
|--|---------------------|
| Neuroscience and Behaviour | £28.2 million (46%) |
| Integrative Animal Physiology | £19.6 million (32%) |
| Mechanisms of Immune Function and Disease Pathogenesis | £13.8 million (22%) |

18. Within ASC's remit there are specific priority areas of science 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. ASC currently has four Priority Areas: Animal welfare; Control of infectious diseases; From the neurone to behaviour; and Genes to physiology.
19. BBSRC also identifies a number of Cross-Committee Priority Areas in areas of relevance to more than one Committee. Four of these are currently relevant to ASC: Cognitive systems; Biology of the transmissible spongiform encephalopathies; Developing alternative methods to replace, reduce and refine animal experiments; and Drug resistance and alternatives to chemotherapeutics.

Logic Chart for Animal Sciences Committee Responsive Mode Funding



QUESTIONNAIRES

1. Completed grants (current grantees were sent a very similar questionnaire)
2. Committee members
3. Other funders

Animal Sciences Portfolio Evaluation 2005 Survey of Completed Grants

*Please complete as many questions as possible, and return to Fiona Hindley, preferably by email, by **17th June**. 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 Hindley, Research Evaluation Manager

fiona.hindley@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. GPA (Government Partnership Award) | |
| b. IPA (Industrial Partnership Award) | |
| c. LINK Programme | |
| d. Other (<i>please specify</i>) | |
| e. 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 Animal Sciences Committee (ASC)? (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? For example did you have to delay the start of the research until you found someone suitable?

YES / NO / N/A (named researcher)

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) |
| | | | |

Comments:

5. Did this grant support your wider research aims? (please tick one or more boxes)

| | |
|--|--|
| a. Enabled extension of my research into new areas | |
| b. Provided funding for activities that other bodies would not fund | |
| c. Helped me to win other grants | |
| d. Strengthened the skill base of the group (e.g. techniques, cross-disciplinary skills) | |
| e. Generated income from patents, spin out companies, etc | |
| f. Helped to publicise the importance of my field of research | |
| g. Strengthened the standing of my research group in the field | |
| h. Contributed to the development of tools and technologies | |
| i. Supported new/stronger collaboration with industry | |
| j. Helped me to establish my lab | |
| k. Other (<i>please specify</i>) | |
| l. 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:

| | |
|---|--|
| Staff e.g. difficulties in recruiting and retaining staff | |
| Experimental/methodological/technical reasons | |
| Lack of resources, e.g. funding, equipment | |
| Unrealistic objectives | |
| The objectives of the research changed due to new information or after initial findings | |

Comments:

Research outputs - Publications

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

| | |
|--|--|
| Target the highest profile general journals (e.g. Nature, Science) | |
| Target the most appropriate journals for my area of science | |
| Target journals where I can get my results published quickly | |
| A mixture of the above depending on the significance of the findings | |
| Other (<i>please specify</i>) | |

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

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

Industry:

Overseas:

Research outputs – People

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

| Position (please tick one) | | | % time spent on grant | Period of appt (months) | First destination* | For RAs, was this their first postdoc position? |
|----------------------------|-------------|-------------|-----------------------|-------------------------|--------------------|---|
| RA1A (PDRA) | RA1B (PGRA) | Tech-nician | | | | |
| | | | | | | |
| | | | | | | |

* Please indicate category(ies): a – remained in my lab, b - permanent academic, c - fixed-term academic, 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, j - overseas

Research outputs – Further funding

11. Have you received further BBSRC funds through ASC to continue or develop the work funded by this grant? If yes, please provide details

YES / NO

| Grant ref | Value (£) | No. years |
|-----------|-----------|-----------|
| | | |
| | | |

If no, why not? (please tick one or more and comment if you wish)

| | |
|--|--|
| I applied to ASC but my proposal was not funded | |
| The area of science was not covered by the ASC remit | |
| Funding is more accessible from other sources (through other BBSRC Committees, other funding bodies) <i>(please specify)</i> | |
| I already had funding from other sources <i>(please specify)</i> | |
| My research priorities have changed | |
| Other <i>(please specify)</i> | |

Comments:

12. Have you received a follow on grant related to this ASC grant through another BBSRC Committee or another funding body? If yes, please provide details

YES / NO

| Funding body / BBSRC Committee | Value (£) | No. years | Grant ref (for BBSRC grants) |
|--------------------------------|-----------|-----------|------------------------------|
| | | | |

Research outputs - Exploitation

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

YES / NO

| Product, process, tool or technology | Is it potentially commercially exploitable? |
|--------------------------------------|---|
| | |

14. Have you or your colleagues applied, or are you likely to apply, for any patents, licenses 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 | |
| | | | | | | |

Research outputs – knowledge transfer to other users

16. 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 | |

Research outputs – contacts and collaborations

17. 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 - <i>if cross-disciplinary, please specify discipline</i> | UK | |
| | Overseas | |
| New or improved industrial contacts - <i>please specify type of industry</i> | UK | |
| | Overseas | |
| New formal academic research collaboration (e.g. joint publication, joint funding application) - <i>if cross-disciplinary, please specify discipline</i> | UK | |
| | Overseas | |
| New formal industrial research collaboration (e.g. joint publication, joint funding application) - <i>please specify type of industry</i> | UK | |
| | Overseas | |

Comments/details:

Other outcomes

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 | | |

General

19. What is your area of research? (tick one or more classification)

| | | | | | |
|-------------------------------------|--|--|--|--|--|
| 1. Animal anatomy | | 10. Immune system, immunology, serology | | 19. Reproductive biology, reproduction | |
| 2. Animal ethology & psychology | | 11. Invertebrate neurosciences | | 20. Speech, hearing & language | |
| 3. Animal welfare | | 12. Invertebrate physiology | | 21. Vertebrate neuroscience | |
| 4. Bacteriology | | 13. Mathematics, statistics, biomathematics & biometrics | | 22. Vertebrate physiology | |
| 5. Behavioural neurosciences | | 14. Memory, cognition & perception | | 23. Veterinary medicine | |
| 6. Cell biology | | 15. Musculo/skeletal system, locomotion | | 24. Virology | |
| 7. Endocrine system & endocrinology | | 16. Parasitology | | Other | |
| 8. Epidemiology | | 17. Psychology & underpinning neuroscience | | | |
| 9. Genetics | | 18. Psychophysics & perceptual psychophysics | | | |

20. Do you think this area/these areas is/are well supported by the ASC? (please tick one and comment if you wish)

| | | | |
|------------------|---|---|------------------------|
| 4 (very well) | 3 | 2 | 1 (not at all well) |
| | | | |

Comments:

21. The ASC's aim is "to support basic and strategic work on animal function at the level of tissues and systems". Do you think that the Committee is achieving this aim? Please tick one and comment if you wish

| | | | |
|------------------|---|---|-------------------|
| 4 (very well) | 3 | 2 | 1 (not at all) |
| | | | |

Comments:

Are there any areas that the Committee should be covering but isn't? (for the current portfolio see www.bbsrc.ac.uk/science/areas/as.html).

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

23. Do you have any comments on the grant application/administration process?

24. 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 can BBSRC increase the number and quality of referees' comments?

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

Thank you, your contribution is much appreciated.

Please return this form by 17th June (contact details are given at the beginning of the questionnaire).

Animal Sciences Committee Portfolio Evaluation 2005

Survey of Current and Past Committee Members

Please return to Fiona Goff, preferably by email, by 22nd 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 Animal Sciences Committee (ASC)? E.g. are there any particular areas/communities missing?
2. How does the portfolio compare with other UK funders of animal sciences? E.g. is there overlap? Are there gaps in coverage?
3. What areas/opportunities may have been missed in the past? Why were they missed?
4. How helpful do you think the Committee Themes and Priority Areas are? (for current Themes and Priority Areas, see <http://www.bbsrc.ac.uk/science/areas/as.html>)

Achievements

5. What are ASC's key achievements over the past few years in terms of the support it has given to the animal sciences community? In other words, what difference has ASC made?
6. Who are the end users of ASC-supported research, and how are the results used?

7. How well has the research supported by ASC contributed to:

| | 4 (very well) | 3 | 2 | 1 (poorly) |
|--|--------------------------------|----------|----------|-----------------------------|
| Welfare, reduction and replacement of animals in experiments | | | | |
| Public engagement with bioscience | | | | |

Comments:

Industry

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

Extra questions for industrial members

- What is your perception of animal sciences research in the UK? Does your company want to do animal sciences research here?
- Does your company collaborate with BBSRC-funded research? If not, why?
- How easy is it to collaborate with BBSRC-funded research? How could we encourage more contact and collaboration?

Process and Management

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

10. Does the ASC work well as a team in reaching conclusions?

11. Do you have any comments on the fact that so many grants are not discussed at Committee meetings due to lack of time?

12. What do you think of the state of refereeing? How could it be improved?
13. Do you have any other comments on the Committee or the grant appraisal process?
14. What do you think of the final report grade system? How could it be improved?
15. What are your views on BBSRC's management of the grant appraisal process and management of the Committee?

Other

16. 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?
17. Do you have any other comments relevant to this evaluation?

Thank you, your contribution is much appreciated.

Please return this form by 22nd July (contact details are given at the top of the questionnaire).

Animal Sciences Portfolio Evaluation 2005

Survey of UK Funders

*Please answer as many questions as you can, and return to Fiona Goff, preferably by email, by **14th September**. 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 Animal Sciences Committee's remit compare with your remit in this scientific area? E.g. areas of overlap, gaps

2. What do you think of the ASC's remit and themes as described in the enclosed document? Does this remit adequately cover BBSRC funded research in the Animal Sciences area?

3. Do our current priorities (see enclosed document) reflect the major research needs in the area?

4. Are the boundaries between our two organisation's remits 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) ASC's remit that you receive many proposals for but cannot fund?

6. Are there areas relevant to your organisation within ASC'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 Animal Sciences 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 are 3 years in length, with 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 Animal Sciences research community? Are there any barriers to joint working between your organisation and ASC?

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

*Thank you, your contribution is much appreciated.
 Please return this form by 14th September (contact details are given at the beginning of the questionnaire).*

LIST OF SAMPLED GRANTS

Completed grants

1. A search for physiologically active insulin-like regulators of metabolism in *Locusta*
2. A study of the associative mechanisms underlying conditional learning
3. A study of the spinal mechanisms regulating the pathophysiology of inflammatory hyperalgesia in sheep
4. A tapeworm molecule that manipulates insect reproduction
5. Adaptability of an insect herbivore, the diamondback moth, to changes in its nutritional environment
6. Adaptive coloration and visual perception in the cuttlefish, *Sepia officinalis*
7. Adaptive specialisation of memory
8. An investigation using converging methodologies to resolve theoretical and empirical controversies in the study of selection-for-action
9. Analysis of the proteome of tachyzoites and bradyzoites of *Toxoplasma gondii*
10. Attentional functions of the thalamic reticular nucleus
11. Avian rhinotracheitis virus (ARTV): identification of protection-inducing proteins and mechanisms of variation within them
12. Avian UV vision and sexual selection
13. Behavioural and neurological investigation of social and object recognition abilities in sheep and their relationship to motivation and effect
14. Cerebellum and associative motor learning - electrophysiological and anatomical analysis
15. Characterisation of human ovarian gonadotrophin surge- attenuating factor (GnSAF/IF)
16. Chemical and microbial ecology of the orthopteran gut
17. CNS gene expression in a mouse model of scrapie
18. Comparative study of spider silk extrusion systems
19. Computational fluid dynamic modelling of vortex wake generation and evolution in flying birds and bats
20. Control of oxytocin receptor gene expression
21. Dynamics of first and second-order spatial vision
22. Effects of peri-partum steroidal changes on local coordination and noradrenergic control of bursting in oxytocin neurones
23. Environmental and developmental effects on the prioritising and time-budgeting of behaviour
24. Exploration of the complex shape selectivity of visual cortical neurons by automated stimulus optimisation
25. Fine mapping of a quantitative trait locus with a major influence on murine growth
26. Fish and chips: Identifying and quantifying xenobiotic- induced alterations of gene expression in the brain and gonad
27. Functional analysis of *Haemonchus* and *Teladorsagia* GATA factors using *C. elegans* as a heterologous expression system
28. Functional genomics of ecdysteroid homeostasis in regulation of insect development
29. Fundamentals of second-order spatio-temporal vision
30. Gene expression profiles of CD4+T cells during chronic intestinal helminth infection
31. Generation of MHC class 1 tetramers for measuring CTL responses to RSV in infected and immunised cattle
32. Genetic and phenotypic determinants of nutrient demand and feeding behaviour in dairy cows
33. Genetic recombination of traits for protective immunity and drug-resistance in the protozoan, *Eimeria maxima* from the fowl

34. Genomic imprinting and olfactory function
35. The functional utility of colour vision: effects of polymorphism on behaviour in callitrichines (Platyrrhini)
36. Host and parasite interactions in *Xenopus* species
37. Identification of regulators of in vivo expressed genes of *Actinobacillus pleuropneumoniae*
38. Identification of regulatory mechanisms of protease gene expression as targets of parasitic nematode control
39. Identification of virulence genes in *Mycobacterium paratuberculosis* by allelic exchange
40. Immunological memory: An analysis of antigen specific CD4 memory T cells
41. Interactions between bacterial and host factors in the pathogenesis of *Streptococcus suis* in the pig
42. Interactions between short-term verbal memory, rhythm and timing: connectionist modelling and psychological experiment
43. Interleukin 1beta: a comparative study of gene structure and function
44. Investigation of macrophage responses to African swine fever virus infection using a porcine cDNA microarray
45. Leydig cell differentiation and development
46. Maturation of intraepithelial lymphocytes
47. Mechanisms of elementary motion detection in human vision
48. Mechanisms of inhibitory control in perceptuo-motor processing
49. Mechanotransduction mechanisms in fibroblasts
50. Modelling of foraging strategies in ants
51. Modelling the time course of word and object recognition memory
52. Molecular basis for the regulation of body weight in a seasonal animal model
53. Molecular basis of Th subset bias in intestinal nematode infections
54. Molecular dissection of the rotavirus entry process
55. Molecular mechanisms of non-self recognition and encapsulation in insects
56. Morphology and synaptic connections of physiologically characterised baroreceptive neurones in the nucleus tractus solitarius of the rat
57. Muscle power output during ballistic swimming in fish
58. Neural mechanisms of memory formation in imprinting
59. Neural mechanisms of sensory guidance - a study of visual flow field analysis in an invertebrate model system
60. Nonlinearities in early visual processing
61. Pathogenesis of mucosal papillomavirus infections
62. Perirhinal and postrhinal cortex: two cortical systems for visual learning in the rat
63. Physiological and ultrastructural study of the performance of synapses which transmit graded potentials
64. Principles of associative learning
65. Protective immunity in calves against haemorrhagic septicaemia conferred by an attenuated *aroA* mutant strain of *Pasteurella multocida* B:2
66. Proteomics: resolving the molecular dynamics of nematode drug resistance
67. Putting the *C. elegans* genome to work: a proteome model for studying the establishment of chronic parasitic nematode infections
68. Pyrogenicity and apoptosis-inducing activity of recombinant influenza viruses produced by reverse genetics
69. Recognition and assessment of chronic inflammatory pain in calves after castration and neuropathic pain in lambs after tail docking
70. Relationship between the tapasin, TAP and class I in humans and rats
71. Retrospective revaluation
72. Role of purinergic P2X7 receptors in the regulation of brain interleukin-1
73. Sensorimotor representation and manual action

74. Sex-ratios and sex-related survival, selection differentials and dispersal in nestling great tits
75. Sexual differentiation of the reproductive system in the opossum (*Monodelphis domestica*)
76. Signalling pathways modulating synaptic vesicle recycling in rat motor nerve terminals
77. Significance of divergent expression patterns of inhibin-A and inhibin-B during ovarian follicle development in hens
78. Social learning and lifeskills training in hatchery reared Atlantic Salmon
79. Social transmission of stereotypes and redirected behaviours
80. Structural and functional properties of insect voltage-gated sodium channels and their interactions with pyrethroids
81. Targeted cell ablation to study the role of cell-cell interaction in axon guidance
82. The cost of male displays: what is the energy cost of bird song?
83. The evolution and control of reproductive skew in eusocial mammals
84. The functions of repeated aggressive signals
85. The immunobiology of prions during peripheral scrapie pathogenesis
86. The mechanisms of sex ratio variation in birds
87. The molecular basis of emmetropisation. Identification of genes that regulate post-natal eye growth rate
88. The neural basis of executive functions
89. The neural mechanisms for switching between alternating activation and synchronous activation of antagonist motoneurons
90. The operation of the immune system in the intestine of a blood-sucking insect
91. The physiological roles of two *Drosophila* peptidases (*Ance* and *Acer*) in peptide hormone metabolism
92. The relationship of genetic diversity and virulence in the pig pathogen *Streptococcus suis*
93. The retinal connexions of mosquito eyes and the origins of neural superposition
94. The role of exogenous Jaagsiekte sheep retrovirus (JSRV) in the aetiology of sheep pulmonary adenomatosis
95. The role of neurohypophyseal peptides in sperm transport in the ram
96. The role of parasite acetylcholinesterases in *Dictyocaulus viviparus* infection in cattle
97. The role of peroxisomal proliferator-activated receptors in regulating lipid metabolism in fish
98. The role of the hippocampal system in perceptual learning
99. The role of titin in muscle: a gene targeting approach
100. The roles of CD40 and CD154 in haematopoiesis and immunological tolerance
101. The ultrastructure and mechanics of insect wing cuticles, analysed as fibrous composites
102. Type I interferon mediated defence in a natural gammaherpesvirus infection

Current grants

1. A large-scale experimental study of cultural transmission in chimpanzees
2. Age-related cognitive changes in healthy humans: influences from genetic variation in genes related to oxidative stress
3. An associative model of retrieval induced forgetting
4. An integrated proteomic and genetic approach to identify a novel axonal growth factor from developing *Xenopus* limbs
5. An investigation of TSE resistance mechanisms by genetic analysis of PrP binding protein genes
6. An optimisation model of the metabolic costs of bipedal and quadrupedal gaits

7. Are galaninergic systems involved in sexually differentiated aspects of reproductive neuroendocrinology in the ewe
8. Behavioural consequences of compensatory resource allocation during growth
9. Beyond reciprocity: developing new theories for the evolution of altruism
10. Biological function and cellular mechanism of action of bone morphogenetic protein-2 on pituitary gonadotrophs
11. Calcitonin gene related peptide, adrenomedullin and their receptor components in the peripheral microvasculature
12. Changes in follicular granulosa cell gene expression determined by SAGE during dominant follicle selection in cattle
13. Changes in information transmission at an auditory synapse in the binaural pathway during short-term synaptic modulation
14. Characterisation of bovine natural killer (NK) cells and their role in determining immune bias
15. Characterisation of gamma-herpesvirus genome maintenance proteins
16. Characterising high-level motion processing in humans
17. Characterising the role of APC phenotype and activation state in the induction of Th1/Th2 responses in vivo
18. Convergent evolution of integrated systems: vertebrate haemoglobins, their intracellular environment and whole animal function
19. Developmental dynamics, cell-cell, and cell-matrix interactions in the avian corneal stroma
20. Does subversion of Toll-like receptor signalling play a role in directing TH2 responses by the filarial nematode secreted product ES-62?
21. Echolocation in the fruit-bat *Rousettus aegyptiacus*: impulse biosonar, time constants and acoustic localisation
22. Function of intracellular calcium pools in renal transport: unravelling complexities using targeted calcium reporters
23. Functional genomics of homeostatic plasticity in phenotypically-defined hypothalamic neurons
24. Gene expression in the *Drosophila* testis
25. Genetic control of learning behaviour: Characterisation of downstream genes regulated by *zif/268*
26. Hierarchical brain processes in visual word recognition: a magnetic stimulation investigation
27. How do spinal L1 neurones expressing NK1 receptors alter following nerve injury or induction of inflammation?
28. How does uncoupling protein-3 affect skeletal muscle phenotype: small but strong?
29. Identification and characterisation of proteins that interact with the *Drosophila* sex determination transcription factor, *Fruitless*
30. Immunobiology of NKRP1 molecules
31. In vivo measurement of the synthesis rates of individual muscle proteins during wound healing
32. Integration of neurohormonal signalling mechanisms regulating energy balance in the arcuate nucleus in vitro
33. Integrative biology of mosquito-parasite interactions by RNAi-mediated reverse genetics in *Anopheles*
34. Interaction between hair bundles and the tectorial membrane in the control of cochlear sensitivity
35. Interaction of semantic and emotional representations in the processing of meaningful auditory stimuli
36. Investigation of differentially-regulated surface antigens in *Eimeria tenella*
37. Investigation of the utility of the TAT protein transduction domain for in Vivo siRNA delivery

38. Is melanopsin a genuine photopigment? Studies on its role in mediating light-driven melanin granule movement in *Xenopus laevis* melanophores
39. Long-term modulation of excitability in an identified neurone as a cellular mechanism of long-term associative memory
40. Mechanisms of ghrelin-induced adipogenesis
41. Mental time travel by Western scrub jays (*Aphelocoma coerulescens*)
42. Modelling neural responses in the central auditory pathway
43. Molecular studies of the crustacean innate immune system. Do immunostimulants really protect against infection?
44. Neural basis of a corollary discharge mechanism controlling auditory processing
45. Neural mechanisms of perceptual-mnemonic function in the rat perirhinal cortex
46. Paramyxoviruses interferons and virus:host cell protein:protein interactions
47. Potential novel role for a neuropeptide signalling system in the circadian clock
48. Proximate and ultimate causes of intraspecific colour variation in an avian ring species
49. Regulation of angiogenesis by DDAH and ADMA using genetic manipulation and in vivo MR imaging
50. Regulation of luteinisation and progesterone secretion in the bovine corpus luteum
51. Sex differences in post-natal vulnerability to poor embryonic conditions
52. Social cognition in rooks and jackdaws
53. Spike timing-dependent synaptic plasticity during network oscillations in the hippocampus in vitro
54. Structural and functional characterisation of the rat apelin receptor (APJR) gene
55. Targeting mutant connexin 26 genes to mouse epidermis: the role of gap junctions in epidermal structure and physiology
56. The acquisition and performance of visually guided routes in the wood ant
57. The biology of environmental mycobacterium bovis, and its significance to the epidemiology of bovine tuberculosis
58. The characterisation and functional role of novel estrogen receptors in the prosobranch mollusc *Marisa cornuarietis*
59. The development of a composite objective validated scale for assessing pain in dairy cows
60. The evolution of altruism as a display in nonhuman animals: cooperative helping as a signal
61. The hierarchical model of speech segmentation
62. The mechanics of locomotion on compliant limbs
63. The molecular physiology of anhydrobiosis in bdelloid rotifers
64. The neural and neurochemical basis of framing effects in human decision-making
65. The role of gaze in selective attention and face recognition in children
66. The role of the nuclear receptor cofactor NRIP1 in male fertility
67. Tick salivary gland fatty acid binding proteins
68. Viral and cellular factors which determine equine influenza virus receptor specificity and virion morphology
69. Viral RNA transcription and replication as determinants of virulence and host specificity in morbilliviruses

HIGHLIGHTS IDENTIFIED FROM THE SAMPLED GRANTS

The Panel reviewed the final reports of the sample grants and identified a number of highlights:

NEUROSCIENCE AND BEHAVIOUR

Highlights

Fish and chips: Identifying and quantifying xenobiotic- induced alterations of gene expression in the brain and gonad. This research identified the key genes that are regulated by low levels of ethinyloestradiol in the brains and gonads of zebra fish. The findings have important implications for the environment, for the plastics/paints industry and potentially on human as well as animal health and welfare. The work engaged both national and international stakeholders, e.g. DEFRA, US Environment Agency, Astra-Zeneca, and substantive further funding followed with national and international collaborations. The group also worked hard to bring the work to the public by, for example, media presentations, Royal Society summer exhibition, lectures in Schools and universities.

The physiological role of two *Drosophila* genes, Ance and Acer, in peptide hormone metabolism. The investigators used *Drosophila* as a model to identify potential new roles for angiotensin converting enzyme (ACE) in animals. The data represent a considerable advance, providing firm evidence that ACE (known as Ance in *Drosophila*) contributes to the processes regulating metamorphosis and spermatogenesis. The project led to a large number of publications and to data being lodged in a number of public access data bases. In addition, it triggered collaborative programmes with academic labs in Europe and the USA and with the pharmaceutical industry. In addition, the structural studies that this work triggered are expected to provide valuable information for the design of domain-specific inhibitors of human ACE and the recently identified ACE-like gene in cardiac muscle.

Behavioural and neurological investigations of social and object recognition in sheep and their relationship to motivation and affect. Although it has been claimed that complex face perception and recognition is uniquely human, by using a sophisticated mix of the behavioural and neurobiological procedures, this project demonstrated that sheep learn to recognize and remember a large number of individual sheep and human faces, capacities that depend upon same lateralized brain system as in humans. Moreover, the researchers found that sheep can assign emotional and motivational significance to individual faces. This was first class research in comparative cognition, and generated an impressive number of publications, including a Nature paper. The work also attracted considerable media attention.

Targeted cell ablation to study the role of cell-cell interaction in axon guidance. The investigators established a general method for direct gene expression in *Drosophila* using targeted cell ablation to study the role of cell-cell interaction in axon guidance. The work contributed to the development of new methodologies that were then exploited to direct expression of toxins to achieve targeted cellular ablation

and study axon growth. The researchers tested the role of specific cell-cell interaction to drive axon guidance, and identified the signalling molecules potentially involved. These findings have important implications for understanding brain development and for human as well as animal welfare. The team published a large number of papers as a result of this work, and established collaborations with groups in Europe and the US.

Genomic imprinting and olfactory function. This work was an excellent example of the value of an integrated approach to research questions. The researchers integrated neurobiology, genetics and behaviour techniques in an elegant investigation of the role of genomic imprinting in olfactory-directed behaviour in mammals. The team identified genetic mechanisms influencing postnatal behaviour in response to maternal cues. They provided evidence that F1 mice are more sensitive to and avoid odour maternal cues. The work also produced innovative animal models, and a continuing line of research. These findings are very relevant for animal welfare. The project produced excellent publications, and the group was active in training and in transferring their results to the public.

Physiological and ultrastructural study of the performance of synapses which transmit graded potentials. This was a particularly elegant physiological study combining physiology with ultrastructural studies to investigate the molecular basis of graded potentials transmitted by synapses. The group demonstrated through a variety of staining procedures that these synapses are operated by acetylcholine, thus implying that Ach can exert both inhibitory and excitatory function in the insect nervous system. These results added significantly to understanding of chemical transmission. Excellent scientific publications were produced, and the group leader made a number of presentations to the lay public.

Other notable grants

Functional genomics of ecdysteroid homeostasis in the regulation of insect development. This work characterised the enzymic regulation of ecdysteroid homeostasis during development in *Drosophila*, and made a number of important findings. The group also identified the cDNA encoding *Drosophila* ecdysteroid oxidase using a sophisticated approach involving bioinformatics/modelling and expression profile analysis and expression of potential genes. Three papers were published (including one in the Journal of Biological Chemistry), presentations at national and international meetings, and valuable vectors.

The evolution and control of reproductive skew in eusocial mammals. This field-based project was part of a larger, high-profile programme of research on the sociality of meercats and was specifically directed at the mechanisms by which reproduction is suppressed in sub-dominant females. An impressive series of published papers were written during the tenure of the project (including one in Science), and the meercat programme as a whole has had a significant scientific impact and attracted much media attention.

The role of the hippocampus in perceptual learning. This is an example of an excellent and highly productive New Investigator grant. Rather than yielding one key result, the project enhanced understanding of the function of the hippocampus by

testing its role in number of psychological functions by using a variety of techniques from behaviour to electrophysiology. The most important finding at the time was the dissociation of the role of the hippocampus in different processes mediating spatial navigation and learning in animals, which was published in Nature.

Role of purinergic P2X7 receptors in the regulation of brain interleukin-1:

Despite needing to change their approach during the grant, the group produced excellent publications and established a strong collaboration.

Cerebellum and associative motor learning - electrophysiological and anatomical analysis: This was outstanding research on motor learning.

Morphology and synaptic connections of physiologically characterised baroreceptive neurones in the nucleus tractus solitarius of the rat: This project was an elegant study of the physiology and morphological architecture of the nucleus of the solitary tract.

INTEGRATIVE ANIMAL PHYSIOLOGY

Highlights

Comparative study of spider silk extrusion systems. This research involved the study of spinning processes and the ultrastructure of silk in several spider species. A number of papers were published both in specialist and general journals, and the work attracted some media attention. The findings were used to optimise the manufacture of synthetic silk analogues, and a spin-out company was established.

Adaptability of an insect herbivore, the diamondback moth, to changes in its nutritional environment. This was an excellent example of the transition from basic research to application. The investigators found (unexpectedly) that the larvae of diamondback moths evolve the ability to eat more carbohydrate without laying it down as body fat. This finding led to a new hypothesis for human obesity and a number of follow on studies.

Computational fluid dynamic modelling of vortex wake generation and evolution in flying birds and bats. Researchers developed a range of computational models to compute and display the vortex wake of a bird in flapping flight and to model the airflow around the body. The work was published in prestigious journals in the field and also caught the public imagination via considerable media attention. A longer term deliverable may be the design of micro-air vehicles with high levels of aerodynamic performance and efficiency.

A study of spinal mechanisms regulating the pathophysiology of inflammatory hyperalgesia in sheep. This research involved comparing spinal cord gene expression levels in sheep following naturally occurring inflammatory disease and experimentally induced inflammation. The work identified a number of mechanisms that could potentially be targeted to provide novel pain treatments and improve animal welfare. The group also found that gene expression patterns in natural versus induced

pain were different, questioning the value of some experimental models of pain in this species.

Other notable grants

Structural and functional properties of insect voltage-gated sodium channels and their interactions with pyrethroids: This interdisciplinary research provided functional information on the molecular basis of resistance to a class of insecticides. The work was important both scientifically and commercially, and led to a number of good publications.

Identification of regulatory mechanisms of protease gene expression as targets of parasitic nematode control: This was a useful molecular study showing the way in which a model organism (*C.elegans*) could be used to study the control of parasite genes. The study identified an important regulatory element and a transcription factor from the parasite allowing the potential for novel control approaches to interfere specifically with parasite gene expression. The work led to a publication in a respected journal and information in public databases.

Fine mapping of a quantitative trait locus with a major influence on murine growth: This project reduced the unknown genetic contribution of Chromosome 1 to body size from a region containing hundreds of genes to a region containing tens of genes. It produced specialist publications and is a good example of progress in the longer-term endeavour to identify what determines mammalian growth.

MECHANISMS OF IMMUNE FUNCTION AND DISEASE PATHOGENESIS

Highlights

Molecular basis of Th subset bias in intestinal nematode infections. This research showed that induction of the Th2 bias in the immune response to parasites is directly initiated by the action of nematode proteins on dendritic cells, and that this does not require B-cell interactions. The findings were particularly important because they came before much of the information about dendritic cell activation through Toll receptors was known, and at a time when there was huge amounts of interest in how infections were recognised and mechanisms of induction of immunity.

Analysis of the proteome of tachyzoites and bradyzoites of *toxoplasma gondii*. The investigators applied evolving proteomic techniques to develop technologies for the analysis of *t.gondii*. They went on to characterise the proteomes of two life stages of this parasite, and identified individual proteins of parasitic stages based on this analysis. The work resulted in a good range of publications, and was notable for its spin-off training of personnel and public engagement.

Putting the *C. elegans* genome to work: a proteome model for studying the establishment of chronic parasitic nematode infections. This research on the parasite *H. polygyrus* characterised the proteomes and individual proteins that are involved in the parasite's response to its host's environment. The research produced

good outputs in terms of publications, achievement of aims, generation of resources for the community, training and public engagement.

Other notable grants

The immunobiology of prions during peripheral scrapie pathogenesis: This group was one of the first to show the presence of PrP^{Sc} in animals without clinical disease at levels comparable to animals with disease, and how inflammation from secondary infections may precipitate clinical disease. This has implications for public health and the presence of BSE agent in sub-clinically infected cattle.

Gene expression profiles of CD⁴⁺ T cells during chronic intestinal helminth infection: This project investigated the whole gut response to helminth infection using microarray technology in a mouse model. The results showed that one of the differences between resistant and susceptible strains of mice is expression of intelectin by the gut epithelial cell compartment. This suggests that local cells as well as immune cells are important in expulsion of helminth infections, and provides novel targets for investigation which may prove important in development of new therapeutic strategies against human helminth infections.

The operation of the immune system in the intestine of a blood-sucking insect: This study investigated the expression and function of insect defensins in the gut. The group showed that the defensins are associated with a serine protease in the tissue but when secreted into the gut lumen are released in an active form. This is of intrinsic interest for innate immunologists working in any species, and may also contribute to the development of insect control strategies.

Generation of MHC class 1 tetramers for measuring CTL responses to RSV in infected and immunised cattle: The group identified peptide epitopes in bovine RSV presented by specific cattle class I MHC alleles and used this to develop MHC tetramer staining. This allowed the researchers to analyse the antigen specific T cell response to bovine RSV in its natural host in a very precise fashion. This is the first time that this has been done outside mice and primates, and will allow detailed analysis of T cell responses to both infection and vaccination in species other than mice and humans.

Identification of regulators of in vivo expressed genes of *Actinobacillus pleuropneumoniae*: This work involved making plasmid constructs for use in the identification of regulators of gene expression *in vivo* in *Actinobacillus*. As these regulators may be central virulence factors in *Actinobacillus*, identifying them and understanding their role in pathogenesis may lead to the development of new therapeutic strategies or attenuated vaccines.

Genetic recombination of traits for protective immunity and drug-resistance in the protozoan, *Eimeria maxima* from the fowl: The group used sexual genetic recombination to select for protective antigenic determinants linked to drug resistance in *Eimeria*. The work led to the development of a tool to select strains expressing interesting antigenic determinants for induction of protective immunity in the host.

SURVEY RESULTS AND ANALYSIS

Contents

| | |
|--|----|
| 1. Introduction..... | 61 |
| 2. Research outputs and achievements..... | 62 |
| 2.1 Committee’s achievements | 62 |
| 2.2 Increased scientific knowledge and awareness..... | 63 |
| 2.3 New collaborations and further funding for research | 65 |
| 2.4 Trained people, increased skills | 66 |
| 2.5 New products, processes, tools and technologies | 68 |
| 2.6 New intellectual property, spin out companies..... | 68 |
| 2.7 Contribution to the reduction, refinement and replacement of animals in experiments..... | 68 |
| 2.8 Success of grants in meeting objectives..... | 69 |
| 3. Balance and coverage of the portfolio | 73 |
| 3.1 Overview | 73 |
| 3.2 Coverage | 73 |
| 3.3 Priority Areas | 75 |
| 3.4 Interdisciplinarity..... | 76 |
| 3.5 Comparison with other UK funders | 76 |
| 3.6 International comparison | 78 |
| 4. Interaction with industry | 81 |
| 4.1 Overview..... | 81 |
| 4.2 Support at outset | 81 |
| 4.3 Involvement as a result of the grant..... | 81 |
| 5. Public engagement | 82 |
| 6. Ultimate impacts | 83 |
| 6.1 Contribution to the ‘public good’ | 83 |
| 6.2 Income to the research community and to UK plc | 83 |
| 6.3 UK ranking in animal sciences | 83 |
| 6.4 Responses from Defra and SEERAD | 85 |

1. INTRODUCTION

1. This paper reports the results and analysis of the surveys conducted for the evaluation of the Animal Sciences Committee responsive mode portfolio. As outlined in the main paper, the results are drawn from a surveys of current and past grantholders, current and past Committee members (serving over the last five years), and other funding organisations. Response statistics are summarised below:

| Survey | No. responses | Response rate | % of total |
|---------------------------|---------------|---------------|---|
| Completed grants | 102 | 70% | 35% of all completed grants |
| Current grants | 69 | 72% | 29% of all current grants |
| Past Committee members | 2 | 13% | 13% of past Committee members (1999-2004) |
| Current Committee members | 8 | 50% | 50% of current Committee members |

2. Questionnaires were received from the following UK funding bodies:
 - Research Councils: Engineering and Physical Sciences Research Council (EPSRC), Medical Research Council (MRC) and Natural Environment Research Council (NERC);
 - Government bodies: Department for the Environment, Food and Rural Affairs (Defra), Scottish Executive Environment and Rural Affairs Department (SEERAD);
 - Charities: Cancer Research UK (CRUK) and Wellcome Trust; and
 - Other: National Centre for the Replacement, Refinement and Reduction of Animals in Research (NC3Rs).
3. To inform the Panel's discussion on contribution to the public good, Defra and SEERAD were also asked to comment on the extent to which ASC-supported research contributes to the departmental science strategy and research and to the development of policy.
4. Relevant information from BBSRC's grants databases and the final reports submitted by the PIs of sample completed grants were also made available.

A note on using the data

5. 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, it should be nevertheless be borne in mind that these are only samples.
6. Respondents were given options to tick in some of the questions, whereas other questions were open-ended. Responses to open-ended questions are marked in the report as 'unprompted'. Representative quotes from respondents are included where appropriate.

2. RESEARCH OUTPUTS AND ACHIEVEMENTS

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

2.1 Committee's achievements

8. **73%** of the sampled PIs felt that the ASC is achieving its aim “to support basic and strategic work on animal function at the level of tissues and systems”. Only **2%** responded that it is not doing at all well.

“The Committee supports high quality research within the constraints of its budget.”

Grantholder

9. Committee members were clear that the key role of the Committee is to support the best UK science through ensuring the most appropriate and fair allocation of BBSRC's resources. All of them said that the Committee works very well as a team, and that there is robust discussion of difficult cases.

“I was immensely impressed by how the ASC worked. It was professional, fair and utterly scrupulous.”

Committee member

10. When asked to identify specific achievements over the past five years, Committee members identified a) areas and occasions where ASC was the only funder providing support, and b) the Committee's research initiatives:
- Supporting the application of emerging sciences to animal research e.g. proteomics, genomics, making them accessible to a broad community;
 - ASC is the only source of funding for livestock/animal genomics. This area is crucial to UK competitiveness in livestock genetics/disease resistance work, and ASC's support has probably put the UK at forefront of this work worldwide;
 - ASC was [at the time] the only source of funding for insect physiology, mechanisms of animal infection, and animal welfare;
 - ASC was the only source of funding for several crucial research areas when other funders made significant funding cuts;
 - The Committee's main achievement is to provide support for basic research, some of which, after a long lead time, has gone on to be very high impact;
 - Post genomics – the Genomics in Animal Function initiative (GAIN, which reinvigorated the whole science of animal physiology); and the Investigating Gene Function initiative (IGF);
 - Brain sciences - the Integrated Analysis of Brain and Behaviour initiative (IABB); and
 - Animal disease – the Combating Animal Diseases of Livestock initiative, which was of great scientific and political importance.

11. When asked whether the grant had supported their wider research aims, **23%** of PIs said that the grant had provided funding for activities that other bodies would not fund.

2.2 Increased scientific knowledge and awareness

General

12. When asked whether the grant had supported their wider research aims, **78%** of the sampled PIs said it had enabled extension of their research into new areas, and **42%** said that the grant had helped to publicise the importance of their field of research.

“This funding was absolutely critical to me making the leap to a more international profile and to establishing new techniques and models in the lab.”

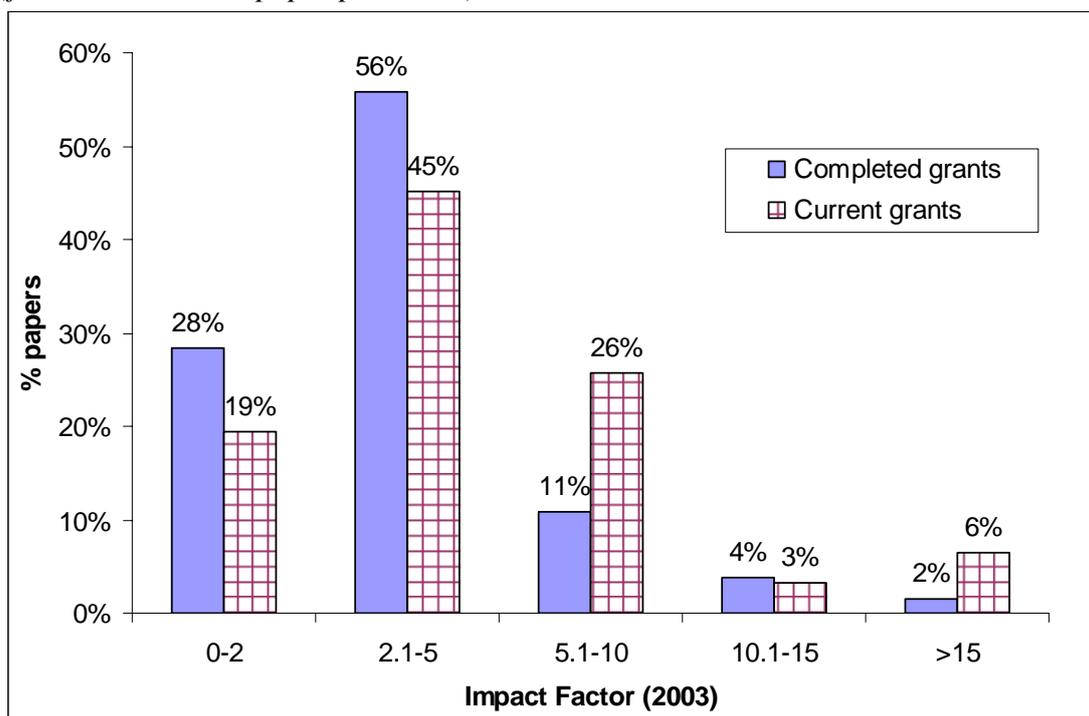
Grantholder

Publications

13. PIs were asked to list publications in peer reviewed journals arising as a direct result of the research supported by the grant. In total (of the 171 questionnaire responses received), **604** papers had been published in **236** peer reviewed journals. Completed grants had a median of **four** peer-reviewed publications per grant for sampled completed grants¹. The publication rate for current grants, as would be expected, was much lower, with a median of **0**, and an average of **1.6** (the majority of PIs had not yet published, a few reported large numbers of publications). **21%** of the papers had co-authors based overseas.
14. **6%** (38) of the papers were in journals with an Impact Factor greater than 10, including Current Biology (7 papers in total), Nature (6), Trends in Ecology & Evolution (6) and Trends in Neurosciences (3).
15. As an illustration of the quality of journals used, Figure 1 shows the distribution of papers published by the Impact Factor of the journals used.

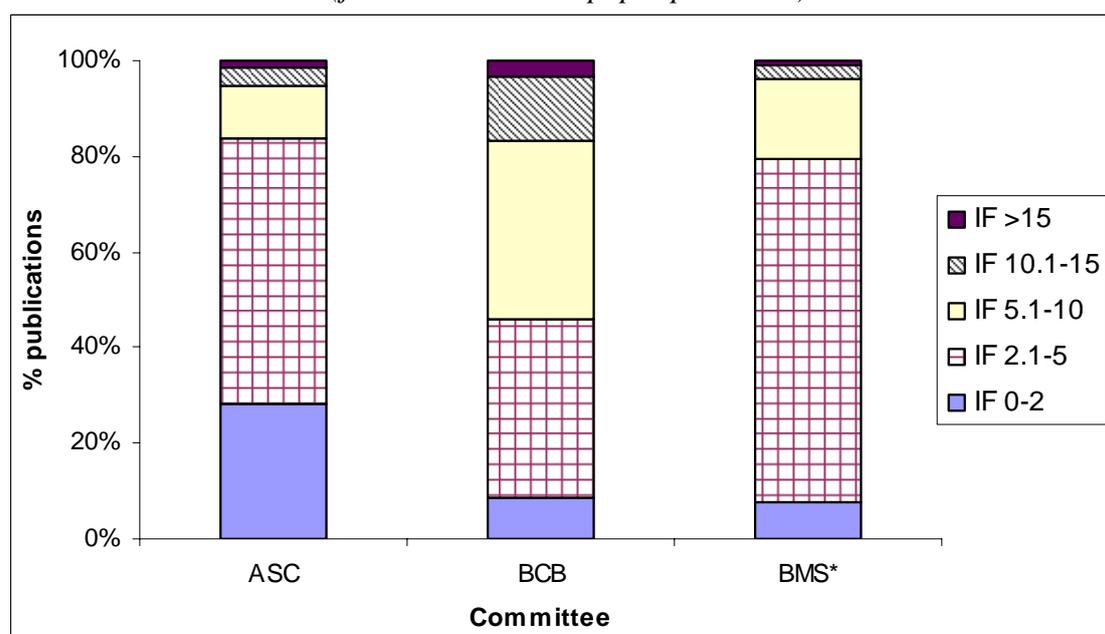
¹ The median is used because the distribution of papers per grant is left-skewed: the majority of grants lead to the publication of 0-6 papers, but a small proportion resulted in larger numbers of papers, with a maximum of 21. The average per grant was 4.8.

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



16. To provide some context, this data can be compared with the results of the PI surveys conducted for the recent evaluations of BBSRC's Biochemistry and Cell Biology (BCB) and Biomolecular Sciences (BMS) Committees' responsive mode portfolios:

Figure 2: Comparison of the distribution of papers by Impact Factor of journal across three Committees (journals where >1 paper published)



* The BMS evaluation excluded the structural biology portion of the portfolio, where in the past many grants have lead to publications in high Impact Factor journals

17. The journals most frequently reported by the sampled ASC PIs were: Journal of Experimental Biology (25 papers), Animal Behaviour (16), Proceedings of the Royal Society of London B (15), Quarterly Journal of Experimental Psychology B (13), Vision Research (13), and Journal of Experimental Psychology: Animal Behaviour Processes (10).

Publishing strategy

18. PIs were asked if they had adopted a publishing strategy for their research. Of the options given, the majority (**64%**) 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. **32%** said that they target the most appropriate journals for their area of science, only **4%** target the highest profile general journals. No PIs selected the option ‘target journals where I can get my results published quickly’.

“My general strategy is to go for the best journal that I think will accept the paper.”

“It takes much longer to get the research into high impact journals. As a consequence the publications won’t be published by the time we wish to renew the grant.”

Grantholders

2.3 New collaborations and further funding for research

New collaborations

19. Over half of sampled PIs reported that the research funded by the grant had helped to establish or strengthen academic contacts:

| Type of contact/collaboration | | Proportion of PIs |
|--|----------|--------------------------|
| Base (all sampled PIs) | | 171 |
| New or improved academic contacts | UK | 60% |
| | Overseas | 59% |
| New formal academic research collaboration (e.g. joint publication, joint funding application) | UK | 40% |
| | Overseas | 33% |

20. **16%** of PIs had established or strengthened cross-disciplinary contacts or collaborations, across a range of disciplines (including genetics, biochemistry, chemistry, medicine, neuroscience, optoelectronics).

Further funding

21. **30%** of the PIs of completed grants had received further funds through the ASC to continue or develop the work supported by the grant. **25%** had applied to ASC but their proposal had not been funded, and **22%** reported that their research priorities had changed. Only **7%** selected the option that funding is more accessible from other sources (including Wellcome Trust, MRC, EPSRC), and only **1%** that the area of science was not covered by ASC’s remit. In comparison, 24% of PIs surveyed as part of the Biochemistry and

Cell Biology Committee portfolio evaluation said that funding is more accessible from other sources.

22. When asked about further funding from other organisations, **17%** of the sampled completed grants PIs had received one or more follow on grants related to the work from nine different funding bodies, including from Wellcome Trust (7 PIs), NERC (4), EU (3) and Defra (2). Two PIs had received follow on grants from another BBSRC Committee, both from the Agrifood Committee. In comparison, 44% of the surveyed BCB PIs reported securing funding from 16 other funding bodies.

2.4 Trained people, increased skills

Staff employed on grants

23. When asked how the grant had supported their wider research aims, **68%** of PIs ticked the option ‘strengthened the skill base of my group’.
24. PIs of completed grants were asked for details of the staff employed on their grant. Of the 100 PIs who gave staff information, **95%** had one RA, **2%** had two. **3%** of the grants had only supported a research technician position. **91%** of the RA positions were RA1A, the remainder RA1B. Almost all of the RAs had been contracted full time on the grant for three years.
25. **53% of grants** employing RAs had an RA on their first postdoctoral research project. This equates to **47% of all RAs employed** on the sampled grants (12 grants had a change of RA part way through, so the total number of staff employed is 112). Both of these figures may be considered to be fairly high, and indicative either of an expanding sector, or a high turnover of RAs. **5%** of PIs made unprompted comments that BBSRC’s Research Committees in some cases cut the budget of the award, requiring PIs to recruit RAs at a lower grade than they had applied for, and that this can be detrimental to the success of the grant.²
26. **30% of sampled grants** had employed 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). This equates to **29% of RAs employed** on sampled grants. This 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) | 52 | 60 | 112 |
| Recruited | 38% | 33% | 71% |
| Named Researcher | 9% | 20% | 29% |
| Total | 47% | 53% | 100% |

² BBSRC’s rule over most of the last 10 years has been that unnamed RAs were funded at spine point 6 unless a very good case was made for funding at a higher level. Usually, the case would need to be that it was not possible to recruit at Sppt 6. This ruling has been relaxed to some extent more recently, especially in areas where it is generally recognised that recruitment is a problem. The move to Full Economic Costing may also impact on this.

27. **43%** of the sampled grants supported research technicians, generally for the full three years but in a part time role (contracted for an average of 60% of the time).
28. **12%** of completed grants had a change of RA during the grant, whereas only **2%** had had a change of research technician. Staff issues such as this, and the impact that they have on the success of grants are discussed further in section 2.8.
29. PIs were also asked for the first destination of the staff employed on the grant:

| First destination | RA | Research technician |
|---|-----|---------------------|
| Base (no. staff recruited) | 112 | 45 |
| Fixed-term in an academic institution elsewhere | 31% | 11% |
| Remained in my lab | 26% | 47% |
| Permanent in an academic institution elsewhere | 12% | 2% |
| Private sector, industry or commerce | 10% | 11% |
| Government or other public sector | 4% | 4% |
| Further training (excl. teaching) | 4% | 0 |
| Not employed | 3% | 2% |
| Teaching or teacher training | 2% | 4% |
| Other employment | 1% | 13% |
| Overseas* | 6% | 2% |

* Likely to be a significant underestimate

30. The proportion of research technicians leaving the lab and leaving academia appears to be fairly high given that technicians are often employed on permanent contracts.

Researchers at an early stage in their careers

31. **32%** of PIs said that the grant had helped them to establish their lab.

“As a new lecturer, this project was my first Research Council-supported grant and, as such, it acted as a springboard to all my subsequent research activities in this area.

Grantholder

32. A total of **83** New Investigator (NI) grants were awarded through ASC during the evaluation period. **21%** of the NI grants starting in 2000 to 2005 were awarded through the ASC (for comparison, ASC awarded **17%** of all responsive mode grants starting the same period).
33. Two proxies are used to examine the success of the sampled New Investigator grants: final report grades and number of peer reviewed publications reported in the questionnaire. By both measures, New Investigator grants are slightly more successful than average:

| Measure of success | New Investigator grants | Whole sample |
|---|-------------------------|------------------|
| % Graded A or B (all sample grants) | 75% (n = 12) | 66% (n = 146) |
| Average no. publications reported in questionnaire (grants with returned questionnaires only) | 7.7 (n = 7) | 4.8 (n = 102) |

2.5 New products, processes, tools and technologies

34. **27%** of PIs reported new products, processes, tools or technologies that had or could result from the work supported by this grant. These outputs are very varied (reflecting the breadth of the ASC portfolio), ranging from molecular outputs to cell clones to animal welfare developments.
35. **46%** of those reporting new products, processes, tools or technologies said that the output was potentially commercially exploitable (**12%** of all sampled grants).

2.6 New intellectual property, spin out companies

36. Six PIs (**5%**) reported securing intellectual property (all in the form of patents) as a result of the work supported by the grant, with a further five (**4%**) likely to apply in the near future. One of the patents had been licensed to another company. As a comparison, 11% of the surveyed PIs supported through the Biochemistry and Cell Biology Committee (BCB) reported securing intellectual property, and 4% of surveyed PIs supported through the Biomolecular Sciences Committee (BMS).
37. Three spin out companies had been established from the research supported by the grant, two of which are currently trading. Another company was in the process of being set up. Again, to put this in context, 2% of the sampled BCB grants had established spin out companies, and 9% of sampled BMS grants.

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

38. When asked whether any other outcomes arose from the research supported by this grant, **21%** of PIs ticked the option 'contribution to the reduction, refinement and refinement of animals in experiments'. The details given encompass the range of welfare, replacement and refinement, related to disease, physiology and animal welfare in a number of different species.
39. Committee members were divided in their opinions on the impact of ASC-supported research on animal welfare. Four members indicated that research supported by ASC had contributed to the welfare, replacement and refinement of animals in experiments (4 or 3 on a 4-1 scale), but five answered that the contribution had been less good (2 or 1 on the scale).

40. Four Committee members commented that few applications for animal welfare research come to the Committee, and that these are generally of poor quality. Although it is BBSRC policy to promote animal welfare, one Committee member commented that BBSRC should not overemphasise this area, as ‘there are already enough Home Office barriers to animal experimentation’; another commented that this is a difficult area mostly beyond the control of ASC.

2.8 Success of grants in meeting objectives

Overview

41. 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.
42. There are two sources of data: final report grades, and PIs 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 similar, and show that the majority of projects did achieve their objectives:
- **72%** of ASC grants completed since September 1994 scored A or B³ for their final reports (on a scale of A to D); and
 - **73%** of PIs of the sampled completed grants and **87%** of PIs of sampled current grants felt that their project has been successful.
43. Analysis of final report grades over time seems to indicate a slight downward trend in overall success, but this is not reflected by the assessment by PIs of whether their projects were meeting their objectives.
44. PIs were given a number of options as to why their projects had been less successful, many ticked multiple options:

| Reason | Proportion of: | |
|--|---|-----------------|
| | PIs indicating that their grants had been less successful | all sampled PIs |
| Base | 33 | 171 |
| Experimental/methodological issues | 48% | 11% |
| Staff issues | 42% | 9% |
| The research objectives changed due to new information or after initial findings | 24% | 5% |
| Unrealistic objectives | 12% | 3% |
| Lack of resources e.g. funding, equipment | 9% | 2% |

³ A is defined as ‘very high class work that has produced results of considerable scientific importance in a cost effective way, and met all of almost all of the agreed or related key objectives’.
B is defined as ‘work that has added significantly to knowledge in the field and met the majority of its agreed or related key objectives’.

Skills and staff issues

45. **32%** of sampled PIs reported difficulties in recruiting staff to undertake the research, or major staff issues during the grant. Of the remainder, **38%** reported no difficulties in recruitment or staff issues during the grant, and **30%** had a Named Researcher on their grant application and therefore had not had to recruit. The most frequent comments given by those reporting difficulties were that it was difficult to find someone with the necessary qualifications (**12%** of sampled PIs), and that staff either left or temporarily stopped work during the grant, leading to delays (**8%**). **4%** of PIs added that although they had had no problems this time, recruitment is usually difficult.
46. Although the dataset is small, analysing the data by the discipline of the PI (see section 3.2 for explanation of how PIs were divided into disciplines) appears to highlight particular issues in the fields of veterinary medicine, animal disease, and immunology, where 40-50% of PIs reported difficulties in recruitment or major staff issues during the grant.
47. PIs were asked to rank how closely the skills of their RA matched the needs of the project. Excluding the 30% of grants that had Named Researchers (where the RA already works in the lab) **73%** of PIs reported that the RAs that they recruited were a good match to the required skills:

| | 4 (close match) | 3 | 2 | 1 (significant training required) |
|------------------|---------------------------|------------|------------|---|
| Completed grants | 45% | 30% | 22% | 6% |
| Current grants | 29% | 40% | 21% | 10% |
| Total | 39% | 34% | 21% | 8% |

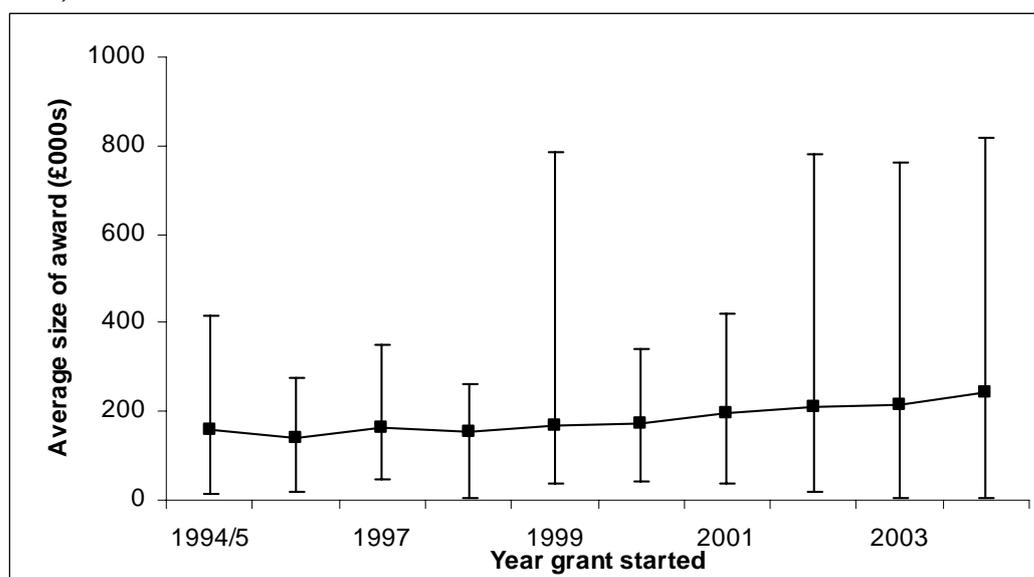
48. These results can also be broken down according to discipline. This analysis indicates less closely matched skills in the fields of animal disease and veterinary medicine. There were no major messages from PIs on particular areas where skills are lacking.
49. It is also relevant to note here that, following the Roberts review of the supply of scientists and engineers in the UK, BBSRC awards enhanced salaries to Research Assistants in areas identified as needing a greater skills base. BBSRC's current priority areas for RAs are:
- Stem cells: posts which involve identifying, isolating, culturing and/or handling stem cells, *in vivo* or in culture;
 - Epigenetics: posts which are primarily or substantially about identifying or understanding the action of epigenetic factors in gene expression;
 - Proteomics: posts involving developing technologies/tools for proteomics and the analysis of proteomics data, conducting high throughput proteome analyses, or interpreting data from such experiments;
 - Bioinformatics and e-science: posts involving the application of informatics or computing knowledge to the handling and interpretation of biological data, or the development of tools for doing this;
 - Industrial partnership awards: RA posts on IPA awards; and

- Physical sciences interface: posts where the RA is working at the interface between biology and physical sciences or engineering and is required to have some significant engagement with both.

Size and length of grants

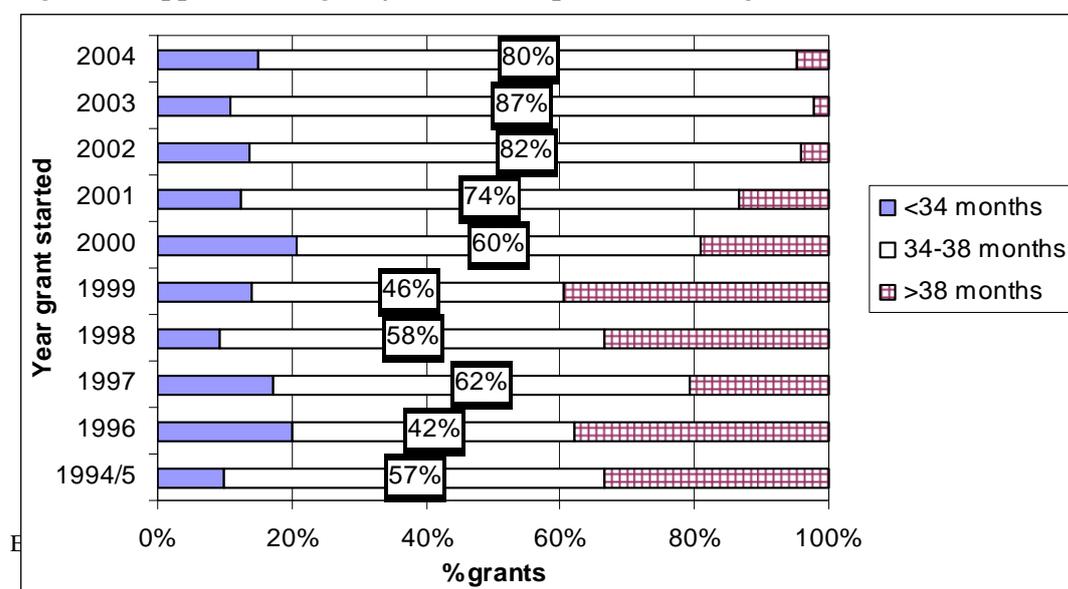
50. The average size of ASC responsive mode grants over the evaluation period was £188,000, slightly lower than the average for all BBSRC responsive mode grants over the same period (£204,000). Responsive mode grants have been slightly increasing in size over the past few years (although obviously inflation has also played a role):

Figure 3: Size of award (all ASC responsive mode grants starting September 1994 – 2004)



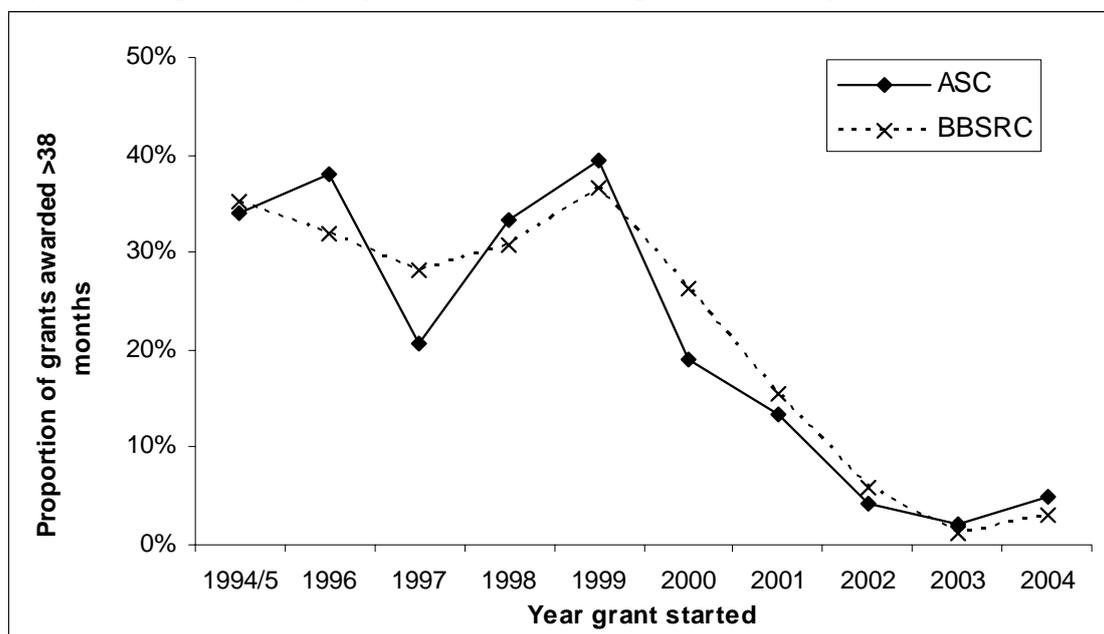
51. The ASC has been awarding increasing numbers of large grants in recent years, with 12 grants of £500,000 to £1 million awarded over the last five years (this number is slightly above the average for all BBSRC Committees).
52. There has been a significant decline in the proportion of longer grants in recent years, but no particular trend for short grants:

Figure 4: Approved length of all ASC responsive mode grants



53. This decline in longer grants mirrors the trend for BBSRC responsive mode grants in general:

Figure 5: Proportion of longer (>38 months) responsive mode grants awarded



54. Except for Cancer Research UK (CRUK) and SEERAD, the other UK funders surveyed confirmed that while they fund grants of a range of lengths, the majority of their grants are three years in length. CRUK funds responsive mode grants ranging up to five years in duration. MRC and the Wellcome Trust both also support longer term grants (e.g. programme grants), which tend to be for five years. SEERAD, in contrast, reported that it funds large programmes (£1-2 million per year) containing several work packages.
55. 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 is slowly starting to see a change. CRUK commented that given the resources required to conduct some of the research supported by ASC, they were surprised that the research is not concentrated more in larger centres with shared resources [note: BBSRC's Core Strategic Grants to Institutes do provide this larger, longer term support]. SEERAD added that larger teams (and grants) are required to deliver inter-disciplinary research.

3. BALANCE AND COVERAGE OF THE PORTFOLIO

3.1 Overview

56. The main message from the surveys is that ASC's remit is very broad. The majority see this as a strong point of the Committee, with only **2%** of PIs commenting that it is too broad.

“There is no other Committee that makes the whole animal kingdom its area of interest. This needs to be preserved.”

Committee member

57. These comments are backed up by the fact that **92%** of PIs reported that they did not have to significantly change the direction of their research to fit their application to ASC's remit.
58. Three of the ten Committee members surveyed noted that the breadth of the Committee's remit can be problematic as the Committee sometimes has to rely on the expertise of only one or two individuals to appraise an application.
59. When asked a general question about the operation of the Committee, the following unprompted comments were made:
- The remit should be kept broad and general; ring fenced funds are too restrictive (**12%** of PIs who made comments);
 - Basic research is important and should be supported (**10%**); and
 - There is too much emphasis on applied/strategic research (**8%**).
60. When asked for their opinion, the other funders generally felt that ASC's remit and themes are appropriate, and fairly comprehensive. Defra welcomed ASC's priority areas in animal welfare and the control of infectious diseases, but felt that as there has been little increase in activity in these areas, a more proactive approach may be required. EPSRC identified biomimetics as a specific gap, and added that it would expect to see more emphasis on systems biology, given its relevance to animal sciences research. SEERAD identified a possible gap in funding for basic, hypothesis driven studies of immunity, pathogenesis and pathogen biology of the UK's non-notifiable endemic livestock diseases, which are not covered by SEERAD or Defra funding [although it should be noted that some of the research supported by BBSRC's Core Strategic Grants to Institutes falls in this area].

3.2 Coverage

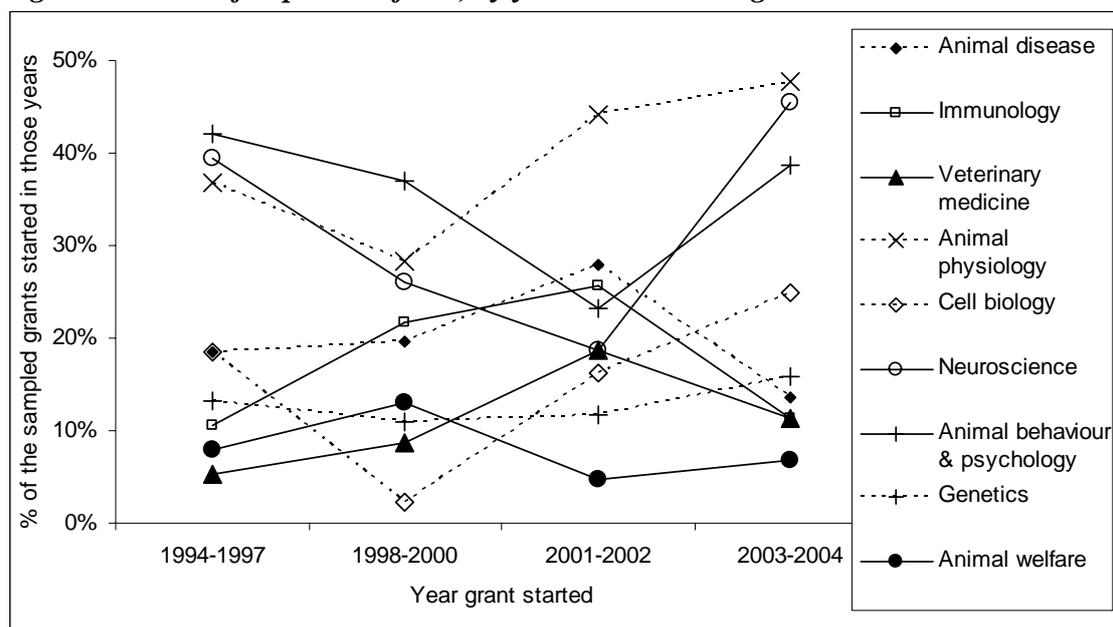
61. PIs were asked to indicate their areas of expertise against a list of 24 areas covering ASC's remit. To facilitate further analysis, these areas were then organised (merging related smaller categories) into 12 discipline areas. The table below shows the proportion of PIs falling into each category.

| Discipline area | Completed | Current | Total |
|-------------------------------|-----------|---------|------------|
| Base (all sampled PIs) | 102 | 69 | 171 |
| Animal physiology | 31% | 51% | 39% |
| Animal behaviour & psychology | 36% | 35% | 35% |
| Neuroscience | 29% | 38% | 32% |
| Animal disease | 25% | 13% | 20% |
| Immunology | 21% | 13% | 18% |
| Cell biology | 11% | 22% | 15% |
| Genetics | 14% | 12% | 13% |
| Veterinary medicine | 12% | 10% | 11% |
| Animal welfare | 10% | 6% | 8% |
| Biomathematics | 5% | 3% | 4% |
| Epidemiology | 2% | 3% | 2% |
| Other | 10% | 10% | 10% |

Note: many respondents ticked multiple categories

62. 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. It should be borne in mind, however, that the data indicates the expertise of the PIs, not necessarily the subject area of the grant.

Figure 6: Areas of expertise of PIs, by year in which the grant started



63. **56%** of PIs felt that their area of expertise is well supported by the Committee, only **11%** felt that it is not at all well supported. The proportion feeling well supported is higher for current PIs (**62%**) than for completed PIs (**52%**).
64. The data show a similar picture when broken down by area of expertise, with only cell biology and immunology consistently having over a third of PIs being less satisfied. The breakdown by area of expertise of PIs' answers to the

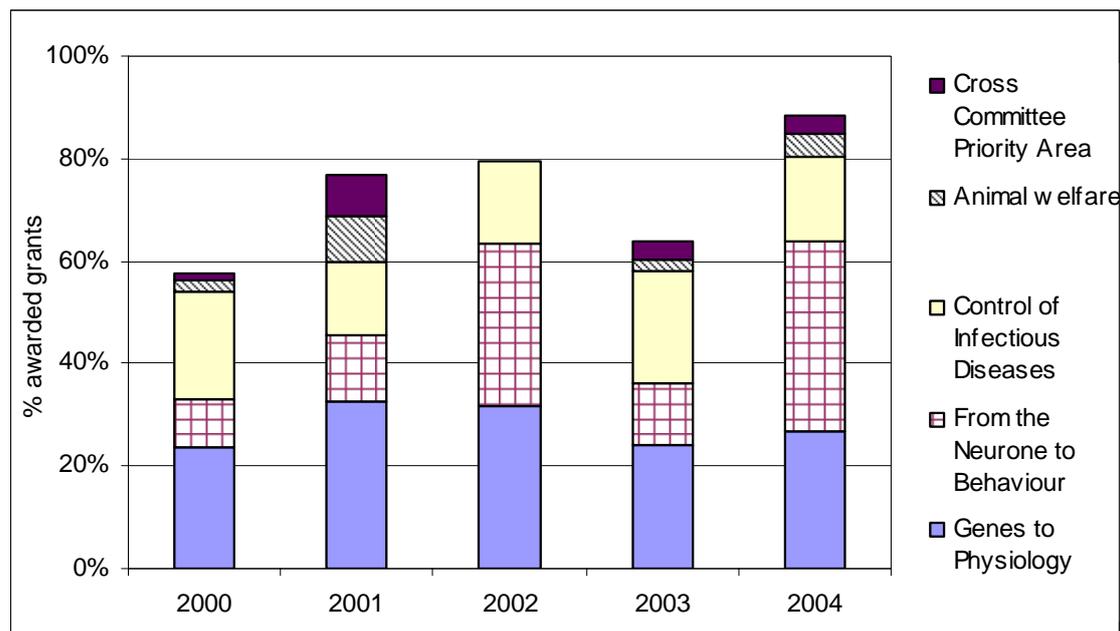
question ‘is the ASC achieving its aim’ is very similar, only immunology stands out as over a third of PIs being less satisfied.

65. When asked about the coverage of the portfolio, the majority of Committee members said it was fine or appropriate, adding that it is very broad. A number of areas were identified as needing more support, but each by only one member: functional imaging; pathogen genome sequencing; tropical disease; and theoretical biology.
66. Several Committee members noted that ASC’s remit overlaps with other BBSRC Committees (Agri-food, Biochemistry and Cell Biology, Genes and Developmental Biology, Plant and Microbial Sciences), but only one felt that this overlap causes confusion.

3.3 Priority Areas

67. In Animal Sciences, the proportion of grants within Priority Areas has been steadily increasing over recent years (with the exception of 2003, see Figure 7). In 2004, only **12%** of grants were not in a PA. For this reason, the Committee considers that the current PAs have served their purpose, and has decided to revise them.

Figure 7: Grants in Animal Sciences and Cross-Committee Priority Areas



68. PAs are intended to encourage applications in particular areas, rather than to influence the way in which applications are appraised. The most important criterion in the appraisal is scientific excellence, but the other criteria of strategic relevance (which includes fit to PAs), prosperity & quality of life, timeliness and promise, and cost effectiveness contribute to the final prioritisation. In practice, this is mainly used where grants of comparable scientific excellence are being prioritised.

69. Data from the most recent grant rounds indicate that, in ASC, there was a slightly higher success rate for applications within the Committee's PAs (**25%**) than for those outside PAs (**20%**). **19%** of the applications for science falling within Cross-Committee PAs were funded.
70. **60%** of Committee members who responded felt that PAs serve their purpose in promoting certain areas.

"[Priority Areas] have been successful in focusing research on new areas and encouraging an integrative approach to important biological problems."

Committee member

71. PAs are less popular amongst PIs. Of the 16 PIs (**9%** of the sample) who made unprompted comments about PAs, only three were positive, the rest making comments about the need to keep the remit broad and general, and that PAs are too restrictive, often not in the most exciting areas of science, and reduce funding for emerging areas and basic science.

"I believe it is very important for the ASC to continue to fund basic research that is of high quality, even if it lies outside the Priority Areas."

Grantholder

72. Similarly, two of the ten Committee members surveyed were concerned that the focus on particular areas means that applicants are put off from applying in non-priority areas.

3.4 Interdisciplinarity

73. A recent exercise to measure interdisciplinarity in BBSRC responsive mode grants considered PIs' departments, identifying interdisciplinary grants as those between a life sciences department and a non-life sciences department, and those based in non life-sciences departments e.g. physical sciences, information technology. By this measure, the ASC has the lowest proportion and value of grants of all of BBSRC's Research Committees, having supported only **five** interdisciplinary grants (**2%** of all BBSRC interdisciplinary grants). This may be a significant underestimate as the scientists working on ASC grants are often from other disciplines (e.g. chemistry, mathematics), yet based in life sciences departments.

3.5 Comparison with other UK funders

74. ASC's remit overlaps with a number of other UK research funders, including Government departments, other Research Councils and charities. Overlap with the Government departments (Defra and SEERAD) is reduced through BBSRC supporting the basic/strategic end of the research spectrum and the Departments support more strategic/applied approach. Furthermore, Defra and SEERAD attend ASC meetings as observers and BBSRC officers attend Defra and SEERAD reviews.

75. Areas of overlap between the remits of BBSRC and of the other Research Councils are monitored, with grant applications being redirected if necessary to the appropriate Council. Where there is mutual interest, co-funding arrangements are put in place.
76. Discussions have taken place between the ASC secretariat and the main charities supporting research relevant to ASC (Wellcome Trust and CRUK) to ensure that the organisations are aware of each others activities.
77. The table below summarises the responses that were received from the other funding organisations:

| Funder | Areas where remits overlap | Approximate budget in overlap area | Comments |
|--------------------------|--|--|---|
| <i>Research Councils</i> | | | |
| EPSRC | Biomechanics, biomimetics, physiology, ageing, systems biology, neuroscience | Current grants with keywords relevant to ASC: £224 million, 630 grants | EPSRC's Life Sciences Interface Programme supports the application of physical sciences to biological research. For applications involving biology and the physical sciences, BBSRC leads on those where the novel aspect of the research is biological, and EPSRC where it is physical. Increasing numbers of grants are being cofunded by the two Councils. |
| MRC | Potentially much of ASC's remit (with MRC interest in all 3 themes), but MRC's focus is different. | | MRS funds any high quality research relevant to human health and disease, whereas ASC excludes research specifically addressing human disease and clinical research. MRC's remit does not cover animal disease or studies of animal behaviour/physiology which have no direct relevance to human health. |
| NERC | Animal behaviour, disease, epidemiology. | | NERC funds research to understand the biology of specific wild animals and their interaction with the environment. The Council does not support research on domesticated and farmed species. ASC focuses on generic biological issues applicable to animals (including humans). |
| <i>Government bodies</i> | | | |
| Defra | Animal health and welfare | £18-20 million ~150 grants (2004/5) | Defra focusses on strategic and applied research, duplication avoided through regular communication. New Government Partnership Awards allow co-funding. |
| SEERAD | Animal health, welfare of farm animals | £53.7 million (2006-2011) | Most overlap in non-notifiable endemic and non-foodborne zoonotic disease of livestock, including studies of immune function in target species. |

| Funder | Areas where remits overlap | Approximate budget in overlap area | Comments |
|--------------------------------------|--|---|---|
| NC3Rs ¹ | Animal welfare; Cross-Committee 3Rs priority area | £1 million 8 grants (2004/5) | NC3Rs funds research designed to have a specific practical impact on animal welfare, whereas ASC funds research aimed at understanding underlying principles and mechanisms e.g. cognition and pain, which underpin welfare research. There is no co-funding at present, but BBSRC provides support to the NC3Rs which contributes to its research funding. |
| <i>Non-government funding bodies</i> | | | |
| Cancer Research UK | Minor overlap in physiology, immune function and disease | ~£4.5 million 23 grants (live at 1 April 05) | CRUK focuses on the biology and causes of cancer, but many grants shed light on animal physiology and disease as a corollary of their primary aims. |
| Wellcome Trust | Much of ASC's remit | ~£19 million 34 grants (2004/5) | Overlaps with 3 of the Trust's funding committees. The Trust also supports animal health research in developing countries. |

¹ National Centre for the Replacement, Refinement and Reduction of Animals in Research

78. In addition, BBSRC, EPSRC, MRC and the Wellcome Trust jointly fund the Cognitive System Foresight Project, an initiative aimed at fostering interdisciplinary collaboration in natural or artificial information processing systems, including those responsible for perception, learning, reasoning, decision-making, communication and action.
79. The funders and ASC Committee members surveyed were all of the opinion that overlap between the remits of funding bodies is not an issue, and that it is often a good thing because it ensures that there are no gaps. None of the funders had concerns about the clarity of the remits. Defra, EPSRC and MRC reported that their and BBSRC's programme managers regularly co-ordinate with each other, for example to discuss applications in the 'grey area' between organisations.

3.6 International comparison

80. While it was not feasible in the context of this evaluation to generate animal sciences-specific international comparison data, the Office of Science and Technology recently published a number of Public Service Agreement target metrics for UK bioscience research as a whole. The metrics compare the UK's performance in biosciences with other major research countries using bibliometric data from ISI National Science Indicators 2003, and generally 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 1994-2003 (the most recent year for which data is available) [the data was corrected for country size].

- Citation impact relative to world baselines in biosciences: The UK ranked 3rd (behind Switzerland and the USA) in ‘citation impact’ (ratio of citations to publications) for biosciences for 2002 (the most recent year for which data is available).
 - Proportion of uncited papers: The UK had the lowest proportion of uncited papers (i.e. the highest proportion of cited papers) for biosciences for 1998-2003 amongst the G8 countries.
81. ASC can also be compared internationally by examining the remits of major funders of animal sciences research in other countries. It was not feasible within the available time and resources to conduct an in-depth survey: the exercise was therefore limited to readily accessible information on the websites of these organisations.
 82. **National Science Foundation (USA):** There are a number of remit overlaps between ASC and NSF, particularly with the Division of Integrative Organismal Biology (IOB), which supports research aimed at integrative understanding of organisms as units of biological organization.
 83. There is a great deal of remit overlap between the ASC Neuroscience and Behaviour theme and the NSF Behavioural Systems Cluster. The Neuroscience and Behaviour theme seeks to encourage research applications in all fundamental aspects of nervous system functioning aimed at understanding how the brain acquires, processes and stores information. The NSF Behavioural Systems thematic area focuses on the development, function, mechanisms and evolution of behaviour, biological rhythms and interactions between organisms.
 84. Both ASC and IOB encourage applications that make use of the tools and techniques of functional genomics to study physiological and behavioural systems. The ASC theme Mechanisms of Immune Function and Disease Pathogenesis covers the study of innate and adaptive immune mechanisms of vertebrates and invertebrates and also encompasses studies into the pathogenesis of viral, bacterial, parasitic and fungal infections of animals, including host/organism interactions at the cellular and molecular level.
 85. There is also overlap between the ASC Integrative Animal Physiology (IAP) theme and the NSF Functional and Regulatory Systems thematic area. The IAP theme covers the study of tissue function in the intact organism and applications using the application of current advances in molecular, cellular and genomic sciences to refine and extend understanding of systems biology in whole animals are particularly encouraged. The NSF Functional and Regulatory Systems theme focuses on fundamental physiological systems, with emphasis on organisms as integrated systems. This NSF theme also covers work in neuronal and glial cell function and immunology which are covered by the ASC themes of Neuroscience and Behaviour and Mechanisms of Immune Function and Disease pathogenesis, respectively.
 86. **Institut National de la Recherche Agronomique (France):** INRA has remit overlap with the ASC. One area of INRA’s priorities for 2001-2004 was

'From the genome to the whole organism integrative biology'. This clearly overlaps with ASC's IAP theme.

87. **Centre National de la Recherche Scientifique (France):** CNRS's Life Sciences division (SDV) identifies integrative physiology as one of its research priorities. This overlaps with ASC's IAP theme.
88. **Deutsche Forschungsgemeinschaft (Germany):** The DFG has a very different funding structure, but there is research overlap with ASC, for example:
 - Priority Programme 1026: Molecular Physiology of Synaptic Interaction: Analysis in Defined Mammal Mutants;
 - Priority Programme 1048: Analysis of the Cellular and Molecular Basis of Neural Repair Mechanisms.

4. INTERACTION WITH INDUSTRY

4.1 Overview

89. When asked to comment on the relationship between ASC-supported research and industry, one member commented that it has remained fairly constant, and another that it is getting worse (which they attributed to industry). In contrast, the one Committee member based in industry said that their company feels that animal research has a solid reputation in the UK. They added that the company finds it very easy to collaborate with BBSRC, and that collaboration between academia and industry could be encouraged by more communication of the opportunities available.

4.2 Support at outset

90. Ten PIs (6% of sampled grants) reported the grant having had co-funding or in-kind support at the outset. Six grants (4%) had direct industrial support at the outset, three as part of the LINK programme, and two involving in-kind technical support from agri-business. None of the sampled grants had received an Industrial Partnership Award.
91. Two Committee members noted that applications with co-funding from industry tend to be ranked at the lower end of the scale during appraisal, i.e. that the quality of the science, while above the funding threshold, is lower than that of some other awards.

4.3 Involvement as a result of the grant

92. Involvement with industry is much more common during and as a result of grants, with almost a fifth of PIs reporting improved industrial contacts:

| Type of contact/collaboration | | Proportion of PIs |
|--|----------|-------------------|
| Base (all sampled PIs) | | 171 |
| New or improved industrial contacts | UK | 19% |
| | Overseas | 14% |
| New formal industrial research collaboration (e.g. joint publication, joint funding application) | UK | 8% |
| | Overseas | 4% |

93. The lower figures for formal collaborations with industry are reflected by the fact that only 3% of the publications reported by sample PIs had co-authors based in industry.
94. PIs cited 15 different industries with which they had new or improved contacts or collaboration, including pharmaceutical and animal health/veterinary pharmaceutical.

5. PUBLIC ENGAGEMENT

95. PIs are required to conduct public engagement activities as a condition of their grant. Recent analysis by BBSRC's External Relations Unit (ERU) indicates that **72%** of recent ASC PIs were involved in public engagement activities, just below the Committee average of 76%.
96. The data presented here are taken from the questionnaire survey of PIs and data included by PIs in their final reports. In light of the recent analysis by ERU, these data are considered to be a significant under-representation because a) some PIs who had included activities in their final reports wrote nothing in the questionnaire, suggesting that PIs would not necessarily have recorded or remembered the activities they had undertaken some years ago; and b) ERU's analysis found that many PIs left the summary section on public engagement in the final report blank, completing only the public engagement Annex, which was not available for this evaluation. The data below are, however, useful in giving an indication of the types of public engagement activities undertaken by PIs.
97. **41%** of PIs reported in the questionnaire that they had undertaken public engagement activities related to their scientific area during the period of the grant. The figure was lower for current grants than completed grants, which is perhaps to be expected as some current PIs would not yet have carried out their activities. PIs were given three options to describe the activities carried out, the most common being publicity in the general non-scientific media:

| | Completed | Current | Total |
|---|-----------|---------|------------|
| Base (all sampled PIs) | 102 | 69 | 171 |
| Contributions to public awareness or science in society debates. More specifically: | 48% | 30% | 41% |
| <i>Publicity in the general non-scientific media</i> | 34% | 22% | 29% |
| <i>Schools activities</i> | 20% | 16% | 18% |
| <i>Public dialogue</i> | 17% | 10% | 14% |

98. When analysed by area of expertise for completed grants, the data shows public engagement to be most common amongst PIs with expertise in animal welfare, animal behaviour & psychology, and neuroscience, and least common in immunology and animal disease.
99. The most frequent activities (using the questionnaires, and the information provided in the final reports) were newspaper articles, popular scientific articles & contributions to books (**27%** of PIs reporting public engagement activities); schools activities (**21%**); and radio (**18%**).
100. Analysis of the proportion of PIs reporting public engagement activities by year shows no obvious trend.

6. ULTIMATE IMPACTS

101. High-level impacts are difficult to measure, because they tend to arise several, or even tens of years after the original basic research was conducted. The survey data relevant to the assessment of high-level impacts is presented below. The responses from Defra and SEERAD to the question ‘*To what extent does ASC-supported research contribute to your department’s science strategy and research, and to the development of policy?*’ are also highly relevant, and are included at the end of the chapter.

6.1 Contribution to the ‘public good’

102. When asked whether and how their research has contributed to the ‘public good’, **35%** of PIs ticked ‘animal health and welfare’; **26%** ‘human health’; **6%** ‘environment’; and **5%** ‘contribution to the formulation of government policy’. From the details given by PIs, some of the contributions may be described as a little hopeful or ‘tenuous’, with PIs (understandably) wanting to represent their research in a positive light. The contribution to government policy is considered to be lower than might be expected from research in this area.
103. When asked who the end-users of ASC supported research are, Committee members identified the biosciences research community and industry (pharmaceutical, medical research, agriculture and veterinary medicine). One member acknowledged that ASC-supported research contributes to the ‘public good’.

6.2 Income to the research community and to UK plc

104. When asked whether the grant had supported their wider research aims, **2%** of PIs ticked the option ‘generated income from patents, spin out companies, etc’. However, as discussed in section 2.6, none reported any income arising from intellectual property as a result of the research supported by the grant.

6.3 UK ranking in animal sciences

105. When asked whether the grant had supported their wider research aims, **80%** of PIs ticked the option ‘strengthened the standing of my research group in the field’.

“The BBSRC grant helped me to initiate and co-ordinate a research network (UK and Europe) which has been awarded over 3 million Euros from the EC.”

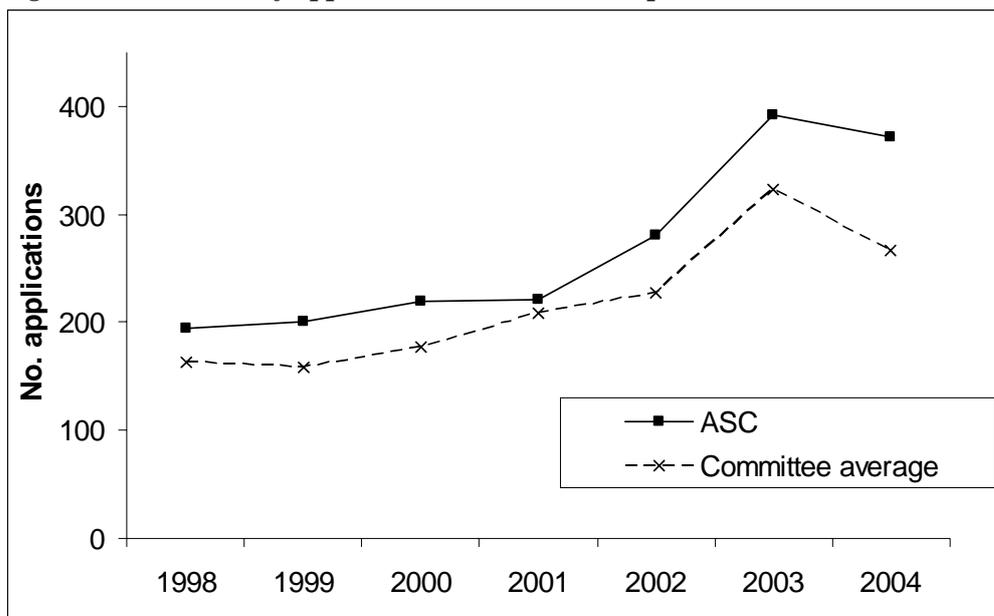
Grantholder

106. BBSRC’s spend through ASC on responsive mode, and the number of applications the Committee receives are indicators of the level of high quality research in animal sciences in the UK. Spend on responsive mode research through the ASC has steadily increased over the past few years (from £6.8

million in 1997 to £19.2 million in 2004), remaining at a relatively constant **15%** of BBSRC's overall responsive mode spend.

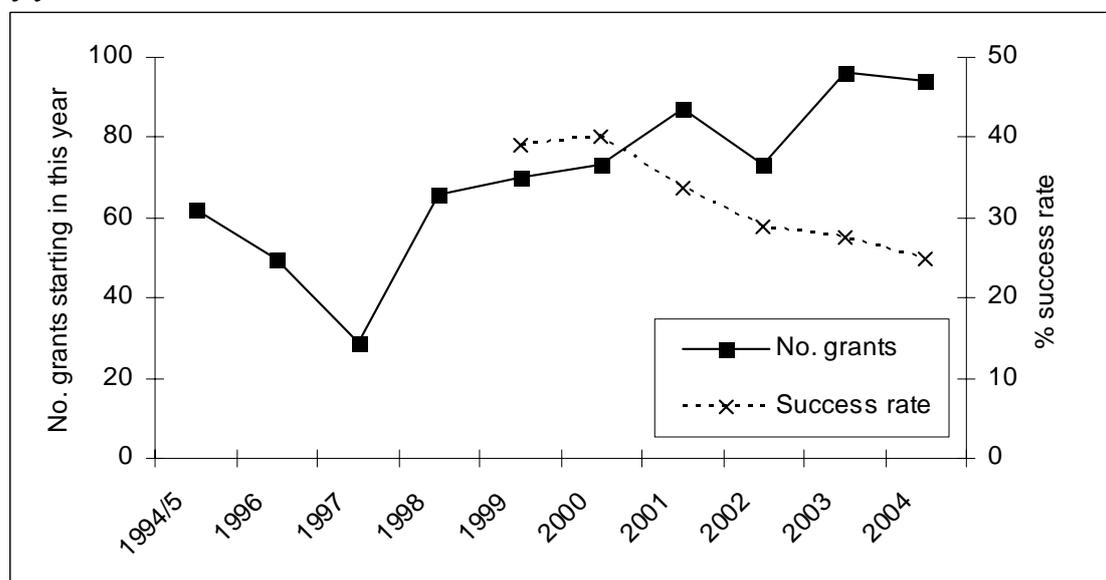
107. The number of applications to ASC responsive mode has increased rapidly over recent years, almost doubling in the last five years. The trend for ASC is very similar to that for BBSRC responsive mode overall. Figure 8 also shows that the ASC consistently receives a greater than average number of applications.

Figure 8: Numbers of applications to BBSRC responsive mode



108. With such an increase in applications, the success rate has had to go down, despite increases in funding (and number of grants awarded). The success rate has fallen from **39%** in 1999 to **25%** in the most recent rounds:

Figure 9: Numbers of ASC grants and responsive mode success rate through ASC by year



6.4 Responses from Defra and SEERAD

109. The following sections contain Defra's and SEERAD's responses to the question: *'To what extent does ASC-supported research contribute to your department's science strategy and research, and to the development of policy?'*

Defra

110. "Basically BBSRC Animal Science projects provide underpinning science supporting work which we fund. BBSRC fund work either through response mode grants or core funding to the IAH on a lot of diseases where we fund the more strategic/applied research. The major areas where we fund research are Marek's Disease, Coccidiosis, Infectious Bronchitis, Mastitis, TSEs (BSE and Scrapie), Foot and Mouth Disease, African Swine Fever, TB, Blue Tongue, Bovine Virus Diarrhoea, Respiratory Syncytial Virus, Avian Influenza, control of helminth parasites. Anything which you fund in these areas will complement our work. Also any work on host pathogen interactions in farm animals or the development of vaccine technology such as mucosal immune responses and vaccination are all highly relevant as is work on farm animal welfare".

SEERAD

111. "ASC funds the basic research at the start of the UK's R&D 'supply chain', which informs (and enables) the more applied research and development supported by SEERAD, other Government departments and industry, and which (often many years later) contributes to the public good, for example improved animal health and welfare, exploitable intellectual property and Government policy. The length of the supply chain, and the breadth of information used in policy development means that it is difficult to identify specific examples.
112. One area where the supply chain is shorter is the contribution of research to disease control strategies. The results of CSG-supported research (in ASC's remit), and in some cases ASC-supported research on the basic biology of exotic diseases such as blue tongue, foot and mouth and avian influenza feed directly into Government control strategies and contingency planning for these diseases. Recently commissioned work for example on epidemiology of endemic diseases in dairy herds could also assist development and implementation of improved farm management based control strategies that will support implementation of the Governments Animal Health and Welfare Strategy.
113. SEERAD considers it important that over the longer term the outputs from the ASC portfolio are likely to contribute (through improved understanding of host responses, pathogen biology and vaccination strategies) to vaccine development, development of host resistance strategies and sustainable use of therapeutics for a range diseases. The recent Combating Viral Diseases of Livestock initiative was particularly important in this regard, in addition to its important role in developing collaborations between institutes and

Universities. Other examples of research that is highly relevant to SEERAD are the proteomic approaches to identification of parasite antigens, identification of drug resistance markers in nematodes and translation of *C. elegans* RNAi and transgene expression technologies to economically important nematodes.

114. The ASC's support for basic research also results in the UK retaining acknowledged international experts who are research active in animal sciences. These experts are available to synthesise and interpret the results of research, and to advise government when needed. SEERAD sees this as an extremely valuable, and often overlooked, outcome of support for research. BBSRC's support to the Institute of Animal Health and Roslin Institute (both through ASC and the Core Support Grant) is particularly valuable, because the Institutes represent a core of expertise in animal health and animal science in the UK that is available for consultation and advice.
115. ASC's support to the biology of animal welfare is also valuable in the context of UK Government priorities, for example the current work on pig welfare is relevant to industry and Government.
116. Many of the issues noted above are of significant interest to the public, in addition to the obvious national economic and governmental interests. Again it is important that acknowledged experts in these fields are available to participate in public debate, public engagement and educational activities”.