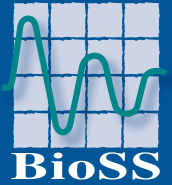


**Biomathematics &  
Statistics Scotland  
Corporate Plan  
2007-2011**



*“to improve science & society through an  
understanding of variation, uncertainty and risk”*

VISION STATEMENT



# BioSS in Brief

BioSS is a specialist organisation delivering high-quality consultancy, training and research in statistics, mathematical modelling and bioinformatics.

BioSS undertakes a programme of applied strategic research to address methodological issues arising in its consultancy work. This research is managed in three broad themes:

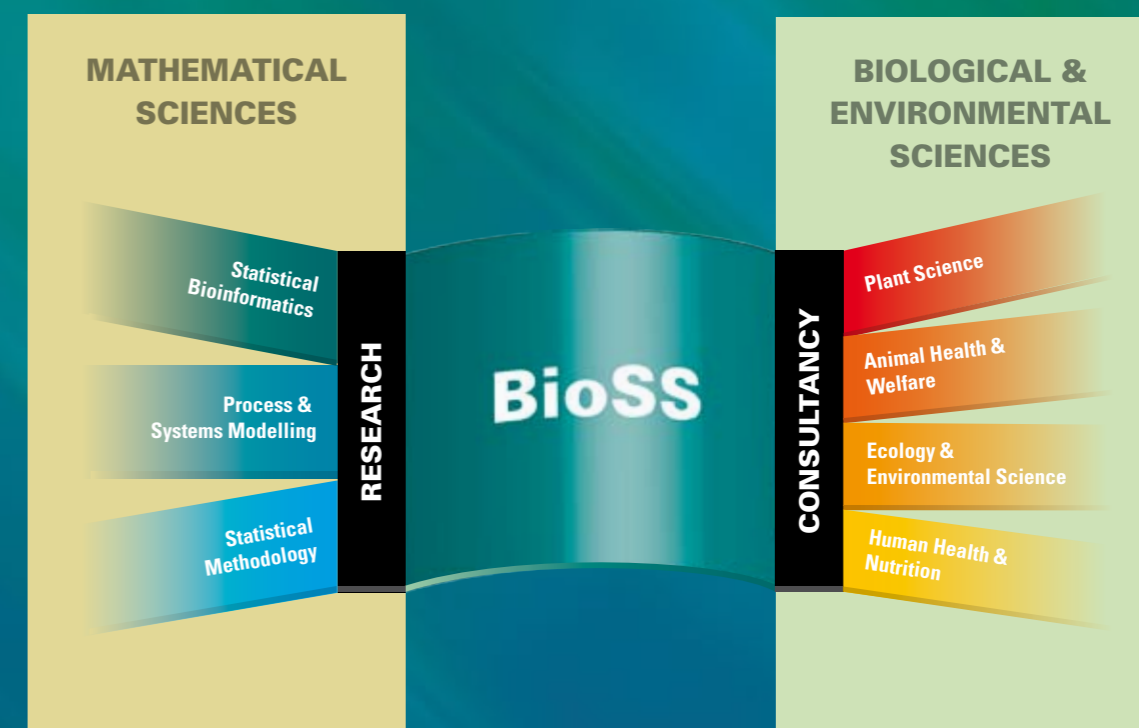
- statistical bioinformatics;
- process & systems modelling;
- statistical methodology.

Each theme is related to all four scientific application areas, demonstrating the generic applicability of BioSS research.

BioSS has particular expertise in four broad scientific application areas:

- plant science;
- animal health and welfare;
- ecology and environmental science;
- human health and nutrition.

Within each area, BioSS enhances the quality and efficiency of scientific research through consultancy-level interactions. This consultancy work is underpinned by training courses, which increase the understanding and computational ability of scientists.



BioSS undertakes Knowledge Exchange activities with a wide range of organisations including government agencies, agricultural levy boards and companies in the private sector. These interactions take many forms, including provision of advice, project work and the development of bespoke software products.

## BioSS Corporate Plan 2007-11

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 Gary Baker, GB Photography

# Role, Vision & Mission

BioSS plays a distinctive role in the Scottish research community. It bridges the gap between research in the mathematically-based sciences of statistics, physics and computing on one hand with the traditionally more qualitative sciences on the other hand.

Since its inception in 1987, BioSS has demonstrated the synergies inherent in researchers being close to application and in consultants undertaking methodological research. This ensures the relevance of our methodological developments and the use of modern methods in our consultancy work. This interplay between methodological research and its application is recognised in our staff management, with almost all our scientific staff fulfilling both a consultancy and a research role.

Our role as one of the Main Research Providers (MRPs) for the Scottish Government's Rural and Environment Research and Analysis Directorate (RERAD) is:

*"to deliver high-quality consultancy, training and research in statistics, mathematical modelling and bioinformatics as part of the strategic research in environmental, agricultural and biological science funded by the Scottish Government".*

Looking more broadly, our vision is:

*"to improve science & society through an understanding of variation, uncertainty and risk".*

This will be achieved through our mission:

*"to develop and apply quantitative methodologies with a rigorous mathematical and statistical basis".*

## BioSS as part of the Knowledge Chain



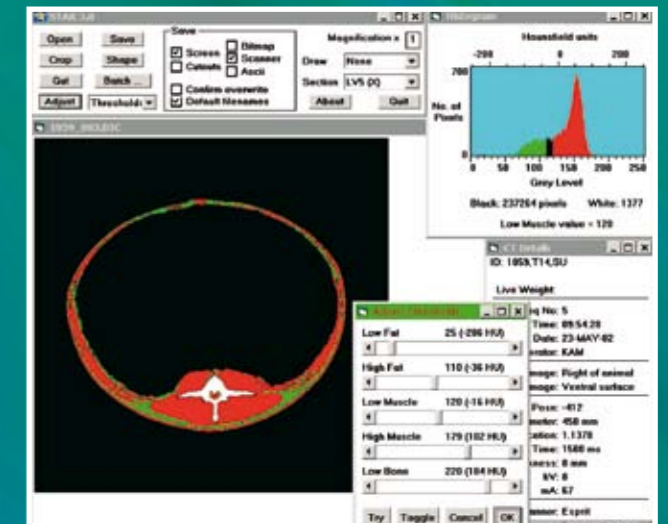
# Productivity & Achievements

BioSS has an excellent record of productivity. The figures produced for our 2003 Visiting Group showed that, between 1996 and 2003, every £60k of core research income led to £40k competitively gained income and 6 research papers.

From our many achievements to date, we highlight three major pieces of research from which the algorithms created by BioSS have been made available to others in a user-friendly software product.

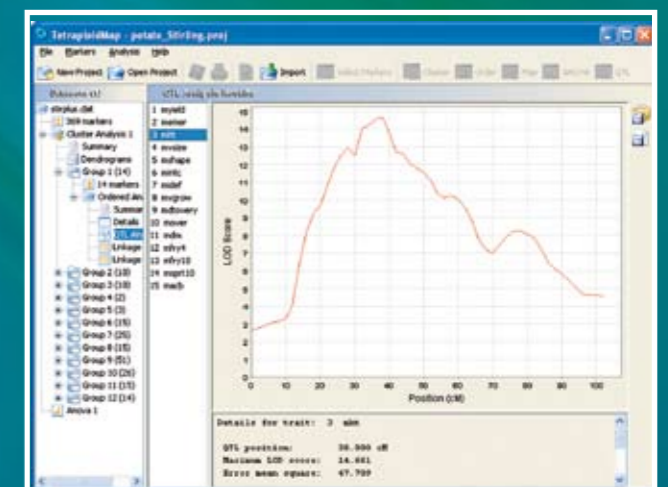
## Image analysis

Replacing manual measurements with digital imaging offers the potential to reduce costs, make measurements more objective and even to measure novel features. We have developed methods for plant variety recognition, based on existing and novel plant characteristics (implemented in our IMAGIN software), which are now in routine use in variety registration. We have also developed methods to estimate the proportions of different tissue types in live sheep, using images derived from computed tomography (CT) scans (implemented in our STAR software), to assist the breeding programmes being promoted by SAC.



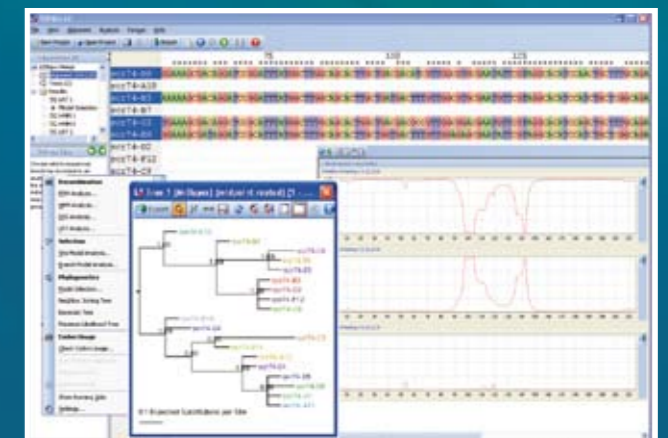
## Analysis of QTL data from tetraploid species

Knowledge of the location of genes influencing quantitative traits along the chromosomes is important for creation of new plant varieties. We have developed methods to map QTLs in tetraploid species and to associate the QTLs with quantitative traits such as crop yield. Our TetraploidMap program is the only software to analyse QTL data from tetraploid species, and is being widely used by groups working on species such as potato, leek and alfalfa.



## Analysis of DNA multiple alignments

Horizontal gene transfer is an important evolutionary process that shapes the genetic structure of microbial populations. We have developed statistical methods to detect recombinant sequences in multiple alignments, by applying a phylogenetic approach. These methods are available in our TOPALi multiple sequence alignment analysis and visualisation Java application, which submits computational jobs to remote high performance computing clusters via web services.



## Structure & Management

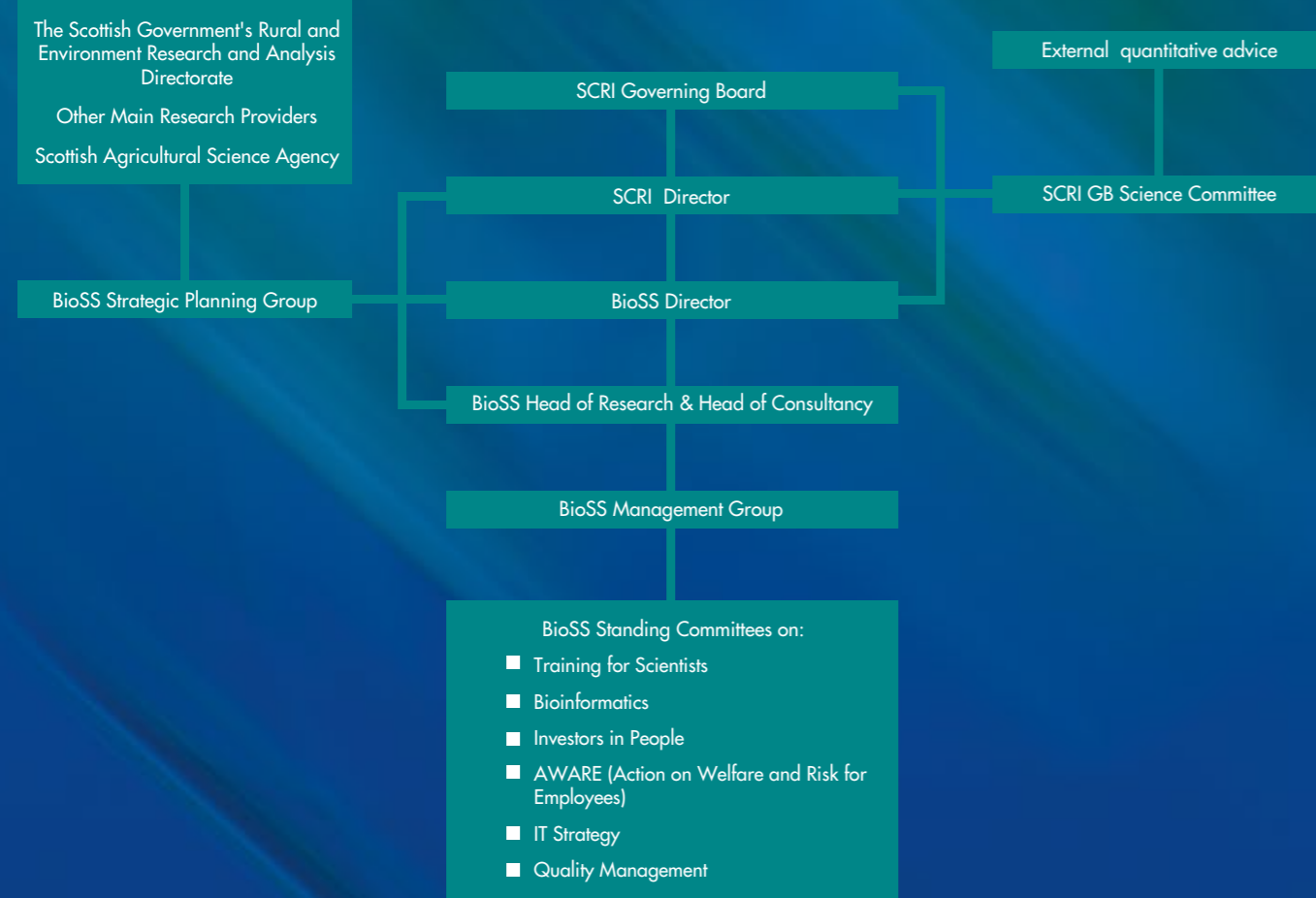
Formally, BioSS is part of the SCRI Group, having always been considered too small to be self-governing. The BioSS Director reports to the Chief Executive of SCRI, and responsibility for BioSS ultimately resides with the SCRI Governing Board. The Heads of Science from BioSS's principal collaborating organisations meet to form the BioSS Strategic Planning Group, with terms of reference:

- i) to provide strategic oversight, both to ensure appropriate development of BioSS expertise to meet the needs of RERAD's programmes of strategic research in environmental, agricultural and biological science and to ensure appropriate engagement between BioSS and other MRPs;
- ii) to ensure equitable allocation of staff resources to meet the wider needs of the MRPs and the Scottish Agricultural Science Agency;
- iii) to assist in the development of BioSS to fulfill its many potential contributions to science and society.

Scientifically, BioSS operates as an independent unit managed by a Director, a Head of Research and a Head of Consultancy. These are joined on the BioSS Management Group by two further Research Leaders, three Principal Consultants, an External Development Manager, IT Manager and Administrative Officer to determine, implement and communicate strategic decisions. A number of working groups focus on specific issues, allowing all staff the opportunity to develop their strategic thinking and to shape working practices within BioSS.

The ability of BioSS to operate as a distinctive unit is an essential ingredient in its success, giving it a sufficiently independent corporate identity to build an international reputation and allowing its staff to collaborate freely with a wide range of organisations.

### BioSS Management Structures



## Research

BioSS undertakes a programme of applied strategic research to address generic methodological issues arising in its consultancy work. Our research takes the form either of novel adaptations of existing techniques or of more fundamental methodological development work. Because of our close links with developing scientific fields, our research is motivated by and applied to solve important scientific problems.

BioSS research is managed in three broad themes.

### Statistical bioinformatics:

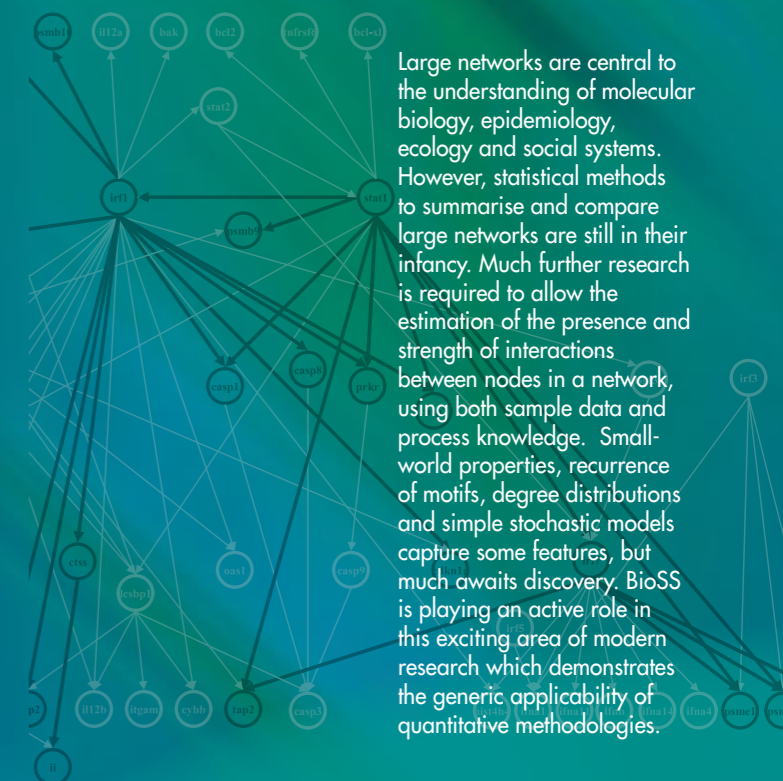
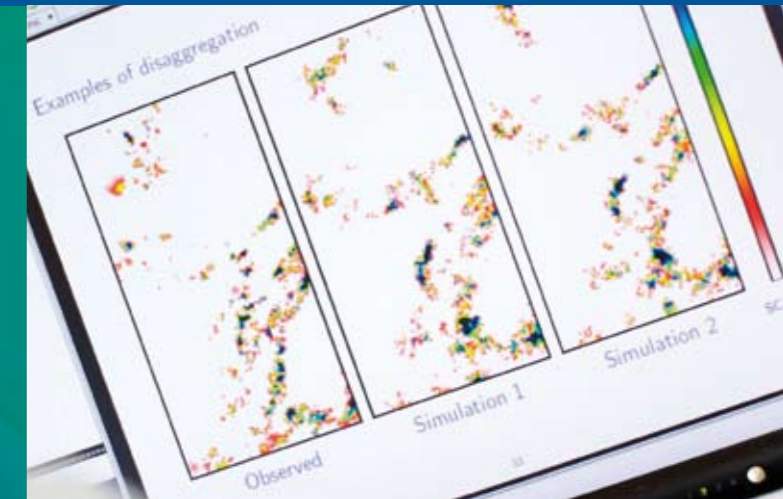
to develop efficient methods, that are robust to the noise inherent in both biological processes and experimental procedures, to extract information from the enormous quantities of new types of data becoming available.

### Process & systems modelling:

to understand and manage stochastic dynamic systems by development of statistically sound parameter estimation and model selection methods, with particular application to epidemiology and biodiversity.

### Statistical methodology:

to correctly interpret large, highly-structured, data sets, allowing for correlations induced by their spatial, temporal and spatio-temporal nature, with particular emphasis on image analysis and environmental applications.



Large networks are central to the understanding of molecular biology, epidemiology, ecology and social systems. However, statistical methods to summarise and compare large networks are still in their infancy. Much further research is required to allow the estimation of the presence and strength of interactions between nodes in a network, using both sample data and process knowledge. Small-world properties, recurrence of motifs, degree distributions and simple stochastic models capture some features, but much awaits discovery. BioSS is playing an active role in this exciting area of modern research which demonstrates the generic applicability of quantitative methodologies.

Over the period 2007-2011 we aim to:

- undertake a broad programme of strategic research that addresses generic methodological issues required to answer key scientific problems;
- fund at least 40% of research time through competitive grant applications, and publish at least 2 research papers per year per research post;
- maintain a high profile in the academic and research communities for our distinctive blend of application-driven methodological research;
- build strategic alliances with key national and international centres and comparators.

## Consultancy Advice & Collaboration



Consultancy arrangements provide opportunities for BioSS to enhance the efficiency of research in which the immediate focus is an applied scientific question. Interactions between scientists and consultants take place at a wide range of levels, from the advisory to the innovative, with analysis tasks carried out by BioSS or the scientist as appropriate. Good consultancy work requires scientific expertise and communication skills as well as quantitative skills, and BioSS encourages its staff to create and maintain long-term working relationships.

BioSS has developed particular expertise in four broad scientific areas, and manages its consultancy work within them:

- plant science;
- animal health and welfare;
- ecology and environmental science;
- human health and nutrition.



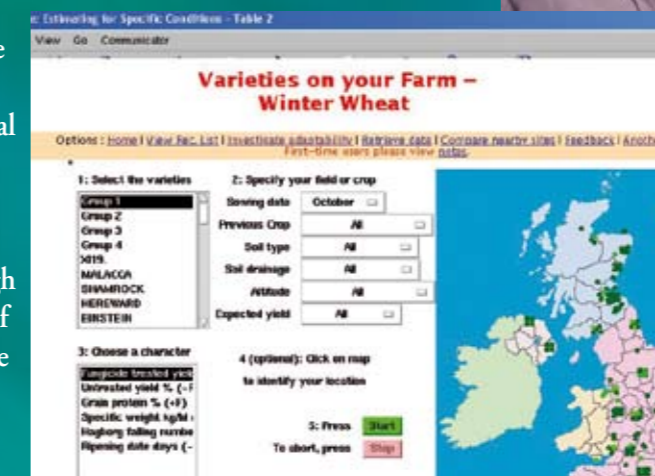
### Over the period 2007-2011 we aim to:

- provide effective advice to scientists to ensure the efficiency of experiments, the validity of analyses, the appropriateness of modelling and a balanced weighing of evidence in the interpretation of the results;
- take a pro-active role in identifying collaborative projects, and develop these through joint funding applications, co-authoring refereed papers and conference/workshop presentations;
- build on established long-term relationships with individual scientists and institutions to widen the scope for scientific application and income generation;
- develop the reputations of BioSS staff in their specialist application areas, so increasing awareness of BioSS's capacity to deliver high-level consultancy work amongst client organisations and their project leaders.

## Knowledge Exchange

BioSS works at the interface between the development and application of quantitative methodologies. Hence knowledge exchange (KE) forms a natural part of our work. We are strongly committed to the dissemination of state of the art quantitative methods to an increasingly wide range of recipients, including the scientific community, research students, government and the bioindustries.

We take a flexible approach to KE, matching mode of operation to the task in hand. In our interactions with scientists, KE ranges from one-to-one discussion to formal training courses. As our scientific collaborators are placing increasing emphasis on commercial products, we will need greater focus on our contribution to product development. In our research, we are increasingly embedding our algorithms in software products made available as stand-alone programs or as Web services, enabling them to be widely used. In our interactions with government departments, agencies, charities and industry, KE requirements are specified as part of the contractual arrangements, and range from giving expert guidance through to the delivery of bespoke software products.



### Over the period 2007-2011 we aim to:

- develop stand-alone software products where there is sufficient demand to apply methodologies developed in our research;
- invest in keeping our formal training courses up to date, and integrate these with a more flexible series of workshops;
- recruit an average of 3 PhD students per year, all submitting theses within four years;
- work with the other MRPs to provide quantitative elements to their KE activities.

## Staffing and Infrastructure



The success of BioSS depends on the knowledge, skills and experience of its staff. BioSS is fortunate to have very able staff, with a strong sense of corporate identity, who are dedicated to their work. These staff are geographically distributed to allow close contact with research scientists throughout Scotland, but meet regularly to create and maintain close working relationships within BioSS. Non-scientific staff are all located in Edinburgh, and play a vital supporting role in providing the infrastructure for our scientific staff. The total staff complement of BioSS in April 2007 was 37 posts.

The critical mass, the range of technical expertise and the diversity of applications encountered all combine to make BioSS a stimulating employer for mathematically- and statistically-minded researchers who choose to follow a career at the interface between the quantitative and applied sciences. BioSS has an excellent record of staff development: of the nine scientific staff on the BioSS Management Group in April 2007, six were originally recruited to BioSS at postdoctoral researcher level or below.

#### Over the period 2007-2011 we aim to:

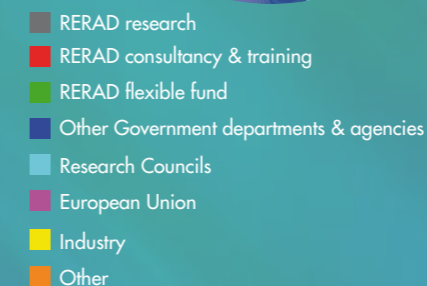
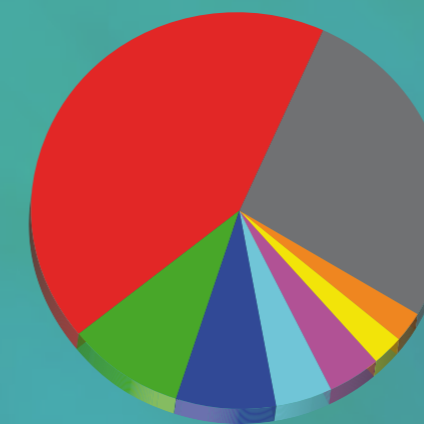
- communicate clearly to staff the objectives of the organisation and the role they play in achieving these objectives;
- create a supportive working environment in which expertise is freely shared between individuals within and between sites;
- encourage staff to develop fulfilling careers;
- provide an excellent computing environment and administrative support through on-line information systems.

## Finance

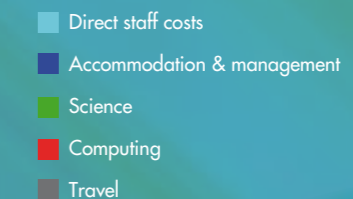
BioSS receives approximately 65% of its income from the Scottish Government's Rural and Environment Research and Analysis Directorate (RERAD) in the form of a base allocation, the remaining 35% of income is drawn from a wide range of sources including Research Councils, EU, Government Departments and Agencies and Levy Boards. Over the period 2006/11, the base allocation from the Scottish Government is expected to diminish by 15-20% in value. This reduction in secure funding will lead to a financially challenging

future, especially given the new legal position that staff are recruited on indefinite contracts with high associated redundancy costs. Nevertheless, BioSS has an excellent record of obtaining competitive funding and a flexible workforce with scarce skills. We envisage the shortfall in secure income being met by successful competition for short-term funding with additional stability provided by reaching long-term collaborative arrangements with an increasing number of organisations.

#### 2006-07 INCOME SOURCES



#### EXPENDITURE



#### Over the period 2007-2011 we aim to:

- expand the range of organisations we collaborate with, and so broaden our funding base;
- increase the external revenue generated from sources other than the Scottish Government by at least 4% above wage inflation;
- assign scientific staff time allocations of at least 20% for competitively funded work;
- ensure collaborations on projects with a substantial IP potential lead to a revenue stream to BioSS commensurate with our contributions.

*"to develop and apply quantitative methodologies with a rigorous mathematical and statistical basis"*

MISSION STATEMENT

## Contact points for BioSS

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