



Interim Review

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Summary

The 5-year NCSE grant from the EPSRC supports 5 research students and 4 postdoctoral research assistants, located in the universities of Cambridge, Kent and St. Andrews. The grant has also provided the foundation for developing the NCSE, so that it now has full members, associate members and student members, including members from a wide range of additional organisations.

The NCSE has a Director (Morgan), two co-Directors (Buckland and Brooks), a scientific administrator (Laurence) and a workshop and conferences coordinator (Rogers). The members of the NCSE meet regularly by means of video-conferencing of seminars, reciprocal visits by individuals, and a regular programme of meetings, workshops and conferences. An annual NCSE seminar has been established, and training of new staff and students has been implemented. The work of the NCSE is enlivened by a program of visits by international collaborators. The scientific direction of the NCSE is monitored by a Steering Committee, and the practical relevance of its work is ensured by a Management Committee, the members of which share the supervision of research students. From the outset, there has been great interest in the NCSE, and we have been able to fill all vacancies easily, with outstanding candidates. For the post-doctoral positions alone, we short-listed and interviewed 16 applicants.

In its first 18 months, the NCSE has established itself both nationally and internationally, and this is reflected by the large number of talks and seminars given by NCSE members at home and abroad. A Newsletter has been established to publicise the work of the NCSE, with a wide circulation. The first NCSE workshop, held in May 2006, was a resounding success, and the first NCSE international conference will be an official satellite meeting to the Dublin *International Biometric Conference* in 2008.

All three participating universities have provided additional resources to the NCSE. In addition to supporting research students in each university, this includes funding for the scientific administrator and the coordinator of workshops and conferences. There is already inward investment from a number of research organisations, and additional grant funding is being sought to ensure the continuation of the NCSE in the future.

An extended version of this report is available at www.ncse.org.uk/report2007. This abridged report references the 20 Appendices of the web-version.

Byron Morgan, Steve Buckland, Steve Brooks, Alexa Laurence, 3 April, 2007.

1. NCSE objectives

1. To create a Centre of international repute for the development and application of novel statistical methods in population ecology.
2. To bring together the UK's three existing University research groups in statistical ecology and to integrate their research programmes and activities for their mutual benefit.
3. To develop novel statistical methodology for the analysis of complex data sets arising in ecology.
4. To apply these methods to a broad collection of topical and important data sets.
5. To train PhD and postdoctoral researchers to work as statistical ecologists.
6. To develop a computer software system to enable ecologists to use cutting edge statistical methodology on their own data.
7. To educate and train end-users in the use of our methodology and accompanying software.
8. To seek additional funding to support the Centre's activities to ensure its continued success.
9. To build upon and create new collaborations with relevant stakeholders.
10. To develop and deliver a programme of workshops and conferences

2. NCSE Structure

2.1 Membership

Three categories of membership have been determined for NCSE, viz Full members, Associate members and Student members. These categories are defined in Appendix 1. We have instituted Associate Membership in response to the peer review of the grant proposal. This report references only those activities undertaken by Full members of the Centre. Associate and student members greatly extend and strengthen the work of the NCSE.

2.2 Current members financed directly or indirectly by the grant

The 5-year grant began in October 2005, and in order to ensure continuity the start date of a number of positions is later than that.

The following PDRAs funded by the EPSRC grant are currently in post. Lynam started work on 1 October 2005 and Cole started work on 1 February 2007, following maternity leave.

- Chris Lynam - *Automated model fitting using sequential importance sampling* (University of St Andrews)
- Diana Cole - *Parameter redundancy and state space modelling using Kalman filters* (University of Kent)

The following PhD students funded by EPSRC grant are in post, having started in October 2005.

- Vanessa Cave – *Integrated modelling of bird populations* (University of Cambridge)
- Daniel Brown - *Climate modelling for prediction* (University of Kent)
- Toby Reynolds - *Population regulation of guillemots* (University of St Andrews)

The following students are due to start work on their PhDs in October 2007, funded by the EPSRC grant:

- Colin Millar - *State-space stock assessment* (University of St Andrews)
- Lauren Oliver – *Time series modelling of long-term data sets* (University of Kent)

The following PhD students and PDRAs are funded other than by the EPSRC grant, but as a direct consequence of the NCSE.

- Eleni Matechou - *Statistical analysis of age-specific survival rates* (University of Kent and the Max Planck Demographic Research Institute, Rostock, Germany.) Appointed October 2006.
- Ella Marley-Zagar - *Modelling the dynamics of southern resident killer whales* (University of St Andrews). Appointed October 2005.
- Leah Johnson - *Modelling dispersal and life-history strategy of linyphiid spiders* (BBSRC grant at University of Cambridge). Appointed June 2005.
- Alison Johnston - *Modelling the dynamics of the UK population of stone curlews* (RSPB at University of Cambridge). Appointed October 2005.

It is intended that all NCSE students and post-docs should have fieldwork experience.

2.3 Committee structure and membership

The composition of the Steering Committee is listed below.

Name	Affiliation
Dr Jean-Dominique Lebreton Member of the French Academy of Sciences	Director, CEFE, Montpellier, France
Dr Jim Nichols	Senior Scientist, Patuxent Wildlife Research Center, Maryland, USA
Prof. Jeremy Greenwood	Director, British Trust for Ornithology, Norfolk, UK
Prof. Bryan Grenfell, CBE, FRS	Center for Infectious Disease Dynamics, Pennsylvania, U.S.A.
Prof. Ian Boyd	Director, Sea Mammal Research Unit, St Andrews, Scotland

All members of the Management Committee are/will be involved in joint PhD student supervision. The composition of the Management Committee is listed below.

Name	Affiliation
Dr Tim Coulson	Department of Biological Sciences, Imperial College
Dr Stephen Freeman	British Trust for Ornithology, Norfolk
Dr Rob Fryer	FRS Marine Laboratory, Aberdeen
Prof. John Harwood	Centre for Ecological and Environmental Modelling, University of St Andrews
Prof. Ian Jolliffe	Meteorology Department, University of Exeter
Dr Rhys Green	Department of Zoology, University of Cambridge
Dr Robert Gramacy	Centre for Mathematical Sciences, University of Cambridge

3. Management of the Centre

3.1 Current arrangements (copies of all documentation are available on request)

- Annual meetings of the Steering Committee, with minutes to track actions
- Six-monthly meetings of the Management Committee, with minutes to track actions
- Meetings between the Co-Directors (video- or teleconference) at approximately monthly intervals, with minutes to track actions
- Meetings in person between the Co-Directors to coincide with other Centre meetings
- Annual Business Plan (January – December) circulated to all Full members
- Regular financial monitoring
- Line management of all staff at an institution by the Co-Director at that institution. (From 1 December 2006 Byron Morgan has assumed this responsibility in relation to Cambridge.)
- Regular, weekly supervisor/supervisee face-to-face contact/discussions on project progress
- Six monthly reports from all PDRAs and PhD students, with subsequent comments and input from the Co-Directors and members of the Management Committee
- Devolved tasks: the NCSE seminar series is overseen by Len Thomas (St Andrews) whilst the student/PDRA seminar series is overseen by Chris Lynam (St Andrews), with support from nominated individuals at the other two institutions. Diana Cole

(Kent) is considering the design of the NCSE web-site and Robert Gramacy (Cambridge) is in charge of keeping the site up-to-date.

- Alexa Laurence is the Editor of the NCSE Newsletter.

3.2 Linkage between projects

Linkage is encouraged by the formation of NCSE research clusters, which are set up to encourage synergistic working. The first such research cluster was on *Animal movement*, and involved Pajaro Morales and Robert Gramacy from Cambridge, Kelly Moyes from Kent, and Paul Blackwell from Sheffield, an Associate member of NCSE. A grant application to EPSRC to continue this work has been submitted by Ruth King in St. Andrews. New clusters under discussion include: biodiversity, evolutionary strategies, multi-site modelling and climate modelling.

3.3 Changes at Cambridge

- Steve Brooks has taken 2 years leave from academic life. He remains as a Co-Director of NCSE and will be consulted on key strategic issues.
- The day-to-day business of NCSE is the responsibility of Byron Morgan and Steve Buckland, who are responsible for developing the Centre as well as managing the work carried out in the NCSE at their respective institutions.

The areas most affected are the projects led by two PDRAs:

- Robert Gramacy - *Modelling via MCMC-automated procedures*
- Ben Wright - *Computational statistical ecology*

Robert Gramacy has been appointed to a two-year lectureship at Cambridge, to replace Steve Brooks. His expertise remains within the Centre as he has joined the Management Committee. Robert has taken over the academic supervision of Vanessa Cave, assisted by Ruth King in St. Andrews. Vanessa also receives strong supervisory input from Stephen Freeman (BTO). A transfer to either Kent or St Andrews was offered to Ben but, for personal reasons, he decided to leave the Centre at the end of 2006. The remaining Cambridge post-doctoral funds have been transferred to Kent and St. Andrews, and the *Computational statistical ecology* project will be carried out by appropriate new PDRAs at each institution, with Particle filtering at St. Andrews, and Kalman filter work at Kent. Bayesian development will take place in both places, and may for example involve ecological developments of WinBUGS. This research will involve input from two Associate members of NCSE, Olivier Gimenez and Takis Besbeas. The Bayesian work will benefit by input from Chiara Mazzetta, formerly a PhD student of Steve Brooks and now a BBSRC post-doc at Kent.

4. Scientific progress

4.1 Research of NCSE research students and post-docs

Robert Gramacy has been chosen as one of four finalists for the Savage Award, which is given each year to the best PhD thesis in Bayesian Statistics. He joined NCSE in February 2006 as a PDRA in Cambridge, to study methods of Monte Carlo inference both generally, and as needed for the applications and models studied by other members of the NCSE. In May 2006 Robert gave a presentation to the NCSE on how Markov chain Monte Carlo (MCMC) could be used efficiently in the setting of approximate inference, i.e. where the likelihood must be simplified through approximation for tractability reasons. Of particular interest was quantifying and combining the errors in inference due to both approximation and the finite sample sizes from the Markov chains. He has been developing a novel methodology for augmenting the MCMC method of Simulated Tempering (ST) by combining it with importance sampling. ST was designed to improve the mixing of standard MCMC techniques like Metropolis-Hastings, by introducing auxiliary (tempered) distributions from which it is easier to sample. Importance sampling is brought in to efficiently re-use the vast majority of samples that ST discards because they come from the tempered auxiliary distributions which are similar to, but not the same as, the distribution of interest. This work is in collaboration

with Ruth King at St. Andrews. It is envisaged that this method, and extensions which are under development, could go a long way towards improving the visibility of ST and related methods, in particular for model selection problems where standard MCMC techniques fall short due to poor mixing. A range of papers are submitted and in preparation.

Leah Johnson joined the NCSE as a PDRA at Cambridge to study how dispersal and life history strategies together with agricultural practices influence population size, composition, and persistence of Linyphiid (or money) spiders in the British landscape. Money spiders have the ability to disperse long distances by floating in air currents using single strands of web, a process known as ballooning. Long distance dispersal complicates the effects of 'local' (e.g. field level) dynamics on the population, so it is important to know how far the spiders can travel. Leah has begun developing a mechanistic model of ballooning to estimate how far the spiders can travel in different weather conditions. Additionally, she is building a dynamic state variable model of spider dispersal in order to understand the mechanisms that influence the initiation of ballooning behaviours. These models can then be combined to learn how together they influence persistence. Leah has recently begun another project, in collaboration with Prof. Patrick Bateson at Cambridge, to examine how signals about habitat quality from a mother to offspring can influence the size of both male and female offspring in polygynous animals. She is developing a dynamic game model to make quantitative predictions about the differences in signal response (i.e. size) between male and female offspring. These predictions will be compared to experimental observations of offspring sizes in mice when the mothers are fed at different levels. A number of papers are in preparation.

Vanessa Cave started her PhD work in Cambridge in 2005. In her research she is using Bayesian methods to describe data arising from the British Trust for Ornithology Constant Effort Scheme. Existing methods are somewhat ad hoc, and liable to overestimate the level of confidence in the estimates of population change obtained. A key issue is how one accounts for missing visits. Vanessa's work has initially focussed on the Sedge warbler, *Acrocephalus schoenobaenus*, and will extend to construct, for the first time, single models for CES data that accurately describe both abundance and demography. A paper has been submitted to *Environmental and Ecological Statistics*.

Ben Wright completed 15 months of post-doctoral work in the NCSE at Cambridge in December 2006. His primary task was to document existing computational ecology software within the NCSE and form an appropriate catalogue, which will be of great use both within the NCSE and more generally. In addition, a prototype user interface was developed, and a library of simulation functions was established for use within the NCSE. The interface was developed in Java, and a demonstration version is available. On the academic front, a simple convergence diagnostic for MCMC simulations was developed.

Daniel Brown's work followed a strong recommendation by the peer review of the original NCSE grant application that there should be research in the NCSE on climate modelling, and how it should influence models for the survival of wild animals. He is currently preparing two papers for submission to the journal *Biometrics*. The first paper develops models where mortality is the effect of local weather rather than, as is currently the case, global measures of weather severity. In order to construct local weather covariates, it is necessary to produce appropriate weather maps, based on thin-plate splines. The approach has been evaluated using simulation, and applied to the survival of blackbirds, *Turdus merula*, in Germany. Current conditional modelling using weather covariates assumes a simplified model, in which recovery probabilities of dead animals are assumed to be constant. As Daniel has now shown, this simplification is not necessary, and a much richer family of models may be fitted, allowing for important time-trends in recovery probabilities, and the reduction of bias as a result. The second paper is being prepared on this work.

Diana Cole, a PDRA at Kent, has been in post for only two months, following a period of maternity leave. However she is already obtaining exciting results. We have been aware for some time that the parameter redundancy work developed at Kent/Canberra by Catchpole and Morgan 10 years ago is paralleled by similar developments in the area of compartment modelling. Both approaches involve the use of symbolic algebra, but there is little cross-fertilisation. Diana is close to understanding the compartmental modelling theory, and how it relates to the Kent/Canberra work. This is important, since much compartment modelling follows the formation of transfer functions, which are also present in Kalman Filtering, which

has also been developed at Kent for integrated population modelling. It is hoped that this work will all tie together to give a general theory. In addition, Diana is undertaking integrated population modelling, using the Kalman Filter, to analyse data on overwintering teal *Anas crecca*, using data supplied by the *Wildfowl and Wetland Trust*.

Christopher Lynam, a PDRA based in St Andrews, spent his first year in the post developing a multi-site state space model capable of modelling the spread of sika deer through the Scottish Borders. Chris has been working with the Scottish Borders Deer Management Group in order to use this model to test and develop alternative management regimes and he is currently preparing a paper for submission to the *Journal of Applied Ecology* detailing this study. The sika deer model was fitted using a Bayesian Sequential Importance Sampling (SIS) approach. However, for complex models this technique is typically unable to explore large model space. In order to combat this limitation within the Sequential Importance Sampling framework, Chris has spent part of the last 6 months starting to develop an algorithm that allows a search through model space in a similar way to the Reversible Jump algorithm used with Markov Chain Monte Carlo. From this work, he aims to produce a paper for submission to *Biometrics* or the *Journal of the American Statistical Association* describing a novel Reversible Jump Sequential Importance Sampling algorithm.

Toby Reynolds is 18 months into his PhD at St Andrews. Under the supervision of Ruth King and John Harwood (St Andrews), and Morten Frederiksen and Sarah Wanless (CEH Banchory), he has developed an integrated population model of common guillemots *Uria aalge* on the Isle of May - a colony of approximately 20,000 breeding pairs, located in the Firth of Forth, SE Scotland - using four independent sources of data from a long-running field study. These comprise: abundance estimates from annual colony counts; capture-recapture data for marked adult birds; capture-recapture-recovery data for birds ringed as chicks; and data on breeding success arising from intensive observations of a sub-section of the colony. The model is non-trivial due to the complex nature of the population (e.g. delayed maturation; emigration of pre-breeders; and reduced visibility and tag loss in 'chicks' of breeding age). The analysis is based around a state-space model to describe the underlying population dynamics, and is implemented in a Bayesian framework using MCMC to obtain parameter estimates, including survival and productivity rates, and previously unrefined estimates of pre-recruitment emigration probability and colour ring loss. A paper focussing on the methodology of this work is currently under preparation for submission to the journal *Biometrika* or similar, with a further paper from a more biological standpoint to follow. This work is the first step in building a model to incorporate the dynamics of neighbouring colonies and ultimately the whole of the Scotland/UK population. Toby has also spent some time undertaking fieldwork on the Isle of May to gain a first-hand impression of the system.

Ella Marley-Zagar is funded by the University of St Andrews and jointly supervised by Len Thomas, John Harwood and Steve Buckland at St Andrews and by John Durban at the US National Marine Mammal Laboratory; she has made excellent progress, although she is currently on leave from study for personal reasons. The southern resident killer whales on the Canada/US border in Puget Sound form a small population that has slowly declined in recent years. The population is intensively studied, and Ella spent the summer of 2006 carrying out fieldwork. She is modelling the near-complete time series of data on deaths, births and abundance of the three extended pods that make up this population. She has shown that birth rates are significantly correlated with chinook salmon abundance, lagged by three years, which is the lag that the biology of killer whales would suggest.

Eleni Matechou started her PhD work in October 2006. Her first 18 months are to be mainly spent in the Max Planck Institute of Demographic Research in Rostock, where she is supervised by Dr David Thomson. She is working to develop statistical methods to study age-dependence in mortality rates. Her research activities commenced with work on a review of current methods in this field, with a particular emphasis on mark-recapture/mark-recovery approaches. In her project there is a particular interest in ways of reconstructing age-trajectories of mortality when the age of individuals is unknown but where the age-structure of the population can be inferred. A broad framework for doing this has been mapped out and comparisons have been made with recent alternative models developed by Associate Professor Shirley Pledger.

Alison Johnston, funded by the Royal Society for the Protection of Birds, is supervised by Rhys Green (Department of Zoology, Cambridge) and Steve Buckland at St Andrews. She is half way through her three-year PhD and beginning to produce interesting results. The population of stone curlews in the UK declined markedly during the 20th century but has increased under conservation management. The management consists of protection of eggs and chicks from agricultural operations and creation and restoration of breeding habitats. It is expensive and it may be possible to rationalise it. Alison's research aims to build a population model which can be used to evaluate the effects on population growth rate and population size of reducing or increasing the effort put into each of the several forms of conservation management. So far she has compared breeding success in different types of nesting habitat and found evidence of a decrease over time in most habitats, perhaps linked to the increase in population size. She is also carrying out analyses of replacement nesting after failure, survival of full-grown birds and age at first breeding. These should enable the construction of population models incorporating the effects of density-dependence.

4.2 **NCSE Workshops**

The Centre held the first of its annual workshops at St Andrews in May 2006. It was attended by 43 researchers in total.

The first two days were spent in training sessions on the key statistical methods used in research throughout the Centre, with a further three days of presentations and discussion of current and future research. Appendix 8 provides further information on the presentations. The primary focus for statistical training for the PhD students and PDRAs was the sessions on the Kalman filter, MCMC and WinBUGS, and Sequential Monte Carlo methods. An additional 16 PDRAs and PhD students also benefited from these sessions. Further training has been provided to Centre PhD students and PDRAs on an individual basis, including fieldwork experience where appropriate. Appendices 13 and 14 provide further information on this training and fieldwork experience. In addition to training which has been delivered, the PDRAs and PhD students have been encouraged, through their regular seminar programme, to review current research papers as a group.

The next annual workshop is scheduled for June 2007 at Kent, when there will be training sessions on biodiversity, distance sampling, evolutionary strategies and the use of score tests.

4.3 **Annual Centre meetings and the NCSE Annual Seminar**

In addition to these large Centre workshops, a series of Annual Centre meetings has been established. The first of these took place in January 2006 and served as the inaugural meeting for the Centre. The second took place in December 2006. Members of both the Steering and Management Committees meet with members of the Centre from all three institutions to discuss the research that is currently ongoing, provide critical input and plan for future developments. Research students and PDRAs gave talks on their work, and all present attended the NCSE Annual Seminar.

4.4 **Visitors and seminars**

Other joint activities between the three member institutions include a series of video-conferenced NCSE seminars, with a minimum of one seminar per term, and a series of student/PDRA seminars. Appendices 9 and 10 provide further information on the seminars.

In addition to Centre meetings and seminars, the Centre has welcomed visitors to one or more of its partner institutions and members of the Centre have visited other parts of the Centre. Appendices 11 and 12 provide further information on the visits that have taken place.

4.5 **International conferences, courses and national meetings**

Members of NCSE from different institutions have collaborated to publish papers, deliver seminars/workshops and present posters. Appendices 2-6 provide further information. One particular example is a meeting of the *General Applications Section* of the *Royal Statistical Society*, for which the NCSE was invited to provide speakers; Byron Morgan, Ruth King, Len

Thomas and Takis Besbeas presented recent research. Appendix 18 provides further information on these talks. In October 2007, a meeting of the local group of the Royal Statistical Society in Sheffield will feature three talks by members of the NCSE.

Members of NCSE have been involved in the delivery of a number of courses since October 2005. These took place in Russia, the USA and Germany, as well as several courses being run at St Andrews. Appendix 5 provides more information.

Further Centre activities that are planned include an invited paper session at the *International Biometric Society* Conference in Dublin in 2008 which, if selected, will allow NCSE to showcase the work of three young researchers from France, Argentina and the USA. The session would be chaired by Byron Morgan, and Paul Blackwell of the University of Sheffield has agreed to act as the Discussant. A copy of the submitted proposal appears in Appendix 19. An NCSE satellite conference is being planned to run alongside the conference in Dublin from 14 to 19 July 2008. This will take place in St Andrews. Accommodation and a venue have been booked and an impressive line-up of invited speakers has agreed to take part. Details are provided in Appendix 20. Members of the NCSE comprised the largest British contingents at both the *International Biometric Conference* in Montreal, in July 2006, and at EURING 2007, in the University of Otago, New Zealand, in January 2007. In both cases, participation was assisted by travel grants from The Royal Society.

5. Contributions to the Centre

5.1 From partner Universities

Contributions from the partner Universities are listed in Appendix 15.

Significant contributions have included 50% teaching and administration relief from Kent for Byron Morgan's input to the Centre as its first Director and 25% teaching and administration relief for each of Steve Brooks and Steve Buckland as co-Directors, from Cambridge and St Andrews respectively. In addition, half-time Administrators have been provided at each of St Andrews and Kent, a studentship has been provided at St Andrews, 50% of a studentship has been financed by Kent and additional PhD fees (overseas student) for Vanessa Cave have been met by the Churchill fund in Cambridge. The PDRA salary of Pajaro Morales was paid from the Leverhulme Prize awarded to Steve Brooks in Cambridge.

No charges have been levied by any of the three Universities for the use of video-conference facilities. In addition, Cambridge purchased video-conference facilities explicitly for the use of the Centre.

5.2 Additional contributions

Significant contributions have included the provision of two research posts, each for one year, by the Leverhulme Trust and a 50% studentship from the Max Planck Institute, Rostock, Germany. Contributions from other institutions are listed in Appendix 15.

6. Links with the academic and user community

6.1 Industrial and commercial organisations

Links with non-academic institutions are being developed, including CEH Monks Wood; The Wildfowl and Wetlands Trust; IMEDEA, Majorca; Cefas; the Fisheries Research Services at Aberdeen (FRS); The National Marine Mammal Laboratory at Seattle and the Centre for Whale Research, San Juan Island; the North Gulf Oceanic Society, Alaska; the Bahamian Marine Mammal Survey; and the Borders Deer Management Group, Scotland; CNRS at both Chizé and Montpellier, France. Appendix 17 provides more information. FRS is investing in St. Andrews to build research expertise in Scotland in Bayesian stock assessment methods. They are funding the salary costs of a Readership in Statistics for 4 years, and a linked

research studentship. David Borchers has been appointed to the Readership, starting in August.

6.2 Academic

Discussions with other academic institutions have begun, to develop their links with the work of the NCSE. These include The Max Planck Institute in Rostock, Germany; ADFA, Canberra, Australia; the Universities of Auckland, Otago, Exeter, Aberdeen, Nottingham and East Anglia. Appendix 16 provides more information.

7. Future plans and challenges

The potential of the NCSE is enormous, and our only restrictions at present are in terms of finance and personnel. With the guidance and approval of the Steering Committee, we have decided to spend the early years building a firm platform for future development.

At Kent, Morgan is working closely with members of the Durrell Institute for Conservation Ecology; he is proposed as a joint supervisor for projects involving sampling reptiles, and a joint grant application for NERC is in preparation for sampling tiger populations in Indonesia using camera traps. He will also jointly supervise a new PhD studentship in ecology at Imperial College, with Tim Coulson. Interest in the work of the NCSE has led to seminar invitations from the ecologists in the University of Cornwall, and CNRS, Chizé. A British Council Alliance grant is being prepared by Gimenez and Morgan, for reciprocal visits between CNRS Montpellier and Kent. A possible Defra grant application is being considered by Cefas and NCSE. There are many possibilities for overseas links, for instance in America, Australia, Hong Kong, Taiwan, Canada, Finland, etc. A grant application for the Public Understanding of Science is in preparation.

At St Andrews, Buckland is increasingly involved with efforts to quantify trends in biodiversity, resulting from a commitment by over 170 countries to reduce the rate of loss of biodiversity by 2010. He is working to improve survey and analysis methods with the Tropical Ecology and Monitoring Network, coordinated by Conservation International and funded by the Gordon and Betty Moore Foundation, and has been asked to teach on two training workshops, one on methods to quantify biodiversity trends and one on distance sampling. He has also been invited to write a book chapter on the topic. The appointment of Janine Illian to an Academic Fellowship starting in September 2007 will enhance NCSE expertise in quantifying biodiversity; she is currently co-coordinator of an international working group on spatial analysis of tropical tree biodiversity. The links with, and funding from, Fishery Research Services (Aberdeen) will allow NCSE to build a group with expertise in stock assessment and marine ecosystem modelling. Thomas will continue the development of the software Distance, together with research projects in distance sampling, funded by the US Office of Naval Research, together with a range of bodies from around the world.