NCSE Newsletter

National Centre for Statistical Ecology

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NCSE reaches out

NCSE has been well-represented at international conferences recently. In January, representatives from Kent, St Andrews and Cambridge joined forces to travel to the EURING conference in New Zealand to promote the research that is currently active within the Centre. You can find out more about this conference and the contribution made by NCSE in the article on page 4.

NCSE has seen some exciting developments in its own meeting plans; it will be hosting an Invited Paper Session at the International Biometric Conference in Dublin in 2008, showcasing the work in statistical ecology of three young researchers from Europe and North and South America. It will also be hosting its International Statistical Ecology Conference in St Andrews as a satellite to the IBC. A call for papers will be launched this summer. More information appears on page 3.

Yosemite05 – a yearling male briefly featured in the BBC's Autumnwatch series © Kelly Moyes

A little closer in time is the NCSE's next scientific meeting, in Canterbury from 18 to 21 June 2007. More information appears on page 5.

As promised in Issue 1, Kelly Moyes tells us a little about her time on Rum, assisting with the BBC's Autumnwatch programme. There are also brief articles on ongoing NCSE research to develop statistical methods in ecology. Many of the projects will be discussed at the NCSE June scientific meeting.

Special points of interest:

- Advance notice of NCSE's International Statistical Ecology Conference 2008
- An update on research projects
- NCSE makes a significant contribution to EURING 2007
- Preview the content of the 2nd Annual NCSE Workshop
- Arrivals and appointments
- Join the mailing list for the NCSE seminar series

Inside this issue:

NCSE at the House of Commons

EPSRC, in conjunction with the Council for the Mathematical Societies, held an "Engaging Maths" showcase event hosted by Anne Snelgrove MP, at the House of Commons Terrace Pavilion on 28 February 2007. The brochure associated with the event is available from

www.epsrc.ac.uk/CMSWeb/Downloads/Publications/Other/EngagingMaths.pdf

and presents 22 case studies of EPSRC-supported research in the mathematical sciences, in each of the following seven areas: security, medicine and biology, telecommunications and the internet, environment, finance and economics, industry, transport and travel.

Keynote speeches were given by Sir David Brown (Motorola) and Lord William Waldegrave (UBS). The event was aimed primarily at MPs and members of the House of Lords. The main messages of the event were that mathematical and statistical techniques are used in a wide range of areas, including health, environment, transport, security, industry, communications and finance, and such techniques play a crucial role in strengthening these important areas, for the benefit of the UK.

The NCSE was represented by Byron Morgan, and the work of the NCSE is described on page 7 of the brochure.

Climate change and ecological populations

As external supervisor for Daniel Brown's PhD, which is concerned with relating survival rates of birds and animals to weather data, I was intrigued when I discovered a series of three workshops on the effects of climate change on ecological populations and communities. These workshops are funded by NERC and led by Dr Frank van Veen of Imperial College. I missed the first one, but managed to get myself invited to the second, in Exeter, in April.

Some workshops consist almost entirely of presentations – this was different. After some brief presentations on the first morning, the remainder of the time was mainly spent actually analysing data. Eleven ecologists from Sheffield, York, the Open University, Madrid, Plymouth, Exeter, Imperial, and the Wildfowl and Wetlands Trust worked in small groups on five projects. There was interaction between, as well as within, groups, and three additional participants floated between groups. These were a climate scientist from the Met Office, a climate scientist with statistical expertise and a statistician with some climate knowledge (me).

Was it statistical ecology and hence relevant to NCSE? The answer to the first part of the question is definitely 'Yes' – all the projects were ecological and needed statistical analyses to some degree. However, the advanced and computational statistical methodology, which is a strength of NCSE, was largely absent. Instead, there was a lot of interesting exploratory analysis and modelling up to and including GAMs. No-one was considering Bayesian techniques, though I did sow the seed that they might be relevant to one of the projects. There is insufficient space to describe any of projects in detail, but the data sets ranged from a fairly simple one on numbers of migratory geese, in which one problem was how to quantify storminess of weather during migration, to the simultaneous analysis of large data sets giving species abundance (plants and birds), traits of the species, and habitat characteristics at many sites across the UK.

The final workshop is in November. I don't know whether I'll be going – I may not be invited – but if I do I'll look out for items of interest to NCSE. I had hoped to give a link to further information but, in line with the informality of the workshops, there is currently very little documentation.

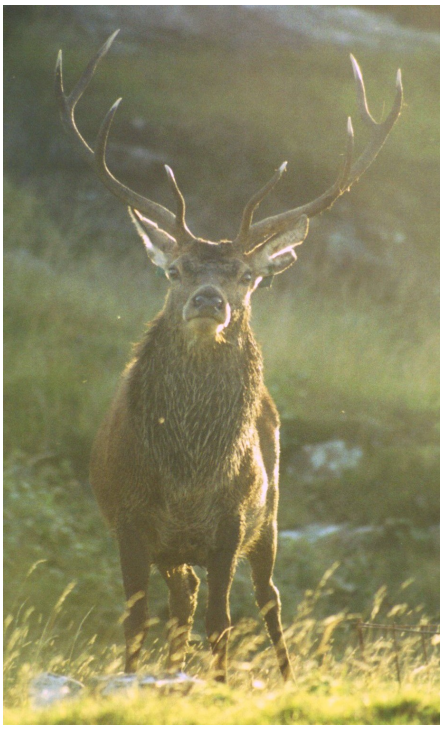
Ian Jolliffe

Autumnwatch and the red deer project

The red deer study on the Isle of Rum was started in the early 1970s and is run by Cambridge and Edinburgh Universities. The study area is just one part of the Isle of Rum, which is owned by Scottish Natural Heritage. The study area has remained unculled since early in the study; there are no natural predators of adult deer, although some calves are taken by eagles. The data collected are incredibly detailed; for every individual their maternity and, in most cases, paternity are known. Birth date (often known to within an hour), birth weight and date of death are recorded for most individuals. A census of the entire study area is taken five times a month for most months of the year; the location of individuals and their proximity to others is monitored. These data are ideal for studying life history traits; there are few studies of large mammals over such a long timeframe that are as detailed as the red deer study. Kelly Moyes is lucky enough to have access to the deer database for her PhD to research life history traits and individual heterogeneity. She describes her involvement with the BBC's Autumnwatch programme as follows:

"The rut is one of the most exciting times of the year on the deer project. Throughout the rest of the year, deer are not really known for their exciting behaviour, but in late summer stags move into the hinds' home ranges and begin to form harems. Conflict occurs between stags, and a near constant background noise of roaring is heard in the study area. Fights between stags are not uncommon, and the deer can be observed at a short distance as they are relatively well habituated. For these reasons, the BBC chose to use the study area, Kilmory, as one of their locations for the Autumnwatch production in October 2006.

The programme was broadcast live from the study area four times a week for two weeks. As Kilmory has no electricity, no telephone or mobile reception and is half an hour along a very rough track from the island's only village, this was a huge undertaking for the BBC. Gales, heavy rain and curious stags all had the potential to damage the enormous amount of equipment needed by the BBC. My main role throughout filming involved sitting with one of the cameramen, identifying individuals and pointing out exhibited behaviour that would be useful for the series. The programmes incorporated much of the information we already know about the deer, including information on the previous reproductive success of stags, the success of their paternal ancestors and also comparisons between antlers, using examples of antlers and skulls from our collection. Autumnwatch aims at promoting interest in British wildlife to the general public. The filming was very successful, and a forum set up to answer any questions about the deer was incredibly popular. It was rewarding that the habituation of the deer and the huge amount we know about them helped to create a successful television documentary."



Tanya94 (aka Caesar – names of stags were changed during filming to protect their identity) © Kelly Moyes

For more information on the Isle of Rum red deer study see: www.zoo.cam.ac.uk/zoostaff/larg/pages/**Rum**.html

International Statistical Ecology Conference, 9-11 July 2008

NCSE will host the International Statistical Ecology Conference at St Andrews on 9-11 July 2008, a week before the International Biometric Conference in Dublin. Plans are progressing well, and we have a full schedule of invited speakers lined up:

Ken Burnham , Assistant Unit Leader, Colorado Cooperative Fish and Wildlife Research Unit

Anne Chao, National Tsing Hua University, Taiwan

Jim Clark, Blomquist professor of the environmental sciences and biology, Duke University

Jim Nichols, Wildlife Biologist, USGS, Patuxent Wildlife Research Center, USA

Shirley Pledger, Reader in biometrics, University of Victoria, Wellington, New Zealand

Roger Pradel, Biometry and population biology team leader, Center for Evolutionary and Functional Ecology, Montpellier, France

Carl Schwarz, Simon Fraser University, Canada

A call for contributed papers will go out this summer. We particularly encourage papers in the areas of:

- mark-recapture methods,
- distance sampling methods,
- other abundance estimation techniques,
- monitoring of biodiversity,
- survey design and analysis for estimating population trends,
- modelling of spatial trends in animal density,
- integrated population modelling,
- stochastic population dynamics modelling,
- stochastic multispecies modelling,
- stochastic modelling of animal movement.

Gateway building, St Andrews

The conference web site is at http://www.creem.st-and.ac.uk/isec2008/

We hope that you will be able to attend.

Integrated models for abundance and demography of bird populations

Vanessa Cave took a poster describing some of her recent analyses to her home country, New Zealand, for the latest technical meeting of the European Union of Bird Ringing. As Vanessa described in Issue 1, ringing under the Constant Effort Scheme (CES) is standardised from one year to the next, so that changes in the numbers of birds caught can be attributed to changes in abundance. Inevitably, of course, some proposed visits to a site are missed, usually because of poor weather, and an adjustment for this is required to keep the analysis valid. Existing methods are somewhat ad hoc, and liable to overestimate the level of confidence in the estimates of population change obtained. Vanessa has therefore developed and begun to explore new methods of accounting for the visits missed, that properly account for the uncertainty involved in 'filling in' the absent observations. Initially she has been concentrating mainly on data for the Sedge Warbler, a small brown bird whose noisy song is a familiar summer sound in British reedbeds. This species is particularly amenable to analysis, as it can be caught in appreciable numbers at favoured sites. Vanessa has also been using these data to estimate the numbers of young birds produced each year. As the project develops, she will be using all of this information to construct, for the first time, single models for CES data accurately describing both abundance and demography.

"Forthcoming paper in Environmental and Ecological Statistics"

Model selection using RJ-MCMC algorithms

Robert Gramacy has been looking into improving the mixing of reversible jump (RJ-) MCMC algorithms for model selection and model averaging.

Simulated Tempering (ST) and Metropolis Coupled MCMC (MC^3) are established methodologies for Monte Carlo sampling from multimodal distributions, where mixing is generally poor. The technique involves introducing an auxiliary "inverse-temperature" parameter k varying between zero and one, which indexes a sequence of marginal distributions for the parameters of interest from which it is somehow easier to sample. A common tempering technique is simply to raise the distribution of interest to the power k, called "powering up". In this way, small k is meant to encourage better mixing by flattening and widening the peaks and raising the valleys, thus making isolated modes more accessible. However, samples from the marginal distribution of interest can only be obtained when the joint chain (for k, and the parameters of interest) reaches k=1. So ST and MC^3 discard the lion's share of samples and potentially great improvements could be made if the discarded samples were recycled. In fact, samples from all k can be saved if importance sampling (IS) weights are calculated.

Unfortunately, this tends not to work well in practice as the established ST and MC^3 defaults thwart efficient IS, and the current methodology for combining IS estimators, one for each k, is not directly usable unless the normalization constants are known. A new optimal heuristic for combining IS estimators has been developed where normalization constants are unnecessary. New temperature ladders (i.e., choices of k) are also developed which give better IS estimators. The end result is a so-called importance tempering (IT) methodology that works particularly well for model selection and inference with RJ-MCMC and offers an order of magnitude improvement over standard ST and MC^3.

The way forward . . .

The Steering Committee of NCSE meets annually to review the progress made by the Centre and to consider opportunities for its future development. Their second meeting took place on 18 and 19 December 2006 at the Centre for Mathematical Sciences in Cambridge. They were joined by members of the Management Committee, who have day-to-day responsibility for advancing the Centre's research projects, and the Centre's PhD students and post-doctoral researchers, some of whom presented their recent work.

Talks were given by Vanessa Cave, Toby Reynolds, Chris Lynam and Daniel Brown. Robert Gramacy, Leah Johnson and Daniel Brown presented posters of their recent work.

" Current research informs future direction of NCSE"

EURING 2007 Technical Meeting

The triennial EURING technical meetings, the latest of which took place in New Zealand in January, are the closest thing we currently have to an international conference series on wildlife statistics. The meetings are closely associated with EURING, the European Union for Bird Ringing, and so have an emphasis on the statistical inferences one can draw from captures and recaptures of individually marked (ringed) birds. However, the meetings have become increasingly general, and the 2007 meeting included a session on inferences from count data (i.e., where animals are not caught or individually identified), and many non-bird datasets. It was also held in Dunedin, New Zealand – a long way outside Europe!

The meeting traditionally provides a forum for exchange of ideas between practitioners, keen to use capture-recapture data to answer biological questions, and statisticians who research new methods to do this. The meetings are small (around 100 people) and friendly; 2007 was no exception. We were exceptionally well looked-after by our hosts, and sincere thanks must go to the local organizing committee for putting on such a great programme of extra-mural activities, which included opportunities to experience both first class wildlife viewing and first class dining, often in close succession.

The technical program had at its core 9 quarter-day themed sessions, each with one or two plenary speakers and three to five contributed talks. A full list of all talk titles, with abstracts, is available at the meeting web site (see link below); topics ranged from the very technical (multistate models, Bayesian methods) through to more application-focussed (evolutionary ecology, wildlife and conservation management). The meeting was preceded by two day-long sessions: a software day, where speakers demonstrated how to achieve useful analyses using various new computer programs, and short course day that gave primers on (i) the role of modelling in wildlife science; (ii) experimental design for capture-recapture and (iii) Bayesian methods. There was also an excellent evening poster session, with around 50 posters.

The NCSE was very well represented at the meeting. Byron Morgan, Chiara Mazzetta and Olivier Gimenez (former NCSE postdoc, now at CEFE Montpellier) gave a short course on Bayesian methods, and Olivier introduced the use of the software BUGS for fitting Bayesian models during the software session. Len Thomas discussed the Distance software in the software session, emphasizing the joint capture-recapture distance sampling part that was developed by David Borchers and Jeff Laake. Len also co-chaired the first session, on inferences from un-marked animals, Byron gave a plenary talk in the "combining information" session, and Olivier talked about some Bayesian smoothing work he'd done as part of his postdoc in Kent. NCSE student Rachel Borysiewicz gave an excellent talk on combined analysis of capture-recapture and count data, and students Kelly Moyes, Chiara Mazzetta, Vanessa Cave and Jon Bishop gave posters on their PhD work. Byron, Len, Olivier and Ruth King were also co-authors on several posters, and Len and Ruth were co-authors on a talk given by Steve Baillie (current chair of EURING), reporting some integrated population modelling he did while on sabbatical with St Andrews.

Many of the other talks and posters also reported exciting new research in statistical ecology. One highlight was a series of talks by researchers at CEFE, Montpellier, presenting methods and user-friendly software further extending the inferences that can be made about the state (e.g., location, breeding status, etc) of marked but unseen animals from capture-recpature data; the new methods allow for uncertainty in determining the state of the animals when they are seen (e.g., known alive but location not recorded or breeding status not confirmed). These new methods are extremely general, and appear to complement those being developed at NCSE Kent and St Andrews on state-space models of animal population dynamics. Another phenomenon of note was the increasingly pervasive use of Bayesian statistical methods, made possible by the general availability of sufficiently powerful computers coupled with relatively new user-friendly software.

Birdwatching in Otago Harbour © David Fletcher

At the end of the meeting, it was agreed to hold the next one in summer 2009 in Italy. Meanwhile, NCSE is organizing a major conference on statistical ecology in summer 2008 in St Andrews (International Statistical Ecology Conference, details below). If these are anything like as friendly, constructive and informative as the Dunedin meeting they will be well worth attending.

Len Thomas, 20 March 2007

More information about the EURING organization is at http://www.euring.org/, and about the EURING 2007 technical meeting is at http://www.phidot.org/euring/main.html. The meeting proceed-

2nd Annual NCSE Workshop—18-21 June 2007

The 2nd Annual NCSE Workshop is taking place at the University of Kent from 18 to 21 June. The packed programme includes:

- Opening talk by David Thomson, Max Planck Institute for Demographic Research, Rostock, Germany - Biodemographic frontiers in statistical ecology.
- Training sessions by Simon Wood—GAMs, Byron Morgan—Score tests, Steve Buckland—Biodiversity, David Borchers and Steve Buckland—Distance.
- Other contributions include: David Borchers—Using hidden Markov models to deal with availability bias on distance sampling surveys, Rachel Borysiewicz—The use of score tests for multi-state model selection, Daniel Brown—The Lasso as a tool for model selection, Diana Cole—Parameter redundancy, Steve Freeman—Trends in avian productivity, Teresa Frost— Seasonal population monitoring data, Ruth King—Recent advances in analysing capture-recapture data, Chris Lynam—The problem with sika deer: sparse data and conflicting information, Laura Marshall— Estimating the relative abundance of harbour porpoise and patterned dolphins to the West of the United Kingdom using gees and a knot placement algorithm, Chiara Mazzetta—Modelling spatial and temporal dynamics of the Soay sheep population, David Miller—The use of symbolic algebra to provide explicit perturbation analysis, Toby Reynolds—Integrating abundance, capture-recapture-recovery and productivity data in a Bayesian population model: an assessment of the Isle of May common guillemot colony, Martin Ridout—Comparing temporal niches of tropical mammals, David Sewell—MARK analysis of great crested newt data.

University of Kent campus

Monitoring Biodiversity

At the 2002 World Summit on Sustainable Development in Johannesburg, political leaders agreed to strive for 'a significant reduction in the current rate of loss of biological diversity' by the year 2010. This raises several statistical issues. For example, how should surveys be designed to measure trend in biological diversity? The plant community generally prefers to sample species, then assess changes in status of those sampled species, taking those to represent all species. This, in principle, allows them to use herbarium collections, to quantify trends retrospectively. However, any statistician is likely to take the view that collections in herbaria are highly unlikely to allow reliable quantification of trends. Even if they do, species well-represented in herbaria are highly unlikely to be representative of species in general.

Site-based schemes seem to offer much greater promise. The difficulty here is that site-based schemes to date tend to be concentrated in areas with pristine habitat, for which great volumes of data are gathered. To quantify regional and global diversity trends, we need sites selected according to some randomized scheme, but we do not need vast quantities of data from each site.

The BTO's Breeding Bird Survey (BBS) is one of a very few schemes based on random selection of sites over a large region. It therefore allows effective quantification of biodiversity trends within the UK. Other schemes are starting to emulate it, and we can expect an upsurge of interest into such monitoring approaches, and in the methods needed to analyse the data. Meantime, 2010 is only three years away, and to demonstrate 'a significant reduction in the current rate of loss of biological diversity', we need at least three time points in our survey .

Classical methods of estimating biodiversity, such as the Shannon and Simpson's indices, are based on relative abundance of species, and tend to be stable and robust to inclusion of rare species. However, if all species in a community are declining at the same rate, these indices show no change. Surveys such as the BBS generate time series of relative or absolute abundance measures of a species across time. A robust way of combining these into a biodiversity measure (provided we exclude the rare species) is to take the geometric mean of the time series. In this case, if all species are declining at the same rate, the index will also decline at this rate. However, if generalist species tend to increase while specialist species decrease, so that so-called beta-diversity declines, such measures may fail to identify the problem. Essentially, biodiversity is a multivariate concept, and any univariate attempt to quantify change will be unsatisfactory.

> ***"NCSE contributes to international research and training workshops in biodiversity"***

Statisticians contributed to the development of classical measures of biodiversity, but the uses of biodiversity measures have changed appreciably in recent years; there is now much greater interest in use of indices to measure the success of management, whereas the classical measures were intended for use in theoretical ecology. There is therefore much scope for statisticians to make important contributions to both design and analysis. Steve Buckland has participated in research workshops at the Royal Society (papers from that workshop subsequently appeared in the Philosophical Transactions of the Royal Society), Silwood Park and Iguacu in Brazil to discuss these issues, and is co-teaching a training workshop in Belo Horizonte in Brazil in June, for scientists who are responsible for sites established to monitor changes in biodiversity in rain forest.

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We're on the Web!
www.ncse.org.uk

NCSE was set up in October 2005 as a joint venture between the Universities of Kent, Cambridge and St Andrews, with funding from the EPSRC. Its objectives include:

- To be a Centre of international repute for the development and application of novel statistical methods in population ecology, integrating the partner Universities' research programmes and activities in statistical ecology.
- To develop novel statistical methodology for the analysis of complex data sets arising in ecology and to apply these methods to a broad collection of topical and important data sets.
- To train PhD and postdoctoral researchers to work as statistical ecologists.
- To develop a computer software system to enable ecologists to use cutting edge statistical methodology on their own data.
- To train end-users in the use of methodology and accompanying software developed by NCSE.
- To build upon and create new collaborations with relevant stakeholders.
- To develop and deliver a programme of workshops and conferences.

Snippets!

Welcome to:

Diana Cole, who has started her appointment as a postdoc in NCSE, based in the statistics group at Kent. Diana will be working with Byron Morgan on Parameter Redundancy. She has just completed her previous postdoc project working on the development of stochastic models of yeast prion propagation.

Congratulations to:

Bobby Gramacy, who has been nominated for the Savage Award for the best applied Bayesian PhD thesis of the year (2006) . His research focused on Bayesian treed Gaussian process models. The winner will be announced in August 2007.

Chiara Mazzetta and Kelly Moyes, who have both successfully completed their PhDs. Well done!

New appointments:

Lauren Oliver will be joining NCSE in September 2007 to work on the EPSRC-funded PhD project 'Models for long-term individual-based time series'. She will be based in Kent and will be supervised jointly by Byron Morgan and Tim Coulson (Imperial College). The project will extend the Centre's work in developing Kalman Filter methods.

Movements:

Chiara Mazzetta has now moved to Kent to work on the BBSRC-supported project: Linking ecological and evolutionary dynamics, co-supervised by Tim Coulson, a member of the NCSE Management Committee.

NCSE seminars:

Recent NCSE seminars include:

- Paul Conn, Colorado State University, USA, speaking on 'White Bayesian analysis of wildlife age-at-harvest data';
- Jean-Michel Gaillard, University of Lyons, France, speaking on 'How does individual heterogeneity influence detection of senescence and trade-offs: ungulates as case studies'.

NCSE seminars are organized as video-conferences between the speaker's 'home' site and Kent, St Andrews and Cambridge. Other sites are able to opt-in as required.

If you would like to be added to the mailing list for future NCSE seminars, please contact Alexa Laurence (A.F.Laurence@kent.ac.uk).