



Centre for Ecology and Conservation

Annual Report 2013

Welcome

It has been another outstanding year for the Centre for Ecology and Conservation (CEC) and high-quality growth seems to be the phrase that best defines 2013. All our research targets have been exceeded, student numbers continue to increase, as does tariff, and we continue to recruit excellent new staff. This upward trajectory follows on from stellar performances in 2011 and 2012, and it really does seem that each year's performance exceeds that of the preceding record-breaking year. We also continue our integration with Geography Cornwall, and this group and the CEC are now acting as a single discipline, the College of Life and Environmental Sciences (CLES) Cornwall, with added benefits for all. Collaboration with the Environmental and Sustainability Institute (ESI) also continues apace. Indeed many ESI staff are members of CLES, and the combined research power of the CEC and ESI is considerable and will continue to grow.

Our research inputs and outputs are simply world-class for 2013. The CEC had £7.3million in new grants this year, taking our total live grants to approximately £17million. This is an outstanding achievement for which all staff and students are responsible, as it is the administrative, teaching and research support plus the intellectual milieu that everyone provides that facilitates this sort of success. In addition to the excellent funding news, publications during 2013 were again numerous (the CEC produced close to 200 publications in 2013) and included many clear 4* papers (see later in this report). This caps off an excellent research (REF) period, and a special congratulations to Dr Annette Broderick, whose work on sea turtle conservation was one of the REF Impact Studies, and to Dr Martin Stevens for his ground-breaking book, *Sensory Ecology, Behaviour, and Evolution*.

In addition to research triumphs, this year saw student numbers in the CEC reach record levels – we now have a total of 438 undergraduate and

74 Masters students on our biology programmes. Our success is now only limited by the size of teaching spaces, although because of the design of our provision, we are still able to deliver the smaller class sizes that make our programmes so popular. The addition of new field courses, to Borneo and the Bahamas, means we are also still able to offer the unique field experience so valued by employers and students. It looks as though this success will continue into the future too, as current projections for the next academic year are very robust for the CEC and for CLES Cornwall as a whole. We also have exciting new undergraduate programmes coming on-stream – Marine Biology and Human Sciences – that will further bolster student numbers and continue to allow us to provide the hands-on and intimate teaching atmosphere that makes our programmes so attractive.

We again ran Science in the Square, our major outreach event, with ESI and Geography colleagues and, as previously, it was a tremendous success. This event is becoming a highlight of Henri Lloyd Falmouth Week and is a great way to pay back the local community for its support, while also raising the profile of the CEC, CLES Cornwall, the Penryn Campus and University as a whole. I again thank all those involved and especially the organisers of Henri Lloyd Falmouth Week for their continued support.

This year saw a large number of new staff join us: Drs Tom Currie, Flo Debarre, Lucy Hawkes, Chris Lowe, Josie Orledge and Martin Stevens all joined the CEC academic ranks in 2013. They are an outstanding group of academics and it will be a privilege to watch their careers develop in the near future. We expect additional staff increases over the next few years, as research and teaching continues to develop. We were also joined by Dr Dan Bloomfield, as an Independent Fellow, and Dr Caitlin Kight joined us as Education Team Leader. Melia Burdon, Martin Canty, Debbie Daniels, Tom Kells, John McKeown and Ben Toulson also joined our Professional Services staff ranks in one guise or another. I should also add that new CLES colleagues Drs Kirsten Abernethy, Amber Teacher and Steve Votier joined the ESI, and we were also joined by Drs Chris Laing and Sue Rodway-Dyer in Geography. We now have a very resilient group of teachers and researchers who are going to serve us well into the future. I would also like to say farewell to the irreplaceable Dr Rob Wilson, who although leaving the CEC has not been totally lost to us as he has relocated to Streatham Biosciences. This move will help cement our cross-campus research interests and provides another good reason for

linkage across Exeter Biosciences. I also want to congratulate Professor Mike Cant on his promotion to Chair and Dr Britt Koskella to Senior Research Fellow. Both thoroughly deserved and testament to continued excellence and hard work.

We were also awarded Athena SWAN Bronze this year as part of the CLES Cornwall submission. This makes us the first department in the University to obtain a Bronze and we plan to apply for a Silver award in late 2014. The continued involvement of all staff and students in this equality programme is tremendously gratifying and I see this as one of our most important achievements in the last 12 months. Although there is much work still to do, it is a testament to the CEC and all its members that fairness is such strong driver of our collective behaviour.

Finally, this will be my last report as Director of the CEC as I will stand down in 2014. I want to thank all staff and students for their support and hard-work over the four or so years I have been Director. They are an amazing bunch and it is a privilege and continuing pleasure to work with them all. I really look forward to reading the next report and trust the next Director will gain as much support as I have received from all members of the CEC. Remain excellent.

**Professor David Hosken – Centre Director
University of Exeter, Penryn Campus**



Research Highlights

ESRC and human cooperation

Dr Shakti Lamba was awarded an ESRC Future Leaders Fellowship to study the effects of sex-biased migration on the evolution of human cooperation. Shakti is setting up two longitudinal field sites in India and her research combines behavioural, demographic and social data to test evolutionary theories about human behaviour.



Mother's little helpers

Dr Andy Russell was funded by NERC to study the role of mothers in generating helpers in cooperative breeding societies. This work uses the Australian chestnut-crowned babbler as a model and requires Andy to spend time in arid areas of eastern Australia. Previous work on the babblers has shown that mothers gain substantial benefits from having offspring remain and help rear brothers and sisters, but whether or not mothers can influence offspring decisions to stay and help versus disperse and breed are not known.



Getting old – the cricket story

A team led by **Dr John Hunt** and **Dr Nick Royle** and colleagues in the USA and Scotland investigated the effects of oxidative stress on aging in crickets. This stress can occur when normal but dangerous by-products of metabolism overwhelm cellular defences. They found that increased early life fecundity (eggs laid) leads to greater late life oxidative stress in females and this increased rates of aging. However, oxidative damage did not appear to accumulate with age in males or females. (Published in *Evolution*)



Pigeon project on BBC's Winterwatch

CEC Zoology student **Adam Rogers** is inviting members of the public to get involved in his project to record the national pigeon population. Adam appeared on BBC Winterwatch leading a project to investigate plumage trends found in the once-domesticated birds. When domestic animals return to the wild and breed, future generations usually take on their natural dull colour, yet urban pigeons have retained their brightness and variety of plumage.



How high does a goose go?

A team led by **Dr Lucy Hawkes** investigated the apparent mismatch between costs of flight and oxygen levels in bar-headed geese during their flights over the Himalayas. They tracked geese during their flights and found that they actually track valleys rather than fly over mountain peaks. Nonetheless, geese fly at altitudes exceeding 7000m, so they are still able to undergo extreme exercise at very low oxygen levels. (Published in *Proceedings of the Royal Society B*)



Eating networks

A team led by **Dr Frank van Veen** and French collaborators investigated how ecological networks are shaped. They were primarily interested in the effects of evolutionary history (phylogeny) and current ecological processes, such as competition, and how these effect the overlap in the resources used by species. They find that effects differ depending on whether interacting species are resource or consumer species, but basically closely related species consume the same things less often than distantly related species. This provides critical insights into ecological communities just as they are being disturbed by climate change and the resulting arrival of invading species. (Published in *Current Biology*)



EMPSEB comes to Cornwall

Students from the CEC hosted the 19th Annual European Meeting of PhD Students in Evolutionary Biology. These meetings provide a platform for evolution students to meet and present their work and the CEC event hosted around 70 students from across Europe. It also included a public outreach event on the importance of evolutionary biology and featured guest talks from some of the biggest names in the field.



War and society

Dr Tom Currie was part of a team investigating the evolution of large human societies from small groups using mathematical models. They found that their predictions matched the real-world extremely well, and that institutions that enable large societies to work without splintering, probably evolved through warfare. The evolution of these cooperative institutions provides an explanation for associations between duration of statehood, political stability and income per capita. (Published in *Proceedings of the National Academy of Sciences USA*)





Cuckoos and hosts

Dr Martin Stevens and co-workers investigated brood parasitism by a species of cuckoo and found that when a host nest was repeatedly parasitized and the proportion of cuckoo eggs increased, hosts were less likely to reject them. This may be because hosts use the proportion of different looking eggs as a cue to reject the odds ones out. Repeated laying in one nest is common and seems to be a cuckoo adaptation to reduce the likelihood that their eggs will be detected and rejected by the host. (Published in *Nature Communications*)



Flying near whom?

Work by **Dr Alex Thornton** and colleagues at Cambridge University investigated the flight-dynamics of flocks of birds that contain more than one species of bird. They found that birds preferred to fly near members of their own species but that flock dynamics depended on the social dynamics of the interacting species, with more dominant birds tending to be leaders. The work has implications more broadly, showing us that understanding group structure more generally will need to include investigating the relationships between individuals within groups. (Published in *Animal Behaviour*)



Inbreeding risks

A study led by **Dr Andy Young** has found that when female sparrowweavers copulate with males other than those in their social group, these males tend to be more related to the female than social mates. Thus extra-pair matings tend to increase inbreeding, a finding that contradicts a range of theoretical prediction about why females mate with extra-pair males. It was suggested that male-male competition might be driving extra-pair matings and this is eroding potential benefits females might otherwise derive from copulating with non-social group males. (Published in *Molecular Ecology*)



CASE STUDY

Super Snails

In May 2013 **Dr Dave Hodgson** and a team of undergraduate bioscientists set out to describe the night-time behaviour and movement of garden snails, *Cornu aspersum*. The work was funded by Bayer International to raise public awareness of lungworm infection, carried by snails but a killer of dogs. Five hundred snails were marked using LED lights and UV paint, then followed through the night using time-lapsed photography, and for the following seven days using visual survey. Snails moved at a maximum speed of one metre per hour, fast enough to explore the length or breadth of an average UK garden. Snails ended their travels hidden in patches of long grass, against tree stumps, or near water features. The snail footage went viral in the world's press: Dave was sent on a whirlwind tour of BBC media city in Manchester, appearing on BBC Breakfast and 6 o'clock News, interviewing with all the regional BBC radio stations, and appearing on Sky Live. The story was picked up by all the national tabloids and broadsheets, and reached an international audience via the internet and TV coverage. Dave's favourite headline was from a German newspaper: "Schnelle Schnecken!" The final report, for public consumption, can be found at www.itsajungle.co.uk/slime-watch



Student Societies



BeeSoc

Beesoc has continued to invite researchers to give seminars, including Dr Lena Wilfert and Dr Matthias Becher from the University of Exeter, and Dr Peter Graystock from the University of Sussex.

Our yearly bee keeping course has taken place one more time with great success, making a new generation of bee keepers out of all the bee lovers who join us! Additionally, our two observatory hives should be completed and ready for the use of undergraduates and Masters students for dissertations and research projects. To bring us all together we also lead social activities such as documentary viewings, as well as nights out and discussions over honey delicatessen.

Expedition Society

The Expedition Society organises walks in the Cornish countryside and along the coastal paths. We also run longer trips, either casual weekend trips, such as camping or caving, and undertake exploration challenges, such as the Three Peaks Challenge. Alongside this we organise and execute expeditions abroad, entirely run by students. We have previously worked in Cambodia, and we are increasing our project base this year. We are looking to send teams to Madagascar and Palau, as well as returning to Cambodia.

Wildlife Documentary Society

Wildlife Documentary Society (WildDocSoc) is a student-run society that aims to provide activities and guest talks that inspire students with a passion for wildlife documentary film. Events that we have arranged in our first year as a society include: workshops and talks from Doug Anderson, a world leading wildlife cameraman. As well as an exclusive talk from James Honeyborne, who was the producer of the popular BBC series "Africa". We also attended, "Wildlife Behind The Lens: An Evening With Ian McCarthy and Mark Yates" in Lostwithiel as a group. We are very excited to have recently confirmed a future talk from BBC presenter Steve Backshall.

BSEC

BSEC is a student-led committee that facilitates relevant networking opportunities for Biosciences students. We aim to encourage students to think about their professional futures, and to provide them with the opportunity to find out how they can get where they want to be. We work closely with Biosciences staff, College work placements, and the Career Zone to organise and host a weekly seminar series and an annual careers fair to inspire the entire Biosciences' student body.

EcoSoc

We think it says something brilliant about our campus and the University that Ecosoc is the biggest society, with over 300 members, and a huge number of events happening every term. We're passionate about providing our members with opportunities to get engaged with nature, and help other people engage with it too. We have ID courses, habitat management, bird trips, moth trapping sessions, small mammal handling, beach cleans and more! We also run regular socials, most recently a Food Chain pub crawl in which each year took their place in the food chain in a fancy dress evening! Coming up we'll be continuing all of our wildlife themed events, including aquarium trips and mammal trapping, we'll be organising a big fundraiser down at the beach, plus we'll be running our annual BioBlitz!



Athena SWAN Bronze Award

The CEC's Athena SWAN agenda is well and truly up and running. In conjunction with our Geography partners we have introduced several initiatives since the creation of our working group back in 2012. This ranges from simple changes such as reviewing the times when staff meetings are held, to longer-term objectives such as assessing training needs and recruitment processes. This year we obtained funding to run the Springboard programme for



the first time in Cornwall. This is a nationally recognised self-development programme for women.

We learnt in September 2013 that the CEC and CLES Cornwall had won a Bronze Award. To mark this achievement, a group of undergraduate

students produced a video summarising what the Charter means to everyone. This video is simply amazing and can be viewed via this link youtu.be/8W29WR3pdwE

We will continue our good work and apply for a Silver award in 2014.

Funding Awards 2013

Once again the CEC secured significant new funding, this year totalling £7.3million. These came from a diverse range of providers including AXA; the Biotechnology and Biological Sciences Research Council (BBSRC); Department for Food, Environment and Rural Affairs (DEFRA); the Natural Environment Research Council (NERC); the Royal Society and the Wildlife Conservation Society.

In all there were 36 different awards, and here are just a few to highlight the range of awards and awardees. BBSRC grants went to Mike Boots (Understanding the

effects of spatial structure on the evolution of virulence in the real world), Angus Buckling (Engineering synthetic microbial communities for biomethane production) and Martin Stevens (Predator vision and avian egg camouflage). David Hosken and Fiona Matthew (Streatham Biosciences) obtained funding from both DEFRA and Natural England to study the impact of wind turbines on bats, and Brendan Godley was funded by DEFRA to work on Marine Protected Areas. The Royal Society funded John Hunt (The stability of the G matrix over evolutionary time) and Shakti Lamba (The effects of Demography

and migration on co-operation and competition), and Sarah Hodge secured funds from the Research Councils UK (RCUK) for a Schools-University partnership and details of this scheme are featured later in this report. The CEC's success at NERC also continued, with awards to Mike Cant and Andy Young, Frank van Veen, Mike Boots, Angus Buckling, Dan Bloomfield, Britt Koskella and Andy Russell, and Angus Buckling, Richard French-Constant and Dave Hodgson won an AXA Award. Finally, Andy McGowan and Lucy Hawkes won JISC funding for the Acorn Project.

Science in the Community



Science in the Square

After our success last year this community event was back by popular demand! This year our theme was “Love your Planet”.

Some 2,000 visitors packed into the marquee to hear talks about dolphins, trees, climate change and British wildlife. There were also various activity zones where everyone had the chance to see and handle exhibits first hand – from identifying bones to looking at life-forms under the microscope and naming the wildlife caught in rock pools that morning. Anyone wanting a break from all this activity could always have their face painted! We are indebted to our staff and PhD students for the work that goes into hosting this event, and not least, for sharing their passion for science. A big thank you also goes to the organisers of Henri Lloyd Falmouth Week and South West Bars for their continuing support.

Taking Science to School

This year we have been working hard to develop our new outreach programme, regularly taking science and research out into schools and the community around Cornwall and beyond.

We now have a menu of workshops that schools can choose from, including sessions on exploring evolution, virtual dissections, live insect handling, endangered species and more. You can view these here on our new outreach web pages: www.exeter.ac.uk/lifesciences/outreach/cornwall

We have secured grants from RCUK and the Annual Fund and these have allowed us to greatly increase the amount of work we do with our local schools. As part of this, we have been able to provide training in science

communication and teaching for a number of our Early Career Researchers, who have been designing and delivering their own workshops. In addition to this, we have also organised a number of events such as “Science: is it for me?” for Year 9 students deciding on which GCSEs to take; our annual BioBlitz where the local community helped us to beat our species total for the campus and, of course, Science in the Square. We have also taken part in a number of large-scale events such as Sidmouth Science Festival, Big Bang South West and the 9th International Student Science Fair, hosted at Camborne Science and International Academy.



Awards and Prizes

Prize Winners

Undergraduate Alexandra North won Best Poster at the Mammal Society Student Conference in June.

This year the Natural Environment Research Council (NERC) held its first photograph and essay competition and two of our PhD students won prizes at the ceremony in December. Paul Hopwood won first prize in the photo section and Dominic Cram was third in the essay section. Essay entries were judged on the ability of applicants to communicate the excitement of their PhD research to a non-specialist audience, while the photography section was judged on eye-catching imagery and whether or not the image conveyed the applicants' research. Paul's photograph showed a pair of burying beetles processing an animal carcass whilst Dominic's essay described catching and tagging birds in the Kalahari Desert.

FXU Awards

Biosciences students were very successful at the 2013 Falmouth Exeter Student Union awards as follows:

Student Society of the Year – *EcoSoc*
Most Innovative Society Project of the Year – *BioBlitz*
Outstanding FXU Committee Member – *Alexandra North*
Student Academic Rep of the Year – *Zeya Wagner*
Best Contribution to Representation and Democracy – *Oliver Maskrey*
Most Significant Contribution to FXU Fundraising – *Amy Brocklehurst*
Most Significant Contribution to FXU Community Action – *joint prize to Kate Buffery and Jenny Coomes*

Congratulations to the following CEC students who were awarded PhDs in 2013:

Alfredo Attisano. Thesis title: Life-history Variation and Evolved Response to Food Stress in *Oncopeltus fasciatus* (Hemiptera: Lygaeidae)

Ritika Chauhan. Thesis title: Bioinformatics of Next Generation Sequencing Approaches: using 454 and Illumina Data to Look at Insect Genomes and Transcriptomes.

Eric Flores de Garcia. Thesis title: Early Development and the Honesty of Aposematic Signals in a Poison Frog.

Fiona Ingleby. Thesis title: Genotype-by-Environment Interactions and Sexual Selection.

Callum Lawson. Thesis title: From Microhabitat to Metapopulations: a Model System for Conservation under Climate Change.

Cheryl Mills. Thesis title: Conservation and Ecology of the Hazel Dormouse, *Muscardinus avellanarius*.

Devi Newcombe. Thesis title: Maternal Effects in the Large Milkweed Bug *Oncopeltus fasciatus*.

Andrew Robertson. Thesis title: Investigating the Causes and Consequences of Individual Niche Variation in Group Living Badgers.

Wayne Rostant. Thesis title: Sex-Specific Effects of DDT Resistance in Flies.

Jennifer Sanderson. Thesis title: Conflict and Co-operation in Vertebrate Societies.

Iain Stott. Thesis title: Modelling Transient Population Dynamics and Their Role in Ecology and Evolution.

Fran Tyler. Thesis title: Sexual Selection and Reproductive Isolation in Field Crickets.

Graduation Awards

Many congratulations to the following students who were awarded prizes at our Graduation ceremony in July:

Undergraduate

Dean's Commendations – **Isabelle Ellis-Cockcroft, Curtis Horne, Sophie Le-Butt, Victoria Lee, Felix Vaux**

CEC Commendations – **Georgina Cass, Tomas Goodgame, Oliver Maskrey, Alexandra North, Stephanie Woolston**

Oxford University Press – **Hannah Dempsey**

Society of Biology – **Isabelle Ellis-Cockcroft**

ZSL Charles Darwin Award – **Ben Kenningale**

Postgraduate

Dean's Commendations for exceptional performance – (70% + Distinction in all MSc modules)

MSc Conservation & Biodiversity 2012/13:

Edward Burrell

Hannah Cole

MSc Evolutionary & Behavioural Ecology 2012/13:

Ellis Langley

CEC Commendations -

MSc Applied Ecology 2012/13:

Outstanding Contribution – **Fraser Bell**

MSc Conservation & Biodiversity 2012/13:

Best Overall Mark (MSc) – **Hannah Hudson**

Best Research Project Mark (Overall Module) – **Hannah Hudson**

Outstanding Research Project – **Yvette Ehlers-Smith**

Outstanding Research Project – **Liliana Poggio Colman**

MSc Evolutionary & Behavioural Ecology 2012/13:

Best Overall Mark (MSc) – **Rebecca Taylor**

Best Research Project Mark – **Rebecca Taylor**

Outstanding Research Project – **Kasha Strickland**

Selected Highlights

Angus Buckling

Royal Society Wolfson Research Merit Award

Professor Angus Buckling was awarded the Royal Society Wolfson Research Merit Award. These prestigious awards recognise research excellence and are given to a very small number of recipients across all UK sciences every year.

Angus is a Professor of Evolutionary Biology and studies the evolutionary ecology of microbes. This is the second award recognising his research excellence, the previous being the ZSL Scientific Medal, and he is the second member of staff in the CEC to hold a Royal Society Wolfson Award after Nina Wedell in 2011.



Britt Koskella

Senior NERC Fellow

Dr Britt Koskella was promoted to Senior Research Fellow in 2013 and won a five year NERC Fellowship to work on co-evolution in complex communities. Britt is particularly interested in virus-bacteria-plant coevolution and her work has the potential to provide insight into how we best address a range of plant diseases by understanding the evolutionary dynamics of these systems. Britt has also played a significant role in our Athena SWAN agenda and in organising WISE workshops, which have been received extremely positively.

Welcome back

We would also like to welcome back Dr Camille Bonneaud after her maternity leave during 2013 and other members of staff also took parental leave including Dr Andy McGowan, Dr Martin Stevens and Dr Alex Thornton. Congratulations to you all.

Mike Cant

Inaugural Professorial Lecture

Professor Michael Cant gave his Inaugural Professorial Lecture on 14 June 2013. Mike joined the Centre in 2007 and his major research focus is the evolution of social behaviour in animal societies. His long-running field study on the banded mongoose in Uganda was the subject of the BBC documentary "Banded Brothers" broadcast in 2010. Staff, students and guests crowded into the Chapel Lecture Theatre to hear Mike's talk, covering his early research and influences through to the present day. Afterwards the celebrations continued in Falmouth with dinner and karaoke, and special mention must be made of Mike's electro-pop guitar heroics that featured some wonderful German lyrical interludes. A man of many talents and an evening to be remembered for many reasons. Congratulations Mike.



Selected CEC Publications from 2013



Archer, C.R., Sakaluk, S.K., Selman, C., **Royle, N.J.** & **Hunt, J.** (2013). Oxidative stress and the evolution of sex differences in life span and ageing in the decorated cricket, *Grylodes sigillatus*. *Evolution* 67:620-634.

Bennie, J., Hodgson, J.A., Lawson, C.R., Holloway, C.T.R., Roy, D.B., Brereton, T., Thomas, C.D. & **Wilson, R.J.** (2013). Range expansion through fragmented landscapes under a variable climate. *Ecology Letters* 16:921-929.

Benowitz, K.M., Head, M.L., Williams, C.A., **Moore, A.J.** & **Royle, N.J.** (2013). Male age mediates reproductive investment and response to paternity assurance. *Proceedings of the Royal Society B* 280:1767.

Cant, M.A. & **Young, A.J.** (2013). Resolving social conflict among females without overt aggression. *Philosophical Transactions of the Royal Society of London B* 368:20130076.

Débarre, F., Ronce, O. & Gandon, S. (2013). Quantifying the effects of migration and mutation on adaptation and demography in spatially heterogeneous environments. *Journal of Evolutionary Biology* 26:1185-1202.

Donnelly, R., Best, A., White, A. & **Boots, M.** (2013). Seasonality selects for more acutely virulent parasites when virulence is density dependent. *Proceedings of the Royal Society B* 280: 20122464.

Elias, M., Fontaine, C. & **Van Veen, F.J.** (2013). Evolutionary history and ecological processes shape a local multilevel antagonistic network. *Current Biology* 23:1355-1359.

Evans, M.R., Bithell, M., Cornell, S.J., **Dall, S.R.X.**, Diaz, S., Emmott, S., Ernande, B., Grimm, V., **Hodgson, D.J.**, Lewis, S.L., Mace, G.M., Morecroft, M., Moustakas, A., Murphy, E., Newbold, T., Norris K.J., Petchey, O., Smith, M., Travis J.M.J., Benton, T.G. (2013). Predictive systems ecology. *Proceedings of the Royal Society B* 280:20131452.

French-Constant, R.H. (2013) The molecular genetics of insecticide resistance. *Genetics* 194:807-815.

Friman, V.P. & **Buckling, A.** (2013). Effects of predation on real-time host-parasite co-evolutionary dynamics. *Ecology Letters* 16:39-46.

Gillespie, D.O.S., **Russell, A.F.** & Lummaa, V. (2013). The effect of maternal age and reproductive history on offspring survival and lifetime reproduction in preindustrial humans. *Evolution* 67:1964-1974.

Harrison, X.A., York, J.E., Cram, D.L. & **Young, A.J.** (2013). Extra-group mating increases inbreeding risk in a cooperatively breeding bird. *Molecular Ecology* 22:5700-5715.

Hawkes, L.A., Balachandran, S., Batbayar, N., Butler, P.J., Chua, B., Douglas, D.C., Frappell, P.B., Hou, Y., Milsom, W.K., Newman, S.H., Prosser, D.J., Sathiyaselvam, P., Scott, G.R., Takekawa, J.Y., Natsagdorj, T., Wikelski, M., **Witt, M.J.**, Yan, B., Bishop, C.M. (2013). The paradox of extreme high-altitude migration in bar-headed geese *Anser indicus*. *Proceedings of the Royal Society B* 280:20122114.

Hayward, A.D., **Wilson, A.J.**, Pilkington, J.G., Clutton-Brock, T.H., Pemberton, J.M. & Kruuk, L.E.B. (2013). Reproductive senescence in female Soay sheep: Variation across traits and contributions of individual ageing and selective disappearance. *Functional Ecology* 27:184-195.

House, C.M., Lewis, Z., **Hodgson, D.J.**, **Wedell, N.**, Sharma, M.D., **Hunt, J.** & **Hosken, D.J.** (2013). Sexual and natural selection both influence male genital evolution. *Plos One* 8:e63807.

Jolles, J.W., King, A.J., Manica, A. & **Thornton, A.** (2013) Heterogeneous structure in mixed-species corvid flocks in flight. *Animal Behaviour* 85:743-750.

Koskella, B. (2013). Phage-mediated selection on microbiota of a long-lived host. *Current Biology* 23:1256-1260.

Lamba, S. & Mace, R. (2013). The evolution of fairness: explaining variation in bargaining behaviour. *Proceedings of the Royal Society B* 280:20122028.

Leggett, H.C., Benmayor, R., **Hodgson, D.J.** & **Buckling, A.** (2013). Experimental evolution of adaptive phenotypic plasticity in a parasite. *Current Biology* 23:139-142.

Mank, J.E., **Wedell, N.** & **Hosken, D.J.** (2013). Polyandry and sex-specific gene expression. *Philosophical Transactions of the Royal Society of London. B* 368:20120047.

Mathot, K.J. & **Dall, S.R.X.** (2013). Metabolic rates can drive individual differences in information and insurance use under the risk of starvation. *The American Naturalist* 182:611-620.

Moore, A.J., Bacigalupe, L.D. & Snook, R.R. (2013). Integrated and independent evolution of heteromorphic sperm types. *Proceedings of the Royal Society B* 280:20131647.

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Plummer, K.E., **Bearhop, S.**, Leech, D.I., Chamberlain, D.E. & **Blount, J.D.** (2013). Fat provisioning in winter impairs egg production during the following spring: a landscape-scale study of blue tits. *Journal of Animal Ecology* 82:673-682.

Stevens, M., Trosianko, J. & Spottiswoode, C.N. (2013). Repeated targeting of the same hosts by a brood parasite compromises host egg rejection. *Nature Communications* 4:3475.

Turchin, P., **Currie, T.E.**, Turner, E.A.L. & Gavrilov, S. (2013). War, space, and the evolution of Old World complex societies. *Proceedings of the National Academy of Sciences USA* 110:16384-16389.

Tyler, F., Harrison, X.A., Bretman, A., Veen, T., Rodríguez-Muñoz, R. & **Tregenza, T.** (2013). Multiple post-mating barriers to hybridization in field crickets. *Molecular Ecology* 22:1640-1649.

Wakefield, E.D., Bodey, T.W., **Bearhop, S.**, Blackburn, J., Colhoun, K., Davies, R., Dwyer, R.G., Green, J.A., Grémillet, D., Jackson, A.L., et al. (2013). Space partitioning without territoriality in gannets. *Science* 341:68-70.

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