Life Science Project Titles 2012-2013

Evolution, Behaviour and Environment Subject Area

Life Science Projects 2012-2013

Faculty Name: Dr Claudio Alonso

Room No: JMS 4B14 Email: c.alonso@sussex.ac.uk

Project Title/Area:

microRNA-mediated regulation of *Hox* gene function during embryonic development

Course requirements:	**No of places**: 3
Developmental Biology Genetics	

Further Information:

The *Hox* genes encode a family of evolutionary conserved transcriptional regulators that control the development of embryonic and adult structures at specific coordinates along the antero-posterior axis of the animal body.

My laboratory investigates the molecular mechanisms regulating the activity of the *Hox* genes, primarily, but not exclusively, in *Drosophila*. Previous work in my lab and in other groups has established that specific small regulatory RNAs such as microRNAs (miRNAs) can regulate *Hox* activity, but the mechanisms underlying these interactions are still not fully understood. This project will investigate such molecular mechanisms and their biological roles during embryonic Hox gene expression in *Drosophila* and vertebrate model organisms.

The selected student will develop this project employing a combination of bioinformatics, molecular, developmental, genetic, and transgenic tools. The results of this work are likely to provide valuable information on the mechanisms by which miRNAs regulate the activity of gene networks during development.

Keywords: Development, *Hox* genes, microRNAs (miRNAs), *Drosophila,* embryogenesis

Remarks: High interest in gene regulation and developmental biology is required, previous lab experience in Molecular Biology and/or Genetics is desirable.

Life Science Projects 2012-2013

Faculty Name: Dr Claudio Alonso

Room No: JMS 4B14 Email: c.alonso@sussex.ac.uk

Project Title/Area:

microRNA-mediated regulation of *Hox* gene function during appendage development

Course requirements:

Developmental Biology

Genetics

No of places: 3

Further Information:

The *Hox* genes encode a family of evolutionary conserved transcriptional regulators that control the development of embryonic and adult structures at specific coordinates along the antero-posterior axis of the animal body.

My laboratory investigates the molecular mechanisms regulating the activity of the *Hox* genes, primarily, but not exclusively, in *Drosophila*. Previous work in my lab and in other groups has established that specific small regulatory RNAs such as microRNAs (miRNAs) can regulate *Hox* activity, but the mechanisms underlying these interactions are still not fully understood. This project will investigate such molecular mechanisms and their biological roles during Hox gene expression in the appendages of Drosophila and vertebrate model organisms.

The selected student will develop this project employing a combination of bioinformatics, molecular, developmental, genetic, and transgenic tools. The results of this work are likely to provide valuable information on the mechanisms by which miRNAs regulate the activity of gene networks during development.

Keywords: Development, *Hox* genes, microRNAs (miRNAs), *Drosophila,* imaginal discs

Remarks: High interest in gene regulation and developmental biology is required, previous lab experience in Molecular Biology and/or Genetics is desirable.

Life Science Projects 2012-2013

Faculty Name: Professor Jonathan Bacon

Room No: 4D19 Email: **j.p.bacon@sussex.ac.uk**

Project Title/Area:

Foraging behaviour in the Yellow Meadow Ant, *Lasius flavus*

Course requirements:

none

No of places: 1

Further information

The project will investigate how *Lasius flavus* ants explore new space, in particular their use of a combination of pheromones to positively and negatively mark pathways between nest and food source in the surrounding environment.

Starting refs:

Jackson et al (2004) Nature 432: 907-909

Robinson et al (2005) Nature 438: 442

Life Science Projects 2012-2013

Faculty Name: Professor Jonathan Bacon

Room No: 4D19 **Email**: j.p.bacon@sussex.ac.uk

Project Title/Area:

Woodlice and Humidity

Course requirements:

none

No of places: 1

Further Information:

Woodlice are very vulnerable to desiccation and tend to locate and remain in damp places. A classical experiment by Gunn (1937) shows that they can do this by a process known as orthokinesis – they move faster in dry conditions and so spend longer in humid. It is possible to set up a simple choice chamber to show this: an experiment which is much used in schools and universities. Gunn (1937) remains one of the most widely quoted papers on this subject (Nature 2011). The project will extend these classical observations to determine, by use a T-maze, whether woodlice can orient towards optimum humidity levels.

Starting refs:

http://www.nature.com/nature/journal/v477/n7366/full/477513f.html

Gunn (1937) J Exp Biol 14: 178-186

Life Science Projects 2012-2013

Faculty Name: Professor Jonathan Bacon

Room No: 4D19 **Email**: j.p.bacon@sussex.ac.uk

Project Title/Area:

Turn alternation in the woodlouse

Course requirements:	**No of places**: 1
none	

Further Information:

When a woodlouse turns in one direction in a narrow walkway, it compensates as soon as it free to do so by turning in the opposite direction. This mechanism maintains the general direction of locomotion. The project will examine this behaviour.

Starting refs:

Beale and Webster (1971) Animal Behaviour 19: 353-356

Hughes (2008) Behavioural Processes 78: 38-43

Kupferman (1966) Animal Behaviour 14: 68-72

Life Science Projects 2012-2013

Faculty Name: Professor **J**onathan Bacon

Room No: 4D19 **Email**: **j.p.bacon@sussex.ac.uk**

Project Title/Area:

Darwin's bees

Course requirements:

none

No of places: 2

Further Information:

Darwin had a lot to say about bees in the *Origin of Species.* This literature-based project will carefully examine these writings of Darwin, on the bees' cell building, pollination activities, and population dynamics, in the light of contemporary research.

Starting ref:

Darwin (1859) *On the Origin of Species by Means of Natural Selection*. John Murray, London, UK

Life Science Projects 2012-2013

Faculty Name: Professor **J**onathan Bacon

Room No: 4D19 **Email**: : **j.p.bacon@sussex.ac.uk**

Project Title/Area:

Pannexin function in humans

Course requirements:

none

No of places: 1

Further Information:

Innexin gap-junction proteins were first discovered in *Drosophila*, and their vertebrate homologues, the pannexins, were subsequently discovered in the human genome. By forming hemichannels, pannexins have recently been shown to perform a vital role in the regulation of apoptosis. This literature-based project will review the role of human pannexins, and contrast these findings to the function of innexins in invertebrates.

Starting refs:

Chekeni et al (2010) Nature 467: 863-867

Panchin et al (2000) Current Biology 10: 473-474

Phelan et al (1998) Trends in Genetics 14: 348-349

Life Science Projects 2012-2013

Faculty Name: Professor Tom Collett

Room No: JMS 3D14 **Email**: t.s.collett@sussex.ac.uk

Project Title/Area:

Neuorscience: Top-down and bottom-up processing in object recognition

Course requirements:	**No of places:**
Knowledge of neuroscience at the level of 'Neural circuits' or better	1.

Further Information:

There is increasing evidence from the primate visual system that object recognition involves a kind of hypothesis testing. Top-down guesses about the identity of an object are altered by bottom- up sensory evidence to converge rapidly on a likely hypothesis. This library project will explore recent literature to articulate what is currently known about interactions between the two streams.

Life Science Projects 2012-2013

Faculty Name: Professor Adam Eyre-Walker

Room No: JMS 5b21 **Email:** a.c.eyre-walker@sussex.ac.uk

Project Title/Area:

Are stop codons used in introns to mitigate the effects of aberrant intron splicing.

Course requirements: None	**No of places**: 2

Further Information:

Many eukaryotic genes contain introns, sequences that lie between the exons, which go to form the protein coding gene. These introns are removed from the newly transcribed RNA to yield the mRNA in a complex reaction; sometimes this reaction fails and introns are left unspliced. This can lead to the production of an incorrect protein, which may be either wasteful or toxic. Potentially the harmful effects of aberrant splicing could be ameliorated by the inclusion of stop codons within the intron sequence. We will test whether this is the case using DNA sequence data from several species. The project will involve learning a computer programming language and using this to process sequence data. The project would suit a student interested in bioinformatics.

Life Science Projects 2012-2013

Faculty Name: Professor Adam Eyre-Walker

Room No: JMS 5b21 **Email:** a.c.eyre-walker@sussex.ac.uk

Project Title/Area:

Recurrent mutations in human disease.

Course requirements:	**No of places**: 1
None	

Further Information:

We have recently shown that there is substantial variation in the mutation rate in the human genome that is not a consequence of context (i.e. it does not depend upon the adjacent nucleotides); we have termed this cryptic variation in the mutation rate. The aim of the project will be to investigate whether cryptically hypermutable sites contribute to the recurrence of human genetic disease. We will analyse several databases of mutations known to be involved with Mendelian disease and investigate the extent to which we observe recurrent mutations at sites and the nature of those sites in terms of their context.

Life Science Projects 2012-2013

Faculty Name: Professor Adam Eyre-Walker

Room No: JMS 5b21 **Email**: a.c.eyre-walker@sussex.ac.uk

Project Title/Area:

The relationship between research group size and productivity in biology

Course requirements:

none

No of places: 1

Further Information:

Well funded scientific research groups probably have an increased chance of procuring more research funding; this can lead to the concentration of funding in a limited number of laboratories. However, there is some evidence that scientific productivity does not increase in line with research funding. We will investigate this question by looking at the relationship between research group size and the number of publications in UK biology departments. The project will involve trawling the internet for information and some statistical analysis.

Life Science Projects 2012-2013

Faculty Name: Professor Adam Eyre-Walker

Room No: JMS 5b21 **Email**: a.c.eyre-walker@sussex.ac.uk

Project Title/Area:

Do animals or plants have higher levels of population sub-division?

Course requirements:

None

No of places: 1

Further Information:

Further Information: Many species have sub-divided populations, in the sense that they are composed of a series of semi-isolated populations, connected by limited migration. One would imagine that animals would have lower levels of population division given that they can move. But is this the case? The project will involve trawling the literature for estimates of population sub-division and the performing a statistical analysis on the results.

Life Science Projects 2012-2013

Faculty Name: Professor Adam Eyre-Walker

Room No: JMS 5b21 **Email**: a.c.eyre-walker@sussex.ac.uk

Project Title/Area:

Changes in the H-index through a scientists career.

Course requirements:

none

No of places: 1

Further Information:

Further Information: The H-index is a commonly used measure of scientific productivity; if an individual has an H-index of x this means that they have x papers, each of which has been cited x or more times. The H-index clearly depends on the career length of a scientist; the longer a scientist has been working the higher their H-index will be. So how does it change through the lifetime of a scientist?

Life Science Projects 2012-2013

Faculty Name: Professor Jeremy Field

Room No: JMS 5b16 **Email**: j.field@sussex.ac.uk

Project Title/Area:

Sociality in sweat bees

Course requirements:	**No of places**: 6
C1135 Behavioural Ecology	

Further Information:

Sweat bees (Halictidae) usually nest in burrows in the ground, with rarely more than 5 individuals in a social colony. They are unusually interesting because unlike other hymenopteran lineages, closely related social and non-social species exist, and there are also socially polymorphic taxa, where females in some populations form social groups while those in other populations of the same species nest non-socially. Project work will be carried out in the summer prior to Year 3, followed by statistical analysis of data in the Autumn term, and will involve studying sweat bee behaviour in greenhouse and/or natural field environments. Exact aims will be decided nearer to the start of projects, depending on progress with on-going research. Examples might be investigating division of labour between workers, mate choice, or longevity in relation to body size. The projects will involve handling (wearing protective gloves that prevent stinging), marking and observing live bees. Note that sweat bees are relatively small (1-1.5cm), with stings that are hardly noticeable even without gloves. Projects may also involve basic husbandry, such as collecting flowers and providing water for caged bees. The projects will run at Sussex between late June and August 2012, and students carrying out these projects MUST be flexibly available from June 23 until at least the end of July. These projects would not be suitable for anyone who is working during that period, or for anyone unwilling to handle live insects or who is allergic to insect stings. Projects will be supervised on a day-to-day basis by a PhD student/postdoctoral researcher.

The following references provide some further general information about sweat bees:

Schwarz MP, Richards MH, Danforth BN (2007) Changing paradigms in insect social evolution: Insights from halictine and allodapine bees. Annu Rev Entomol 52:127-150

Field J, Paxton RJ, Soro A, Bridge C (2010) Cryptic Plasticity Underlies a Major Evolutionary Transition. Curr Biol 20 (22):2028-2031.

See also http://www.sussex.ac.uk/newsandevents/index.php?id=5828 for some information about some of our previous work on sweat bees including a brief video.

Life Science Projects 2012

Faculty Name: Dr. Paul Graham

Room No: 3d10 **Email:** p.r.graham@sussex.ac.uk

Project Title:

The innate responses of ants to visual patterns

Course requirements:

There are no prerequisite 1st or 2nd year courses but students should have opted to take “Intelligence in Animals and Machines” in the autumn term of the third year.

No of places: 2

Further Information:

Individual ants are capable of learning complex foraging routes which are guided by learnt information about visual landmarks. However, they also show innate preferences when presented with visual patterns. These responses may allow for faster learning of foraging routes but are not well understood. This project will involve lab-based studies with wood ants where we will investigate the details of ants’ innate responses to visual patterns.

Life Science Projects 2012-2013

Faculty Name: Dr. Paul Graham

Room No: 3d10 **Email**: p.r.graham@sussex.ac.uk

Project Title/Area:

Do people draw more often than expected when playing Rock-Paper-Scissors?

Course requirements:	**No of places**: 2
There are no pre-requisites but this project will suit a student interested in cognitive neuroscience.	

Further Information:

It has been reported (Cook et al., 2011) that players of rock-paper-scissors will draw more often than one would expect by chance. The suggestion is that the mirror-neuron system underpins a form of automatic imitation, so that players can't avoid imitating even though it is bad for their performance in the game. This has implications at a low level, in terms of mirror neurons and motor control, and also at a higher level in terms of the imitation that is part of social intelligence and cultural transfer of information.

In this project we will look to replicate the basic result and investigate factors that might influence the effect, such as visual cues, motor complexity, timing and strategy.

Cook et al (2011) Automatic imitation in a strategic context: players of rock-paper-scissors imitate opponents' gestures. PRSB (doi: 10.1098/rspb.2011.1024)

Life Science Projects 2012-2013

<table>
<tr><td colspan="2">Faculty Name: Dr. Paul Graham

Room No: 3d10 Email: p.r.graham@sussex.ac.uk</td></tr>
<tr><td colspan="2">Project Title/Area:

A literature research project on cognitive maps in animals.</td></tr>
<tr><td>Course requirements:

Students should have taken Neural Circuits in year 2 and also opted to take “Intelligence in Animals and Machines” in the autumn term of the third year.</td><td>No of places: 2</td></tr>
<tr><td colspan="2">Further Information:

All animals have to navigate through the world and there is much debate about what cognitive mechanisms might be used by small brained animals, like ants, and large brained animals, like humans, in order to achieve this. The label cognitive map usually refers to a presumed mental representation of the world which animals can use to plan routes and navigate around familiar places. The concept of a “cognitive map” is frequently invoked to describe spatial behaviour in all types of animal and is always contentious. This project firstly would involve literature research to come up with a useful working definition of a cognitive map. Secondly, the project would involve reviewing the literature on behavioural experiments with a range of animals to see which, if any, can be said to represent their world knowledge in a unitary cognitive map.</td></tr>
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Life Science Projects 2012-2013

Faculty Name: Dr. David Harper

Room No: JMS 5B5 **Email:** david@sussex.ac.uk

Project Title/Area:

Flicking Moorhens

Course requirements:

Nothing formal

No of places: 1+ (up to six students across all topics)

Further Information:

Information sheet with references available.

Many animals show elaborate behaviours such as rapid tail movements when confronted with a potential predator. Hypotheses for this seemingly conspicuous behaviour have included: signalling social submission (i.e. predator irrelevant); signalling to warn conspecifics about the predator; startling the predator; signalling to the predator (pursuit-invitation; detection; pursuit-deterrence). All have been tested using studies of rails such as Eurasian Moorhens *Gallinula chloropus.* The resulting tangle of conflicting results is a nightmare, which you will try to resolve using some combination of metanalysis, observations and field experiments. Expect to spend some time 'videoing' Moorhens.

Life Science Projects 2012-2013

Faculty Name: Dr. David Harper

Room No: JMS 5B5 **Email**: david@sussex.ac.uk

Project Title/Area:

Harlequin Ladybirds

Course requirements:

Nothing formal

No of places: 1+ (up to six students across all topics)

Further Information:

Information sheet with references available.

The Harlequin Ladybird *Harmonia axyridis* gets its generic name from Harmonia, the goddess of harmony and concord. Native to east Asia, it has been deliberately released into the Americas and Europe. This attempt at biological control of aphids has not led to harmony or concord! Few invasive species have had a worse press! It achieves a double whammy against native ladybirds by depriving them of prey and eating their larvae.

The species was first spotted in England on 19th September 2004 in a pub garden in Essex. It had clearly invaded on a broad front, with the first records in Sussex on 11th October 2004 in Eastbourne and 18th October 2004 near Preston Park, Brighton.

In the autumn, ladybirds are easy to monitor at hibernating clusters. In 2004 on campus these clusters were dominated by the dainty little Two-Spot Ladybird *Adalia bipunctata* and the larger (and commoner) Seven-Spot Ladybird *Coccinella septempunctata.* I did not detect Harlequins on campus until September 2006, when they were already numerous. One excuse is that are not easy to identify because they are incredibly variable in colour. Most can be described as belonging to three main forms: red or orange with a variable number of black spots (known as form *succinea*); black with four uniformly red spots (form *spectabilis*); and black with two red patchess, each marked with a black spot (form *conspicua*). In 2006, the local population was dominated by the *succinea* form.

In autumn 2011 Karl Stone did a pilot study of ladybird found just five Seven-Spots and one Two-Spot, but over 100 Harlequins, mainly *succinea* with some *conspicua* and *spectabilis* (and one odd-ball with irregular markings). These data add to evidence that: (i) Harlequins are, as feared, driving the numbers of native ladybirds down; (ii) the non- *succinea* morphs are spreading faster. Lots of projects possible, both literature- and field-based.

Fieldwork will require humane killing of Harlequin Ladybirds but not other species.

Life Science Projects 2012-2013

<table>
<tr><td colspan="2">Faculty Name: Dr. David Harper

Room No: JMS 5B5 Email: david@sussex.ac.uk</td></tr>
<tr><td colspan="2">Project Title/Area:

Compositional analysis of habitat use in vertebrates</td></tr>
<tr><td>Course requirements:

Nothing formal</td><td>No of places: 1+ (up to six students across all topics)</td></tr>
<tr><td colspan="2">Further Information:

Information sheet with references available.

My main study species are European Robins Erithacus rubecula Corn Buntings Emberiza calandra

Habitat availability and habitat use are both examples of compositions: the proportions formed by each habitat have to sum in total to 1. This so-called unit-sum constraint renders statistical analysis dodgier than most authors realise. The problem was solved ages ago by statisticians: it is simply taking time for biologists to switch on.

Numerous possibilities (one species or a species comparison; variation with season, year of study, habitat; …). Projects could involve various combinations of: fieldwork (must be able to walk, and be tolerant of bad weather); data-analysis (if a lot, you'll need to be statistics-friendly); literature research.</td></tr>
</table>

Life Science Projects 2012-2013

Faculty Name: Dr. David Harper

Room No: JMS 5B5 **Email:** david@sussex.ac.uk

Project Title/Area:

Compositional analysis of bird diet

Course requirements:	**No of places:** 1+ (up to six students across all topics)
Nothing formal	

Further Information:

Information sheet with references available.

Since 1985, I have been collecting and analysing the pellets (oral ejecta of bones, fur, feathers, etc.) of the three common owls of the South Downs (Little *Athene noctua*, Long-eared *Asio otus*, Barn *Tyto alba*). The most common mammal prey for all three owls has been Field Vole *Microtus agrestis* (which in itself raises questions). I also like poking around in bird faeces, notably those of Green Woodpeckers *Picus viridis* and Corn Buntings *Emberiza calandra.*

Dietary analyses are examples of compositions: the proportions formed by each prey species have to sum in total to 1. This so-called *unit-sum constraint* renders statistical analysis dodgier than most authors realise. The problem was solved ages ago by statisticians: it is simply taking time for biologists to switch on.

Numerous possibilities (one species or a species comparison; variation with season, year of study, habitat; …). Projects could involve various combinations of: fieldwork (must be able to walk, and be tolerant of bad weather); lab-work (pellet analysis requires you do not mind skulls and faecal analysis that you can be hygienic); data-analysis (if a lot, you'll need to be statistics-friendly); literature research.

Life Science Projects 2012-2013

Faculty Name: Dr. David Harper

Room No: JMS 5B5 **Email:** david@sussex.ac.uk

Project Title/Area:

History of bird catching

Course requirements:

Nothing formal

No of places: 1+ (up to six students across all topics)

Further Information:

Information sheet with references available.

Although they are scarce breeders in Sussex, Wheatears remain a familiar and attractive sight on the South Downs while on migration. In the past the autumn passage of these shockingly white-rumped little birds supported a major local industry. Vast numbers were caught for food by downland shepherds between Shoreham and Eastbourne; in the 1750s over 22,000 birds were killed annually around Eastbourne alone. This is just one of dozens of industries that exploited wild birds in Britain. For example, Skylarks were lured using 'lark-glasses' around Brighton, and many Sussex villages had a duck decoy for killing wildfowl. A whole host of really weird library-based projects awaits people to do them. More practically, can anybody get a lark-glass to work? Can you locate any of the 'missing' duck decoys 'on the ground'.

Life Science Projects 2012-2013

<table>
<tr><td colspan="2">Faculty Name: Dr. David Harper

Room No: JMS 5B5 Email: david@sussex.ac.uk</td></tr>
<tr><td colspan="2">Project Title/Area:

Summer project on animals</td></tr>
<tr><td>Course requirements:

Nothing formal</td><td>No of places: 1+ (up to six students across all topics)</td></tr>
<tr><td colspan="2">Further Information:

Information sheet <u>not</u> available.

If you are available to do fieldwork during the summer vacation, and are interested in mammals. birds or spiders, please come and talk to me. You might well have ideas of your own.</td></tr>
</table>

Life Science Projects 2012-2013

Faculty Name: Professor Liz Hill

Room No: 5D22 **Email:** e.m.hill@sussex.ac.uk

Project Title/Area:

Literature review or data mining of a variety of environmental/ecological topics

Course requirements:	**No of places**: 4
none	

Further Information:

Am happy to consider suggestions from students on a literature review or analyses of ecological or environmental datasets.

Life Science Projects 2012-2013

Faculty Name: Professor Liz Hill

Room No: 5D22 **Email**: e.m.hill@sussex.ac.uk

Project Title/Area:

Analysis of plant and dietary metabolites in human urine

Course requirements:	**No of places**: 2
An interest in biochemistry and metabolism	

Further Information:

My group has undertaken biochemical profiling of number of urine samples, which contain many thousands of metabolites. However urine profiles of biochemicals from individuals are very variable, mainly due to the high amounts of dietary metabolites present in the samples which vary from day to day based on the diet. The aim of the project is to make a library of the key dietary metabolites found in urine, and then to subtract these metabolites from urine databases and examine whether the resulting biochemical profiles are less variable from day to day samples.

Candidates should have an interest in metabolism, simple mass spectrometry profiling and computing.

Life Science Projects 2012-2013

<table>
<tr><td colspan="2">Faculty Name: Dr. Ted Morrow

Room No: Email: ted.morrow@sussex.ac.uk</td></tr>
<tr><td colspan="2">Project Title/Area:

Genetic variation in fitness: laboratory and field estimates using fruitflies</td></tr>
<tr><td>Course requirements:</td><td>No of places: 2</td></tr>
<tr><td colspan="2">Further Information:

Measuring genetic variation in fitness is a difficult task, not least because fitness can be measured in so many ways. Laboratory adapted populations of fruit-flies offer one way in which we can measure fitness reasonably easily but what do these measures mean for flies in the real world? I'll be offering small projects that are aimed at developing laboratory and field protocols for assaying sex-specific fitness in adult flies (Drosophila melanogaster).

You should have some background knowledge of the following areas:

Genetics

Evolution

Entomology

Ecology</td></tr>
</table>

Life Science Projects 2012-2013

Faculty Name: Dr Jeremy Niven

Room No: 327 **Email**: jen23@sussex.ac.uk

Project Title/Area:

Sensory inputs and the behavioural transition from walking to gap crossing in locusts.

Course requirements:	**No of places**: 2
Neural Circuits	

Further Information:

Locusts use visual and antennal cues to place their limbs when walking on an uneven substrate that contains small gaps. However, at larger gaps locusts do not continue to walk but instead use a sequence of behaviours to determine the size of the gap and to cross it. At what distance does the transition from walking to gap crossing occur? What sensory cues do the locusts use to detect the gap? How do gap crossing behaviours differ from walking? This project will use behavioural techniques including automated video analysis and behavioural sequence analysis to answer these questions.

Blaesing, B. and Cruse, H. Stick insect locomotion in a complex environment: climbing over large gaps. J. Exp. Biol. *207* 1273-1286.

Niven, J.E. *et al*. (2009). Visual targeting of forelimbs in the desert locust. Curr. Biol. *20* 86-91.

Pick, S. and Strauss, R. (2005). Goal-driven behavioral adaptations in gap-climbing *Drosophila*. Curr. Biol. *15* 1473 – 1478.

Life Science Projects 2012-2013

Faculty Name: Dr Jeremy Niven

Room No: 327 **Email**: jen23@sussex.ac.uk

Project Title/Area:

A short-term memory for object features and locations in locusts

Course requirements:	**No of places**: 2
Neural Circuits	

Further Information:

Given a choice between two objects, locusts prefer and will orientate towards the taller, narrower object. Preferences are absolute – taller objects are preferred even if the difference in height is just 1 cm. Locusts walking towards one of a pair of objects appear to ignore the other object even if its height is increased to make it the tallest. Recent work on fruit flies suggests that they retain a memory of the objects they have previously seen. When an object the flies are walking towards disappears they will orient towards another object. If this too disappears they will orient towards the original shape again. Will locusts orient in similar ways? Do they remember the position of an object once orientating to a preferred object?

Neuser K, Triphan T, Mronz M, Poeck B, Strauss R. (2008). Analysis of a spatial orientation memory in *Drosophila*. Nature *453* 1244-7.

Osorio D, Srinivasan MV, Pinter RB (1990). What causes edge fixation in walking flies? J. Exp. Biol. *149* 281-292.

Wallace GK. (1958). Some experiments on form perception in the nymphs of the desert locust, *Schistocerca gregaria* Forskål. J. Exp. Biol. *35* 765-775.

Life Science Projects 2012-2013

Faculty Name: Dr Jeremy Niven

Room No: 327 **Email**: jen23@sussex.ac.uk

Project Title/Area:

Analysis of head and limb movements during turning in the locust.

Course requirements:	**No of places:** 2
Neural Circuits	

Further Information:

Desert locusts scan their environment making rapid turns alternating with distinct epochs of peering. Peering involves a side-to-side movement of the head, which causes nearby objects to move more in the visual field than more distant objects, allowing the locusts to estimate object distance. Because locusts have a compound eyes that give them a large visual field, whilst peering at one object, they can see many others. It is unknown whether the locusts use this information to turn directly to face other objects or whether their turns are made without visual inputs. By videoing the movements of the body, head and legs of the locusts combined with muscle recordings, it will be possible to distinguish between these possibilities.

Collett T.S. (1978). Peering – a locust behaviour pattern for obtaining motion parallax information. J. Exp. Biol. *76* 237-241.

Kein J., Land M.F. (1978). The fast optokinetic nystagmus in the locust. Physiological Entomol. *3* 53-57.

Wallace G.K. (1959). Visual scanning in the desert locust, *Schistocerca gregaria* Forskål. J. Exp. Biol. *36* 512-525.

Life Science Projects 2012-2013

Faculty Name: Professor Daniel Osorio **Room No**: 3B31 **Email**: d.osorio@sussex.ac.uk	
Project Title/Area: Marine aquaculture Projects	
Course requirements: No. Interest in visual behaviour, some quantitative skills.	**No of places**: 2
Further Information: We have a lab at Brighon SeaLife Centre and will supervise projects suggests by the Centre in a range of applications. Possible subjects for 2011-12 include aquaculture and biology of soft corals and of	

Life Science Projects 2012-2013

Faculty Name: Professor Daniel Osorio

Room No: 3B31 **Email**: d.osorio@sussex.ac.uk

Project Title/Area:

Cuttlefish visual behaviour

Course requirements:	**No of places**: 2 - 4
No, but convenient access to Brighton Sealife Centre is useful	

Further Information:

We study cuttlefish camouflage and visual signalling. At present we are especially interested in behaviour during prey capture, and defensive behaviour when the animals move.

References: Kelman, E.J., Osorio, D., Baddeley, R.J., 2008. A review of cuttlefish camouflage and object recognition and evidence for depth perception. Journal of Experimental Biology, 211, 1757-1763.

Langridge, K.V., Broom, M., Osorio, D. 2007. Selective signalling by cuttlefish to predators. Current Biology, 17, R1044-R1045

Life Science Projects 2012-2013

<table>
<tr><td colspan="2">Faculty Name: Professor Daniel Osorio

Room No: 3B31 Email: d.osorio@sussex.ac.uk</td></tr>
<tr><td colspan="2">Project Title/Area:

Colour measurement in healthcare or in bird plumage coloration</td></tr>
<tr><td>Course requirements:

No, interest in photography beneficial, some quantitative skills.</td><td>No of places: 2</td></tr>
<tr><td colspan="2">Further Information:

We have a simple method to measure colour accurately in photographic images/ Project students will use this tool to use colour and spectral information to address problems in healthcare (especially wound treatment with clinical collaborators) and in measurement of bird plumage or similar colours.</td></tr>
</table>

Life Science Projects 2012-2013

Faculty Name: Professor Daniel Osorio

Room No: 3B31 **Email:** d.osorio@sussex.ac.uk

Project Title/Area:

Numerical cognition in animals or similar

Course requirements:

None

No of places: 2

Further Information:

A literature based project. There is much interest in the numerical skills of non-human animals. This project will critically review the proposal that animals have a concept of number that is distinct from the evaluation of quantity. It will focus on a few key studies in animal cognitive neuroscience, including neurophysiology and psychology. Students are welcome to suggest a similar project of their own.

*Reference*s: Dehaene, S 1997. *The number sense*. Penguin.

Elizabeth M. Brannon EM, Herbert S. Terrace HS. 1998 Ordering of the Numerosities 1 to 9 by Monkeys *Science* 282. 746 – 749. DOI: 10.1126/science.282.5389.746

A. Nieder and K. Merten (2007)A Labeled-Line Code for Small and Large Numerosities in the Monkey Prefrontal Cortex. *J. Neurosci.* 27, 5986-5993

Life Science Projects 2012-2013

Faculty Name: Dr. Mika Peck

Room No: 5D24 **Email**: m.r.peck@sussex.ac.uk

Project Title/Area: (GIS/Land change modelling)

Modelling the impact of proposed oil exploratory drilling in the Southern Ecuadorian Amazon

Course requirements:	**No of places**: 1
Must have successfully completed GIS course	

Further Information:

The Southern Ecuadorian Amazon remains largely intact, with few roads and development. This is now threatened by government plans to undertake exploratory drilling to identify remaining oilfields. Little oil is expected to be found (estimates of 125 million barrels have been suggested) however the potential impact to biodiversity, and indigenous groups is a major concern. We (Universidad Andina Simon Bolivar and the University of Sussex) were approached by Pachamama Alliance, who represent indigenous groups in the Amazon, to provide scientific information on the potential rates of land use change following the establishment of roads during exploratory drilling. We will use recently acquired Ecuadorian Ministry of Environment Land use maps to model the predicted impact of future exploratory work. Using Land Change Modeller software (Clarke laboratories) we will generate predictive maps to model impacts to the Amazon.

Life Science Projects 2012-2013

Faculty Name: Dr. Mika Peck

Room No: 5D24 **Email**: m.r.peck@sussex.ac.uk

Project Title/Area:

Analysis of large bird survey dataset from NW Ecuador (potential for fieldwork in Ecuador June – August 2012)

Can we detect altitudinal shifts in bird communities in the Ecuadorian Andes due to environmental change? Will the current network protected areas in the Choco-Andean corridor in NW Ecuador protect bird species in light of expected shifts in distribution due to climate change?

Course requirements:	**No of places**: 1
Statistics / Field survey techniques	

Further Information:

The rate of environmental change in the NW Andean region has no historical precedent; with current land-use change in the region at up to 2.4% per annum and ongoing and projected climate change a potent new addition. Dramatic changes have already been observed in both both biotic and abiotic systems and processes across the tropical Andes. These changes are having profound impacts on species' distributions, abundances and phonologies that are only likely to accelerate in the near future. It is critical that we understand the rates of changes in these distributions and abundances that will allow us to undertake adaptive conservation management. Of particular concern is the need to understand how effective current (and planned) protected areas will be in conserving the biodiversity of mountain flora and fauna. Given the projected pace and likely consequences of climate change, magnified as they are in regions such as the high Andes, we urgently need to understand the rates of changes in species distributions and abundances to ensure our protected area networks are best positioned to maximise species survival through this rapid global transition. What is currently lacking is scientific information on how species are shifting in response to environmental change.

Our existing altitudinal dataset for bird species (with 194 species and over 13,000 records to date) will be used to determine whether species-specific and community level shifts in altitude are detectable between 2008 and 2012.

For students with funds to support independent travel to NW Ecuador there is the opportunity to join our team of scientists on the Earthwatch 'Climate Change, Canopies and Wildlife' Project that runs from 15 June 2012 to 3rd August to collect the 2012 records for the bird dataset.

See: http://www.earthwatch.org/exped/peck.html for more information

Life Science Projects 2012-2013

Faculty Name: Dr. Mika Peck

Room No: 5D24 **Email**: m.r.peck@sussex.ac.uk

Project Title/Area:

A critique of conservation focus – is it worth saving endangered species?

Course requirements:	**No of places**: 1
N/A	

Further Information:

Most conservation at the species level is focused on critically endangered or endangered species (as defined by the IUCN), however endangered category species inherently have low population numbers or live is fragile habitats making their long-term survival doubtful. It is clearly important to conserve these species if they play vital roles in maintaining ecosystem functions and biodiversity i.e., are 'keystone species' but is this the case – should we not focus instead on those that play more important roles in the ecosystem.

The key question asked by this project is whether species in endangered categories disproportionately represent keystone species in ecosystems and should therefore remain the focus of conservation effort. You will review terrestrial/marine and freshwater systems to determine whether there are ecosystem level differences and provide a timely review of conservation action.

Life Science Projects 2012-2013

Professor Ratnieks: Projects on the Behaviour & Ecology of Social Insects

Students will typically work in pairs and 3-4 of the projects below will be run

<table>
<tr><td colspan="2">Faculty Name: Professor Francis Ratnieks

Room No: Laboratory of Apiculture & Social Insects, BES Ancillary Building

Email: F.Ratnieks@Sussex.ac.uk</td></tr>
<tr><td colspan="2">Project Title/Area: 1. Nestmate recognition and guarding in honey bees</td></tr>
<tr><td>Course requirements:

No specific requirement, but background/interest in some of ecology/behaviour/behavioural ecology/cognition/evolution/social insects is necessary. Students wear bee suits for protection but it is likely that one or two stings will occur. As a result the project is not suitable for students who are allergic to bees or who are fearful of bees. The student must have a schedule that allows them to spend several days per week doing the field work in October and November. Field work must be completed by end of November.</td><td>No of places:
2</td></tr>
<tr><td colspan="2">Further Information:

Research project (experiment) working with guard bees at the entrances of bee hives to investigate guarding behaviour, and especially mechanisms of nestmate recognition and adaptive responses of guards to intruders. The project will investigate a specific, focused question/hypothesis within this. Field work is done in autumn (October and November) when it is still warm enough for the bees to be active, in the apiary of the Laboratory of Apiculture & Social Insects which is 50m from the JMS building.</td></tr>
</table>

Life Science Projects 2012-2013

Faculty Name: Professor Francis Ratnieks

Room No: Laboratory of Apiculture & Social Insects, BES Ancillary Building

Email: F.Ratnieks@Sussex.ac.uk

Project Title/Area:

Acquisition of flower constancy in foraging honey bees

Course requirements:

No specific requirement, but background/interest in some of ecology/behaviour/behavioural ecology/cognition/evolution/social insects is necessary. Students will not need to wear bee suits for protection and it is unlikely that students will get stung, but it is possible. As a result the project is not suitable for students who are allergic to bees or who are fearful of bees. The student must have a schedule that allows them to spend several days per week doing the field work in October and November. Field work must be completed by end of November.

No of places: 2

Further Information:

Research project (experiment) working with foraging honey bees at artificial flowers to investigate learning of flower colour/pattern/odour by individual honey bees and the effect of nectar reward on this. The project will investigate a specific, focused question/hypothesis within this. Field work is done in autumn (October and November) when it is still warm enough for the bees to be active, in the apiary of the Laboratory of Apiculture & Social Insects which is 50m from the JMS building.

Life Science Projects 2012-2013

Faculty Name: Professor Francis Ratnieks

Room No: Laboratory of Apiculture & Social Insects, BES Ancillary Building

Email: F.Ratnieks@Sussex.ac.uk

Project Title/Area:

Decoding honey bee dances to investigate honey bee foraging

Course requirements:

No specific requirement, but background/interest in some of ecology/behaviour/behavioural ecology/cognition/evolution/social insects/geography is necessary. Students will not need to wear bee suits for protection and it is unlikely that students will get stung as they will work mainly with videos and observation hives, but it is possible. As a result the project is not suitable for students who are allergic to bees or who are fearful of bees. This project is also suitable for a student who wants to begin a project early (i.e., in the summer vacation).

No of places: 2

Further Information:

Research project working with honey bees in which students decode waggle dances to determine where in the landscape bees are foraging. The project will investigate a specific, focused question/hypothesis within this. Because the waggle dances are videotaped in the summer and autumn, the project is not weather or season dependent. Data collection to be completed by mid-December.

Life Science Projects 2012-2013

Faculty Name: Professor Francis Ratnieks

Room No: Laboratory of Apiculture & Social Insects, BES Ancillary Building

Email: F.Ratnieks@Sussex.ac.uk

Project Title/Area:

Organization and communication in foraging ants

Course requirements:

No specific requirement, but background/interest in some of ecology/behaviour/behavioural ecology/cognition/evolution/social insects is necessary. Chemistry background may also be useful for students interested in chemical aspects. The project is carried out in a laboratory where we also study honey bees and so is not suitable for students who are allergic to bees or who are fearful of bees. The student must have a schedule that allows them to spend several days per week doing the field work in October and November. The project is not weather or season dependent as lab colonies of ants are studied. Data collection to be completed by mid-December.

No of places: 2

Further Information:

Research project (experiment) working with ants (either the common garden ant *Lasius niger* or the Pharaoh's ant *Monomorium pharaonis*) in which students investigate a specific, focused question/hypothesis in foraging behaviour. This will investigate some aspect of communication or learning as it relates to the organization of the foraging trail system. Colonies will be studied in the laboratory. Laboratory work/data collection should be completed by mid-December.

Life Science Projects 2012-2013

<table>
<tr><td colspan="2">Faculty Name: Professor Francis Ratnieks

Room No: Laboratory of Apiculture & Social Insects, BES Ancillary Building

Email: F.Ratnieks@Sussex.ac.uk</td></tr>
<tr><td colspan="2">Project Title/Area:

Comparing insect visitation rates to commonly grown garden plants</td></tr>
<tr><td>Course requirements:

No specific requirement, but background/interest in some of ecology/behaviour/behavioural ecology/cognition/evolution/social insects/geography is necessary.</td><td>No of places: 2</td></tr>
<tr><td colspan="2">Further Information:

Many garden flowers are attractive to bees and pollinating insects, but which. This project will compare the visitation rates of bees and other pollinating insescts to 25 varieties of garden flowers including various varieties of lavender, borage, Phacelia, Pelargonium, Nasturtium, etc. The project will be based on field work within walking distance of the university. This is a summer project that requires the student to gather data in July-September.</td></tr>
</table>

Life Science Projects 2012-2013

Faculty Name: Professor Francis Ratnieks

Room No: Laboratory of Apiculture & Social Insects, BES Ancillary Building

Email: F.Ratnieks@Sussex.ac.uk

Project Title/Area:

Autumn flowering ivy as a nectar and pollen resource for flower-visiting insects

Course requirements:	**No of places**: 2
No specific requirement, but background/interest in some of ecology/behaviour/behavioural ecology/cognition/evolution/social insects/geography is necessary.	

Further Information:

Ivy, *Hedera helix*, is a common native British plant. It flowers from September to November and is the last common native plant to flower. As a result, its flowers attract large numbers of insects including butterflies, bees, wasps, and flies. The project will be based on field work within walking distance of the university and will characterize important aspects of the natural history of the ivy-insect pollinator interaction including phenology, types of insects attracted, attractiveness of ivy growing in different sites (i.e., in sunny v. shady area). Data to be collected during the flowering of Ivy, September-early November.

Life Science Projects 2012-2013

Faculty Name: Dr Alan Stewart

Room No: JMS 5B19 **Email**: a.j.a.stewart@sussex.ac.uk

Project Title/Area:

Data analysis projects

Course requirements:	**No of places:** 3
Biodiversity Past & Present; Methods in Ecology & Conservation	

Further Information:

Several organisations (including the Sussex Biodiversity Records Centre and other organisations with which we have contact) hold a number of large ecological datasets, often on the occurrence of several species over several years, which could be used to inform conservation decisions. Some of these are long-term datasets which need to be analysed to establish the extent to which population changes reflect annual variation in the weather, the effects of local habitat management or long-term patterns, perhaps as a result of climate change. Various projects could be devised around particular datasets depending upon your interests, but they would all involve careful analysis of large and usually complicated datasets. Possible datasets include: (i) large-scale survey of invertebrates in Welsh peatlands, (ii) survey of flies on the South Downs, (iii) changes in plant communities in coppice woodland over 30+ years, (iv) survey of insects in pine forests. No fieldwork would be involved (unless the student had a particular desire to do some and it was appropriate to the analysis). Such projects would therefore suit someone who **enjoys handling data and analysing it statistically**. Some experience with handling data would be advantageous, but it is much more important that you are prepared to learn and to get stuck into some challenging data manipulations and analyses.

Life Science Projects 2012-2013

Faculty Name: Dr Alan Stewart

Room No: JMS 5B19 **Email**: a.j.a.stewart@sussex.ac.uk

Project Title/Area:

Comparative methods for estimating invertebrate population size

Course requirements:

Course requirements: Biodiversity Past & Present; Methods in Ecology & Conservation

No of places: 2

Further Information:

Estimates of invertebrate population density depend critically upon the sampling method used. For example, ground beetles (Carabidae) are widely used as indicators of habitat quality and change (Koivula et al., (2011) ZooKeys 100: 287-317; open access on www) and are usually sampled by pitfall trapping. However, the numbers caught in such traps are the product of population density (the parameter of interest) and the level of activity. The latter can vary considerably between species and sexes and in response to the weather and the density of vegetation in the immediate area around the trap. Similarly, the numbers caught of individuals in other grassland-inhabiting groups (Coleoptera, Hemiptera, Orthoptera etc.) depend upon which sampling method is used (e.g. pitfall traps, water traps, sweep netting, Malaise trap, suction sampling). The projects would either (a) compare different sampling methods, or (b) manipulate the habitat structure to examine the effect this has on sampling efficiency. In both cases, a lot of species-level identification work in the lab would be involved. The field work would have to be done in the summer vacation period, so you **MUST** be available at this time.

Life Science Projects 2012-2013

<table>
<tr><td colspan="2">Faculty Name: Dr Alan Stewart

Room No: JMS 5B19 Email: a.j.a.stewart@sussex.ac.uk</td></tr>
<tr><td colspan="2">Project Title/Area:

Own project</td></tr>
<tr><td>Course requirements:

Course requirements: Biodiversity Past & Present; Methods in Ecology & Conservation</td><td>No of places: 1</td></tr>
<tr><td colspan="2">Further Information:

I would be happy to discuss original ideas with individuals who are interested in a project involving the population or community ecology or conservation of invertebrates. Please note: you MUST come and discuss your ideas with me BEFORE opting for this project.</td></tr>
</table>