1 Adaption in a changing world: Human influences on evolution.

Speaker: Dr Kiyoko Gotanda (*University of Cambridge*)
Date: 2nd November 2017

The biodiversity which we see in the world is due to a large amount of adaptive divergence - where selection chooses for the peak fitness under different circumstances. Previous studies have assumed that selection is the same through time and populations, in reality selection is highly variable in time and between populations. Humans have a significant impact on the distribution of these selection pressures.

Does hunting affect adaptive behaviour? In Barbados fish in protected areas (where spear fishing is not allowed) were more tolerant of humans and had a shorter flight initiation distance (FID) - the distance that prey flee - as well as other decreased anti-predator behaviours.

In the Galapogos human presence may be impacting the evolution of Darwins finches. There are 14 recognized species with adaptive divergence between islands. Humans are changing the niche characteristics of these birds with populations living closer to populated areas having a greater niche overlap - as they do not need specialised beaks to eat human food, while further from town populations of different species become more specialised - reducing competition between species.

Urbanisation has also impacted the anti-predator behaviour. one hypothesis was that with a greater concentration of predators in town (where the food is) a faster anti-predator response should be expected. However the opposite was found with reduced anti-predator behaviour in town, possibly due to populations becoming more accustomed to the noise and disturbance.

Invasive species are another impacting factor on adaption with the galapogos being ideal to study as some islands are pristine while others have feral cats and rats and others have had invasive populations eradicated. They found they found that islands with invasive predators had an increased FID with no reversion on islands which had since had the populations eradicated.

2 Studying cognition-emotion interaction in non-human primates using cognitive bias tasks; emerging trends and future directions.

Speaker: Dr Emily J Bethell (*Liverpool John Moores University*)
Date: 23rd November 2017

The cognitive theory of emotion: Cognition is the processing of information in the the brain (including perception), Emotion is the response to stimulus. There are 2 routes to processing info in the brain, high road cognitive response and low road emotional response.

The cognitive theory of emotion in humans. There is a feedback loop in emotional disorders - if you are in a poor emotional state then stimuli are processed negatively. The interaction between emotion and cognition is well established. Anxious people make negative judgments with ambiguous information, focussing more on negative and threatening stimuli - in an experiment they were quicker to notice threats (snake in the grass etc). Human studies provide many lessons we can adapt to other species.

Do monkey exhibit cognition-emotion interactions as humans do? Attention bias was found to be opposite to humans with anxious monkeys displaying avoidant behaviour - after being stressed the monkeys would look away/ignore threatening faces. However the results of this experiment did have a very high variability. Current work is staring to look at genetic factors and the impacts of early maternal separation. In summary there is an increasing amount of evidence pointing to primates displaying cognition-emotion interactions. This is influenced by both genetic and environmental factors.

3 General Ecosystem Models: mechanistic ecology linking scales from individuals to ecosystems.

Speaker: Dr Mike Harfoot (*UN Environment; WCMC*)
Date: 7th December 2017

Biodiversity is complex and fundamental to a habitable planet. Due to the complexity of moset conservation based models it is very difficult to unpick the mechanisms behind them and transfer the models to other systems. Climate and weather are similarly complex (though not quite on the same scale) and we have been developing mechanistic models around them for the last 60 years - with incredibly large amounts of data being collected. In ecology we are in the 1950's relative to climate models – but we have to start off with gross oversimplifications.

The Madingley Model is a General Ecosystem Model which aims to explain the mechanisms which underpin how ecosystems on land and in the sea function and are structured. It attempt to consider all trophic levels and provide reproducible results. The model has realistic geography with continents, ocean circulation and environmental conditions. The aim is to run the model at the individual level – looking at functional traits rather than specific species. Individuals with similar functional traits are grouped into cohorts and abundances calculated. What emerges is broadly similar to reality (though very simplistic). It's success varies with geography as well.

They are using the Madingley Model to predict response to Global environmental changes – combining it with the PREDICTS database (which looks at impacts of humans on species/ecosystems). They have found that different ecosystems have quantitatively different responses. Larger organisms tend to respond faster. With this research they are able to look at the biodiversity planetary boundary and determine tipping points in environmental change beyond which the planet will be unable to recover.

4 Why do the consequences of biodiversity loss diverge from expectation?

Speaker: Prof. Martin Solan (*University of Southampton*)
Date: 8th February 2018

Half a billion years ago the majority of life on Earth was algal grazers. The evolution of life which penetrated the sediment layer led to a significant diversification of life as the nutrients within these sediments was released back into the water column and fuelled primary productivity. Today more than 30,000km^2 of sediment in turned over everyday (that's a lot of sediment!). Soils and sediments are an extension of each other and form the largest habitat on Earth.

When the biodiversity of an ecosystem is altered there can be a variety of consequences. The NULL hypothesis would be that each species contributes equally to ecosystem function and so an linear relationship. However there are many other possibilities: there could be a single or few key species which or it could be stochastic. The order in which species are lost could also have a significant impact.

Random *vs* Ordered Extinctions: They did a few simulations to test this and found that loosing species by body-size is worse than random (i.e. larger sized species contribute more). They also found that loosing species by rarity (with rarest first) was not as bad as random extinctions – suggesting rare species contribute little to ecosystem functioning. Clearly the order of extinction events does have an impact! They tested this experimentally with mudflats. Mudflats are ideal for this experiment and the only have 3-4 species it is possible to test each possible order of extinctions.

5 Can nature survive the global infrastructure tsunami?

Speaker: Prof. William F. Laurance (*James Cook University*)
Date: 2^{nd} March 2018

The last few decades have seen an unheard-of expansion in infrastructure (roads, power-lines, dams, fossil fuel projects) especially in developing nations such as China and South America. Much of this expansion is poorly planned out with little thought on its environmental impact. The impact on the environment is increased by the fact that these developing nations are often the most biodiverse.

Roads have a multitude of effects. Direct effects: such as habitat loss, edge effects where the climate/environment is harsher at the habitat edges which are created. Road kill is also a problem and barrier effects where roads divide individuals territories is having an impact on bird behaviour. Roads also act as a corridor for invasion with mosquitos, cane toads and fire ant all utilising roads to spread. Indirect effects are also a problem: the presence of roads increases the amount of illegal deforestation/poaching/gold mining that can occur. **In summary roads are bad!**

Beyond the impact of the initial road there are also problems with infrastructure projects. These start with the corruption and negative impact on local economies and end with poorly built roads which need significant maintenance if they are going to be useful.

6 Whole-genome sequencing sheds light on patterns and processes of sympatric speciation in Neotropical Midas cichlid fish.

Speaker: Dr Andreas F. Kautt (*University of Konstanz*)
Date: 12^{th} April 2018

"Sympatric speciation is like the measles, everyone gets it and we all get over it"

Speciation is the build up of inherent barriers to gene flow, traditionally a geographic barrier has seemed like an obvious instigator of speciation, however an understanding of sympatric speciation - divergence from a single ancestor in the same geographic location shows this is not necessary. Cichlid fish are an ideal candidate to study speciation, 1 in 30 vertebrates are a cichlid and their presence in crater lakes - some with flow between and others not allow for comparison of sympatric and allopatric speciation.

They looked at a number of traits which differed in fish within and between lakes and asked a number of questions to determine if divergence was occurring:

1. Is the divergent selection acting on the trait?
2. Is there non-random mating?
3. What is the genetic basis of the trait?
4. How far in the speciation continuum is overall divergence?
5. What does the genomic landscape look like?

Lippy *vs* non-lippy: Feeding experiments on wild-caught fish showed there is a trade-off in lip size with large lips making it harder to catch evasive fish but easier to get into crevasses. Assortative mating was also found and genome studies confirmed this - it is hard however to say where along the divergence spectrum they are. There are genomic signatures around the 'lip-locus'.

Benthic *vs* Limnetic: Where benthic fish live at the bottom of the lakes and limnetic fish stay at the top layer. There is strong evidence for assortative mating - which from experiments does not seem to be due to habitat isolation.

7 Lasers in the jungle: new measurments of structure and function, from tropical forests to city churchyards.

Speaker: Dr Mathias Disney (*University College London*)
Date: 3rd May 2018

Lidar is the future! Using a device mounted on a terrestrial tripod they are able to very accurately capture and reproduce graphically the 3D structure of a forest. The example shown was that of Wytham wood outside Oxford. From this complex 3D structure they are able to get much more accurate measures of the above ground biomass. Historically this has come from either satellites or crude allometric equations based or even destructive methods in which they cut down the tree and actually weigh it. These methods both very inaccurate and incredibly expensive or time consuming.

Terrestrial laser scanning allows for accurate measures of volume and so above ground biomass as well as providing insights into tree branching length and limits on tree height. Initial scans return a dense cluster of points and so some clever computer algorithms are needed to turn these points into discrete volumes – trees. While testing out this technology they are focussing mainly on sites which are already very well understood for their ecology – making understanding their results much easier. Evidence suggests that their measures of biomass match pretty well when compared with the destructive method of cutting down and weighing trees. This method is also advantageous as it removes any chance of bias, all trees are sampled.

Another interesting outcome from this work is a realisation of how much tree branching occurs. For example the team LIDARed an Oak in Judi Dench's garden as part of project with the BBC. They found 12.5km of branching on what is a fairly usual oak tree – similar results are found across all trees! They also produced a 3D model of the tree and allowed people to explore it in virtual reality which seemed pretty cool!

8 How Behaviour influences evolution: experiments in burying beetles.

Speaker: Prof. Rebecca Kilner (*University of Cambridge*)
Date: 17th May 2018

Burying beetles lend themselves to evolution studies for a bunch of reasons... For the breeding experiments each beetle has their own individual box, they are then put together when they want to breed them and ensuing larvae are counted and measured.

Burying Beetles and Mouse Decomposition: Female beetles use mice carcasses to lay their eggs in. Without intervention a decaying mouse carcass will rupture due to gas expansion in the gut and then fungi will invade the carcass. The beetle want to try and prevent this to avoid competition for her offspring and so: Eats the whole gut, Rolls the carcass into a nice ball of flesh, Covers the carcass in antibacterial exudate and Buries the carcass.

A question they tries to answer is how the antibacterial exudates affect the bacterial community. To do this they had 3 treatments. 1. Sample carcass with no beetle present 2. Sample carcass beetles added after a day and bury the carcass 3. Sample carcass with no beetles but manually buried after a day.Results from this experiment show that carcasses which had been prepared by the beetles had a much higher bacterial load, this was unexpected. They suggest this is as the beetles eats the gut bacteria and relocates it to the surface of the mouse.

A further question is how selection from the parents can drive evolutionary change. For this they had two line: one with parental care and the other without, bred for 6 generations. They found that parents from the no care line (who are removed from their offspring) were more likely to make feeding incisions in to the carcass - leading to a better survival chance for their offspring. They also found differences in cooperation between the care/no-care offspring, with offspring from the line with parental care evolving to be much more competitive, with a smaller brood and larger average body size.

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9 How far can machine listening help with acoustic bird surveying?

Speaker: Dr Dan Stowell (*Queen Mary, University of London*)
Date: 24th May 2018

Birdsong recordings can carry a lot of information: which species are present, how many birds are present, how the birds are interacting. Machine learning algorithms could be used to answer questions similar to this on a much larger scale, both on contemporary recordings and archives. Traditional measures in birdsong include: frequency range, syllable count/duration and bout duration. Classification of birds is complicated by the fact that many species have 'regional dialects'. A common method for machine learning in birdsong is 'Feature Matching' where slices of audio (just a few milliseconds) are matched with templates. Similar to image recognition neural networks can be 'trained' on tagged audio clips.

Dan and his colleagues have developed an app 'Warblr' based on the neural network they have produced. The app can take a short recording of birdsong and return a ranked list of birds present with a percentage confidence. They combine this with geographical data from the ornithological society to produce better predictions. A number of insights have come from this endeavour including confusing results from around Camden (where ZSL is) and many recordings which do not have any birds in but still the app attempts to classify.

Beyond classification, detection is the next big challenge - this would be the ability to detect where in a recording a species is present, as well as what that species is. Using data from the Warblr app and other crowdsourced data they now have a fairly substantial 'training' dataset which can be used in machine learning. They have set up a 'Bird Audio Detection Challenge' one ran in 2016/17 and one is open now. This is an efficient way of pooling expertise from a wide variety of sources.

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10 Monitoring birds and tropical forest in a changing world.

Speaker: Dr Martin Sullivan (*University of Leeds*)
Date: 7th June 2018

The world and its environment is changing rapidly on different spatial and temporal scales. Long-term monitored datasets are a vital resource to better understand biological responses to these changes and predict how these changes will progress in the future.

UK Birds: Examples of long term datasets include the monitoring of grey herons in the UK (since 1984) and the 'Uk breeding bird survey' which has run since 1994 with around 2800 volunteers monitoring bird populations at over 3500 1km grid squares. Different species are faring differently with some species' populations decreasing while others are increasing. This may be related to functional traits or habitat, with the fate of a species being strongly linked to the type of habitat they prefer, explained by density dependence. Generalist species are doing better in the UK now compared with specialist species.

Change of tack to the rainforest: Rainforests are home to ¿50% of terrestrial biodiversity and a crazy amount of carbon. Usual measures of rainforests involve surveying 1km plots, measuring the diameter of all trees at a specific height and extrapolating biomass from that using allometric equations. Evidence suggests tropical forests are continuing to sequester carbon and so the question arises: does protecting carbon dense forest also protect biodiverse forest? If this was the case its a win-win however Martins study suggests that there is no clear link - even when accounting for climate/soil and spatial autocorrelation.

11 Local adaption in humans and other primates.

Speaker: Dr Aida Andres (*University College London*)
Date: 14^{th} June 2018

Local adaption is the adaption of a population to be better suited to local conditions - while remaining part of the same species, local adaption occurs on relatively short timescales. Humans are an excellent example of local adaption, having colonised to the majority of the globe: moving out of Africa about 50,000 years ago and now living comfortably in all kinds of environmental conditions. By comparing populations from Europe and Africa it is possible to determine which alleles differ and so may have been impacted by selection pressure - leading to local adaption. Using an ancient 'out-of-Africa' genome it is possible to eliminate alleles which were fixed due to drift - as drift occurs at a much faster rate than selection and so this early genome will have fixed alleles due to drift but will not have had time for local adaption to occur when compared to a modern day 'out-of-Africa' genome. There is evidence that local adaption significantly contributed to strong allele frequency population differentiation.

Adaption to ambient temperature is an obvious trait to study as average annual temperature varies so much globally; around $28\,^{\circ}\mathrm{C}$ in Africa and $6\,^{\circ}\mathrm{C}$ in Finland. Cold response has also been shown to be impacted by a single gene controlling a Transient Receptor Potential (TRP) ion channel. They found that the cold adapted allele had a much higher frequency in higher latitudes with colder temperature and actually found a significant correlation between the allele frequency and latitude/temperature.

12 Predicting changes in the diversity of functionally important plants in response to extreme weather: How far can we go with statistical species Niche Models?

Speaker: Dr Simon Smart (*NERC Centre for Ecology & Hydrology*)
Date: 21^{st} June 2018

The aim of this study was to determine how key service-providing plants respond to extreme weather events and gradual climate change. There are multiple of global biodiversity change - detailed in Sala et al (2000) 'Global Biodiversity Scenarios for the Year 2100' all affecting the biodiversity and composition of ecosystems.

This study looked at the impacts and response to flooding (after storm Desmond) in high quality agricultural land and hill land/river valley (Lyth Valley) valued by wildlife and for its natural beauty. They are trying to answer questions such as: Will extreme weather with climate change lead to colonization failures due to the estimated vacant nice space? and Will potential colonists deliver a different set of services than existing vegetation.

Statistical species niche model: key axis which define where a plant lives, for example; shade, disturbance, fertility, pH. Using the R package MultiMOVE they made predictions on the species composition of ecosystems under different climatic and weather stresses. The package covers all nectar plants, all dominant ecosystem species as well as a breadth of rarer species, with each niche model being the weighted average of 5 models (MARS, GLM, Random Forests, GAM and Neural Networks). They predicted for Lyth Valley, negative impacts for all but one group and found that a warmer, drier climate buffers the impact of flooding but increases the risk of drought.

There are a number of criticisms of the model which he addresses. Space $\neq$ time. No dynamic and so no novel outcomes. Models depict niches of the past with possible unknown interactions.