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The annual BHS meeting was held in Bournemouth, 3rd December 2016. Abstracts of presenter contributions made are listed below.

Solving the detection error problem: a GCN case study using occupancy modelling

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Standard practice for herpetological surveys in the UK is to conduct multiple surveys from which peak count data can be extracted, recognising that counts can vary between surveys because of variable detection rates. Peak counts generate a relative abundance and, where this varies between sites or years, it is assumed that detection rate is controlled for and that the metric therefore represents differences in the abundance of animals. However, this assumption is not always valid, as demonstrated in my study, and is generally likely to be false, rendering peak counts not fit for purpose.

Occupancy models offer an alternative approach to interpreting count data: they identify which detection and abundance covariates best apply and by estimating detection rates allow calculation of a population estimate, with confidence intervals to compare between sites or years.

In my study, surveys were conducted on a large disused clay-extraction site in Peterborough, England, with a superabundance of great crested newts *Triturus cristatus* to assess their current population. Count data obtained in 2012, providing a measure of relative abundance, were unsuitable for comparisons against the known founding population of 9,000 animals translocated to the study area in the early 1990s. By contrast, occupancy modelling in 2013 revealed a population estimate of 7025 (±1000), proving the successful application of the technique; this approach can now be replicated in ongoing monitoring to determine population trends.

Potentially the biggest barrier to the application of occupancy models is that they are data-hungry, requiring a large sample size of ponds. This hurdle can be overcome through pooling resources, and is exemplified by a new partnership project in North Wales between NGOs, local authorities, statutory bodies, consultancies, volunteers and the local records centre, which has created a shared dataset with 526 ponds from 57 sites to date, including historical records from some sites dating back up to 30 years. This project provides an excellent model for data handling of long-term monitoring and should be rolled out more widely to other regions. Standardised recording also facilitates analysis and reporting.

In this presentation, I call for more practitioners to apply simple occupancy models to analyse their data, given these analyses are fully compatible with existing data and data collection methodologies, but actually require fewer repeat surveys and provide more accurate measures of abundance than peak counts. Furthermore, despite a complex mathematical underpinning, they are easy to apply using free software.

The New Forest smooth snake survey (NF-SSS…)

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In 2013, a steering group called the New Forest Amphibian and Reptile Monitoring and Surveillance (NF-ARMS) Partnership was established with the aim of gaining a better understanding of the status of all reptile and amphibian species in the New Forest. The Partnership consists of eleven key organisations involved in the land management and conservation of the New Forest National Park. A central goal of the Partnership is to make up-to-date species data available to inform and support conservation and habitat management across the range of sites where reptile and amphibian species occur, both in the open forest and surrounding habitats.

The New Forest is well known as a national stronghold for reptiles; it is the largest unspoilt tract of lowland heathland in the UK, providing primary habitat for all six of our native reptile species. The smooth snake (*Coronella austriaca*) is recognised as the country's rarest reptile. It is a secretive creature, choosing to bask within heather vegetation and burrowing out of sight, and for this reason its ecology, behaviour and distribution have been difficult to study. The species occurs predominantly on the lowland heathlands of Dorset, Hampshire and Surrey and the New Forest may hold the most significant population in the country.

The NF-ARMS Partnership has identified the smooth snake as a priority for investigation due to the lack of information available on its range and status. The New Forest Smooth Snake Survey (*NF-SSS*...) is the first

project to be created by the Partnership and has been implemented by Amphibian and Reptile Conservation (ARC) since April 2015. The *NF-SSS*... project has two primary aims:

- To further our understanding of the distribution and status of the smooth snake in the New Forest National Park (NFNP). This is achieved by, (i) gathering and performing analyses on existing species data and, (ii) engaging and coordinating volunteers to look for the smooth snake (and other reptiles) within areas of the New Forest where its presence is uncertain.
- To promote awareness of the smooth snake, and all our native reptile species, through the media and local events, highlighting the New Forest as of great importance for wildlife and people.

I will focus on the project's achievements and results to date, lessons learnt, and plans for the future.

Re-assessment of priority amphibians in Peru

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There are approximately 616 amphibian species in Peru, of which 493 are on the International Union for the Conservation of Nature (IUCN) Red List. Of these 111 are classified as Threatened, with 69 species classified as Critically Endangered or Endangered. In addition, 140 amphibian species remain Data Deficient. We re-assessed the conservation status of 38 amphibian species originally identified as potentially Threatened by von May et al. (2008), using the IUCN Red List Categories and Criteria. We used a variety of tools including consulting recent primary literature, talking with Peruvian experts and using an online *Peru Amphibian Red List Assessment Forum*. As a result of the re-assessment, 14 species had a change in Red List assessment status. Eight species changed from Data Deficient to Threatened; two changed from Data Deficient to Near Threatened and Least Concern respectively; two were up-listed from Least Concern to a Threatened status and two were down-listed. The eight species with a change from Data Deficient to a Threatened category belonged to four anuran families: Craugastoridae, Dendrobatidae,

Hemiphractidae and Telmatobiidae. The reasons for a change in assessment status were: changes in taxonomy, distribution, population status, threat status, or previously incorrect information. The main threat affecting re-assessed amphibian species was habitat loss, with other threats including pollution, disease outbreaks, and collection for the pet trade. Only 53% of the re-assessed species were found to occur in a protected area. Findings of this study indicate the continuing fragility of many Peruvian amphibians and highlight the need for improving their protection and for further research into their population status and threats.

Investigating putative non-native grass snakes

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With a range including Africa, Asia and Europe, the grass snake (*Natrix natrix*) is one of the most widespread terrestrial snakes. This broad distribution has led to multiple different proposed phylogenies, with certain morphological variations suggested to help identify subspecies. During the past 40 years, several atypical populations of grass snake have been observed across the UK, including recently discovered populations in Essex and Staffordshire. The individuals' phenotypic appearances (dorsolateral stripes) suggested a southern or eastern European origin, for which this study was sought to ascertain the geographical origin using genetic analysis. Grass snakes were sampled from the Staffordshire and Essex populations, with a single tissue sample being provided for a previously studied non-native population in Esholt, Yorkshire. The phylogenetic analysis was undertaken using an 827-bp-long alignment of 355 mtDNA sequences (ND4), from both this and previous molecular studies. Results indicated that the Staffordshire population originated from northern Italy, whilst the sequences from the Essex and Yorkshire populations indicated an origin from the Balkan Peninsula. A lack of physical barriers at all sites would allow for free movement of these non-native individuals, leading to the possibility of hybridization, introgression and spread of disease. Introduced species are regularly demonstrated to be one of the major threats and factors in the decline of global diversity. Further surveys would allow for population trends and range expansions to be monitored, whilst further molecular analysis is recommended to ascertain whether hybridization is taking place.

Population study of Morelet's crocodile (*Crocodylus moreletii*)
in the Laguna del Tigre National Park, Guatemala

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Occurring in the Yucatan Peninsula (Mexico, Belize and Guatemala), Morelet's crocodile (*Crocodylus moreletti*) is a medium-sized crocodilian species (males up to 4.5m) currently listed as Least Concern by the IUCN (2012) but up until 2000 was listed as endangered as a result of unregulated hunting. The current listing mostly relates to work done in Belize and Mexico to protect Morelet's as the status and distribution in Guatemala is largely unknown. The main threat to this species now is the expansion of agriculture and cattle ranching into their habitats and so there is a real need for status surveys to be carried out in Guatemala to help formulate the most appropriate management plans.

I will discuss a study carried out this summer in the Laguna del Tigre National Park, in the northern region of Guatemala, that firstly tried to assess the population

of Morelet's along a 17km stretch of the San Pedro River and 7km of the Sacluc River by completing spotlight surveys over the course of two months. The data collected from this will hopefully help to start quantifying the population of Morelet's in Guatemala. Secondly this study investigated how agricultural and human activities surrounding these stretches of rivers are affecting the population distribution as in this survey area there are multiple land uses including oil palm and papaya plantations, and areas where local people are using the river for washing purposes. Previous studies have already shown how agricultural chemicals entering river systems are decreasing the body condition of Morelet's and other crocodilian species, and how there is evidence to suggest that these chemicals could be building up in the population between generations. However, there appears to be very little data available on how these chemicals are affecting the population distribution. In this study, therefore, we also measured the water quality at different sample points along the river and used Geographical Information Systems (GIS) to try and assess how the distribution responded to water quality and land use.

Ranavirus UK : Investigating the impact of Ranavirus on UK amphibian populations with the help of Citizen Scientists

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Ranaviruses are emerging viral pathogens capable of causing disease in cold blooded vertebrates. At least one species of Ranavirus is known to have been present in the UK since the early 1990s and has been implicated in a decline in numbers of the common frog (*Rana temporaria*). Infection of a habitat can often result in a mass mortality event, during which a large proportion of the frogs present at a field site will die over a short period of time.

Scientists from the Zoological Society of London formed the "Frog Mortality Project" (FMP) in response to the first reported cases of mass mortality events. The FMP aimed to monitor the occurrence of Ranavirus outbreaks in the early days of its UK emergence through the collation of a database of known cases. The FMP has continued to this day in various guises administered by the charity FrogLife and ZSL's Garden Wildlife Health project.

From this database a collaborative research network that brings together both professional researchers and citizen scientists has been formed. This network allows us to monitor populations know to be infected with Ranavirus and to conduct comparative studies into the impacts of infection by utilising both known infected and known uninfected field sites.

Current projects include, investigating differences in gene expression between infected and uninfected populations, trying to understand how infection influences population demographics and further looking into apparent assortative mate choice behaviour displayed by common frogs from infected field sites. I will outline ongoing research within the UK Ranavirus research network and present some new results from several projects. I will also talk about the future of the UK Ranavirus research network and how you can get involved.

Influences on great crested newt environmental DNA

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In the last five years, environmental DNA (eDNA) has become increasingly available as a tool for surveying freshwater species. Great crested newts (*Triturus cristatus*) were one of the early demonstration species chosen to show the effectiveness of the method. The technique was trialled on a large scale in the 2013 PondNet study using volunteers in the UK, and the following year Natural England adopted eDNA as a tool for assessing populations in development mitigation projects. We compared different methods of sample collection (preservation of sampled water in an ethanol sodium acetate solution versus syringe filtration of larger volumes of water). In addition, we monitored the fluctuation in eDNA concentration in a series of ponds, from February to October, in relation to newt abundance and environmental variables. A range of biological and environmental factors influence seasonal changes in eDNA, and the currently accepted survey window for sample collection may need reviewing in relation to these factors.

Can hybridisation explain venom evolution in rattlesnakes?

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Rattlesnakes display two distinct venom strategies. Type I venoms are rich in metalloproteinases (SVMPs) and cause tissue damage, bleeding and coagulopathy. Type II venoms are rich in highly lethal neurotoxic phospholipases A2 such as Mojave toxin or crotoxin and can cause neurotoxic symptoms, but largely lack SVMPs. Surprisingly, both venom types are distributed seemingly randomly across the phylogeny of rattlesnakes, and several distantly related species contain populations with both venom types. Interspecific hybridisation has been advanced as a possible explanation, and especially for the unexpected presence of neurotoxins in populations of some species. Here, we use the discovery of a hybrid zone between the prairie rattlesnake (*Crotalus viridis* - type I venom) and the Mohave rattlesnake (*Crotalus scutulatus* - type II venom) to test whether interspecific hybridisation is indeed likely to lead to introgression of neurotoxin-encoding genes into a different species. Our data show that, despite ample evidence of frequent

hybridisation and backcrossing in the contact zone, there is no evidence of selective spread of Mojave toxin genes across the hybrid zone. This suggests that even extensive hybridisation between type I and type II venom rattlesnakes does not necessarily result in introgression of toxin genes, and also implies that highly lethal neurotoxins such as Mojave toxin do not necessarily confer a strong selective advantage. It therefore appears that hybridisation is unlikely to be an important reason for the phylogenetically incongruent distribution of venom types across rattlesnakes.

How much effort is needed to detect population changes in amphibians? A test using a bromeliad-inhabiting frog

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Amphibians are declining worldwide and priority actions have been proposed for species conservation, such as long term monitoring of target populations. However, declining amphibians are often rare, cryptic and difficult to detect in the field, and this presents challenges in designing cost-effective surveys to detect population changes. We combined power analysis and occupancy modelling to explore the levels of survey effort needed to determine population trends in a monitoring program of a threatened amphibian species. We used a case study from a single species and used empirical data to compare different sampling designs. Our target species is *Crossodactylodes itambe* – a frog endemic to the Brazilian highlands and found only in a single species of bromeliad. Treating bromeliads as 'sites', we applied night visual encounter surveys to record presence and absence of frogs at over 130 sites over two years. Detection probabilities were high and there was no significant change between years, months or seasons. However, repeated visits are needed to obtain estimates of occupancy that have a high degree of certainty. The precision of our estimates increased with number of survey visits, but there is no improvement in detection after a fixed number of occasions – this means that sampling effort can be optimised to get precise estimates of occupancy and detectability. For our target species, current survey effort can detect large changes in occupancy over time. Although optimising sampling designs can improve precision of estimates of site occupancy and detectability, in the monitoring context, researchers should carefully consider issues of statistical power (i.e. the survey effort needed to detect a true decline in a population). In this case, power analysis should be routinely applied to amphibian population assessments to improve design and determine whether survey effort is sufficient.