horse densities, the highly contagious nature of the disease meant that most horses were infected rapidly and then infection became self-limiting as there were no further susceptible horses to facilitate ongoing spread. Response efforts shifted over time from control to clearing previously infected areas and testing for proof of freedom from infection. Australia declared provisional freedom from EI on 14 March 2008 and subsequently declared official freedom from EI on 25 December 2008, in accordance with protocols outlined by the World Organisation for Animal Health (OIE).[1]

It is estimated that the 2007 outbreak involved approximately 10,000 infected premises and a total of 76,000 infected horses[2].

The successful control, containment and eradication of EI in Australia was the result of a coordinated national response, involving cooperation between government and industry stakeholders at all levels[1]. The presence of an effective national animal health system, pre-existing strategies and agreements to guide rapid implementation of an exotic disease response and cooperation and participation of industry stakeholders in the development and implementation of response strategies were major contributing factors to the success of the response. Changes have been made as a result of internal and independent inquiries into aspects of the outbreak, with a particular focus on strengthening quarantine procedures to minimise the risk of further incursions of this and other exotic animal diseases into Australia[1,5].

References

1. Australian Chief Veterinary Officer (2008) *Recovery of EI country free status. Australian Report to the World Organisation for Animal Health (OIE)*. Available at http://www.outbreak.gov.au/pests_diseases/pests_diseases_animals/equine_influenza/index.htm#situation. Accessed 12 June 2009.
2. EI Epidemiology Support Group (2008) *Equine Influenza 2007: The Australian Experience. Report to the Consultative Committee on Emergency Animal Disease*.
3. Callinan, I. (2008) *Equine influenza: The August 2007 outbreak in Australia. Report of the Equine Influenza Inquiry*. Available at http://www.equineinfluenzainquiry.gov.au. Accessed 12 June 2009.
4. East, I.J. (2009) The Role of Land Use Patterns in Limiting the Spread of Equine Influenza in Queensland During the 2007 Epidemic. *Transbound. Emerg. Dis.* DOI: 10.1111/j.1865-1682.2009.01080.x
5. *Equine influenza inquiry: the government's response*. Available at http://www.daff.gov.au/aqis/about/eiimplementation. Accessed 12 June 2009.

Nigel Perkins is a veterinary epidemiologist, Director of AusVet Animal Health Services and Program Coordinator within the Australian Biosecurity Cooperative Research Centre. He was involved in the 2007 EI response as a member of the EI Epidemiology Support Group.

A new arbovirus in northern Australia

Christopher Cowled

CSIRO Livestock Industries
Australian Animal Health Laboratory
5 Portarlington Rd East Geelong, Vic. 3220
Tel (03) 5227 5026
Fax (03) 5227 5555
Mobile 0403 566 502
Email chris.cowled@csiro.au

Routine arbovirus surveillance has unearthed a number of novel viruses circulating in domestic and wild animals in northern Australia. One of these is a new virus named *Middle Point orbivirus* (MPOV). While its disease potential remains unknown, evidence suggests that this virus emerged quite recently in Australia and it has now become the single most commonly isolated animal virus in the Northern Territory. The discovery of MPOV highlights the importance of obtaining prototype data on novel Australian viruses.

Beatrice Hill research farm, Middle Point (Figure 1), is located approximately 50km East of Darwin and has long been recognised as a hot spot for arthropod-borne viruses (arboviruses)[1]. For over 30 years, the National Arbovirus Monitoring Program (NAMP) has maintained herds of sentinel cattle at this site for virus isolation and serological studies[2]. From the mid-1990s onwards, an increasing number of viruses were isolated that could not be identified by traditional methods (such as using panels of antibodies raised against all known Australian arboviruses) and by 2005 the unidentified virus collection had exceeded 1000 specimens [Richard Weir, personal communication].

Using a genetic sequencing approach, the collection has yielded a number of viruses new to science, including the virus now known as MPOV[3]. Our initial examination of MPOV by electron microscopy had shown that this virus had morphology consistent with members of the genus *Orbivirus,* of which 10 species were already known to exist in Australia. At the genetic level, however, MPOV was distantly related to all known Australian viruses, but

shared a high level of similarity with a virus from China called *Yunnan orbivirus* (YUOV) [4]. Despite this relationship, some major differences were immediately apparent: YUOV had been isolated only from mosquitoes and would not grow in any of the mammalian cell culture systems tested, whereas MPOV was isolated from a domestic cow and grew very rapidly in mammalian cells *in vitro*. Analysis of the genetic sequence of the two viruses indicated that immunity to one would be very unlikely to confer protection against the other. Finally, the two viruses had been found in locations separated by more than 5000km of land and sea. Analysis of blood from infected animals confirmed that cattle were able to make immune responses to MPOV; however, antibody levels were consistently found to be low, leading to long-lasting infection in some animals. Furthermore, cattle with antibodies against MPOV were identified in multiple locations across the Northern Territory, indicating that the virus was much more widespread than anticipated. A diagnostic test was developed for screening further unidentified viruses in the arbovirus collection and almost half of all isolates screened to date turned out to be isolates of MPOV. In recent years, MPOV has accounted for more than one third of all arboviruses isolated from animals in the Northern Territory.

The oldest isolates of MPOV identified so far were collected in the Northern Territory in 1994 and we estimate this to have been around the time that it first emerged in Australia. There are two main hypotheses regarding the origin of MPOV in this country. The first and most likely scenario is that it arrived on the wind in the body of an infected insect blown here during a tropical storm. Alternatively, MPOV may have been present in the Australian environment much longer, but has only recently acquired an adaptation allowing it to become so widespread. Either way, it is a timely reminder that viruses are unstable entities, capable of rapid change and that their emergence in new environments needs to be carefully monitored.

The diagnostic test is now used by the NAMP to allow the ongoing identification of isolates of MPOV. Now that this virus can be quickly and easily identified, diagnostic laboratories can allocate more resources towards the diagnosis of known pathogens and towards the characterisation of additional unknown viruses. With the advent of high throughput sequencing, the net is fast closing in on the mystery viruses of northern Australia.

Acknowledgement

This work was supported by the Australian Biosecurity CRC for Emerging Infectious Disease (AB-CRC). In addition, I would like to thank colleagues and collaborators from the CSIRO Australian Animal Health Laboratory, the Berrimah Veterinary Laboratory and the Centre for Infection and Immunity (New York) for their role in this work.

References

1. St. George, T.D. *et al.* (2001) The history of bluetongue, Akabane and ephemeral fever viruses and their vectors in Australia 1975-1999. Animal Health Australia.
2. *National Arbovirus Monitoring Program Annual Report 2006-2007* (2007) Animal Health Australia
3. Cowled, C. *et al.* (2007) Genetic and epidemiological characterisation of Middle Point orbivirus, a novel virus isolated from sentinel cattle in northern Australia. *J. Gen. Virol.* 88, 3413-3422.
4. Attoui, H. *et al.* (2005) Yunnan orbivirus, a new orbivirus species isolated from Culex tritaeniorhynchus mosquitoes in China. *J. Gen. Virol.* 86, 3409-3417.

Dr Chris Cowled is a postdoctoral fellow at the CSIRO Australian Animal Health Laboratory in Geelong, Victoria. His research interests include viral genomics and the interaction between viruses and the mammalian immune system.

Figure 1. The climate and ecology of Middle Point support very high levels of arbovirus activity, making it an ideal place to conduct arbovirus research and surveillance. ***Photo: Lorna Melville.***