# Articles for 'Change and Evolution' Activity

## 1) The Hendra virus – an evolving story

If you live in an eastern Australian city or town between Darwin and Melbourne it's not unusual to look into the sky around sunset and see flying foxes embarking on their nightly food forays. Some may even be headed for a tasty morsel in your backyard.

These nocturnal trekkers have made the headlines of late, not because of the impact they can have on orchards or your favourite fruit tree but because of the 'free ride' they give to some viruses which cause them no harm but which can be fatal to other animals. The Hendra virus is one such virus. It has proved fatal to horses and humans. At the time of writing it has been detected in 39 horses and six humans. (See Table 1 below)

**Table 1. A summary of Hendra virus infection as at 21 August 2008**

| Year (month) | Location | Equine cases | Human cases | Human deaths |
|---|---|---|---|---|
| 1994 (August) | Mackay (QLD) | 2 | 1 | 1 |
| 1994 (September) | Hendra (QLD) | 21 | 2 | 1 |
| 1999 (January) | Trinity Beach (QLD) | 1 | 0 | 0 |
| 2004 (October) | Gordonvale (QLD) | 1 | 1 | 0 |
| 2004 (December) | Townsville (QLD) | 1 | 0 | 0 |
| 2006 (June) | Peachester (QLD) | 1 | 0 | 0 |
| 2006 (October) | Murwillumbah (NSW) | 1 | 0 | 0 |
| 2007 (June) | Peachester (QLD) | 1 | 0 | 0 |
| 2007 (July) | Clifton Beach (QLD) | 1 | 0 | 0 |
| 2008 (July) | Redlands (QLD) | 5 | 2 | 1 |
| 2008 (July) | Proserpine (QLD) | 3 | 0 | 0 |
| | | 38 | 6 | 3 |

Source: ***Hot topic Hendra virus, Australian Biosecurity CRC for Emerging Infectious Disease*** *http://www1.abcrc.org.au/uploads/64156968-c65a-4718-bf36-d67afd69b330/docs/HotTopicHendraVirus090708%5bnew%5d.pdf*

Note: The 5 cases entered for Redlands are a change to the original table. The number was supplied by Redlands vet Dr. David Lovell.

### The first outbreaks

Our story of this virus begins in Brisbane, in September 1994 when horse trainer Vic Rail, his stable hand, and most of his horses fell ill to a sudden and unknown illness with pneumonia-like symptoms. Within several days Vic Rail and 14 of his horses were dead.

Shockwaves went through the horsing industry and headlines such as '***Death virus cancels races, threatens Cup***' sold newspapers. Until this outbreak a brain infection, which killed two horses, and caused horse illness in owner Mark Preston a few weeks earlier in Mackay north Queensland, had gone relatively unnoticed.

CSIRO's Australian Animal Health Laboratory (AAHL) in Geelong isolated and identified the cause of each outbreak – a virus new to science and named it the Hendra virus after the name of the Brisbane suburb where Vic Rail had his stables. The discovery of Hendra virus led to the establishment of a new genus within the Family Paramyxoviridae. Unlike other viruses in this family, which tend to be host-specific, this virus can infect more than one animal species.

AAHL research shows that horses, cats and guinea pigs can excrete the virus in their urine but that it isn't carried on the breath of horses, which helps to explain why it isn't highly contagious. The exact means by which the virus is passed onto horses isn't known but infected bat urine, an aborted bat foetus or reproductive fluids could be involved. The incubation period can be up to 16 days.

**Redlands outbreak**

Fourteen years and eleven outbreaks later, Hendra virus was again in the news in the winter of 2008. A new outbreak in Redlands, Brisbane killed more horses and vet Ben Cunneen and this time the symptoms were different.

The first horse to get sick had been living in an outside yard of a Redlands veterinary practice for more than a year. Overnight it had changed from being healthy to its death throes.

Vet David Lovell, the owner of the Redlands practice said 'We found it on Thursday morning in a dire and extreme physiological state. And it was certainly a neurological presentation, we recognise that, but it was also so close to death when we caught it, that it was impossible to consider any sort of treatment. And in fact the animal was very deranged and quite difficult and dangerous to restrain, as soon as we caught it, we euthanased it because it was just in a terrible condition.'

Unlike most previous outbreaks where fluid had flooded the lungs drowning the horses, this time everyone was caught by surprise as the virus had attacked the brain. Lovell considered Hendra virus to be unlikely as this syndrome 'showed absolutely no signs that would suggest that it could be, because we were all being led to understand that it is a respiratory system disease, and that you get signs of pneumonia and nasal discharge and things like that, so there was absolutely none of that from this horse. On the understanding at that time that really didn't cross our mind.' said Dr Lovell.

Within ten days three more horses at the practice went down with similar symptoms. David Lovell called the Queensland government vets and described a disease he thought might have been Herpes virus, because it didn't look at all like the Hendra virus. From around 20 staff from the practice who had been in contact with infected horses, two were to fall ill with flu-like symptoms; high temperatures, headaches, drowsiness and muscular pain. Vet Ben Cunneen became ill and died several weeks later. A vet nurse fell ill but recovered.

**The Hendra virus**
The AAHL team, led by virologist Dr Linfa Wang, has discovered that the virus from the Redlands clinic is a new strain of Hendra. 'This virus has different variants in its genome compared with the previously known Hendra virus. The differences between the old and new strains aren't big, but they're enough to cause a different disease in people and horses. One strain mainly produces a lung disease and the other seems to more likely cause a brain disease.' He said.

Wang long suspected that different strains of Hendra were out there as antibodies from some wild bats just weren't neutralising the old virus, which meant that those bats had been infected with related, but different viruses. 'This really suggests to me that there are different Hendra viruses out there. So I would not be surprised that we will find different variants and have different sort of symptoms.' said Dr Wang.

**From flying foxes to horses**
Just how does the virus get from flying foxes to horses to humans? We're not exactly sure but one possibility is that contamination occurs because a bat with the virus urinates on some hay in a horse yard. The virus gets into the horse and thrives producing so much virus that a speck of body fluid is enough to infect another horse or a human.

**What's next?**
No doubt this is just an instalment in the Hendra virus story. The new symptoms caught everyone by surprise and the Redlands case indicates that it is just possible that other isolated virus outbreaks have gone unnoticed. Research indicates that there are variations in the virus out there and that the virus occurs in bats in all areas of Australia and Papua New Guinea where bats reside. More outbreaks, some with new symptoms may be on the horizon.

**References:**

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## 2. Stressed out bats

There are four kinds of fruit bats found in Australia - the grey headed flying fox *Pteropus poliocephalus*, the black flying fox *Pteropus alecto*, the little red flying fox *Pteropus scapulatus*, and the spectacled flying fox *Pteropus conspiculatis* and they are all under stress, even the ones that might be living near you or visiting your homes. And what's stressing them out? We are!

**Human competition**
For too long now we've been in competition with these bats for their food sources and resting camps. We've cleared away much of their native food sources (eucalypt forests, rain forests and paper bark forests) for agricultural, forestry and residential purposes and disrupted their resting camps if we feel they're too close to ours.

And we've done this with scarce regard for the important role they play in forest regeneration. We've ignored the fact that they are important pollinators of forest and woodland trees, and that they disperse rain forest seeds. We're rather more aware of the destruction they can do to orchards and that they harbour deadly viruses.

**Feeding**
As they feed on nectar and pollen, grains stick to their fur and are carried to other flowers - pollination results. And they pollinate over much greater distances than bees, moths, butterflies, wasps, flies, beetles and other small mammals for some of these bats travel up to 100 kilometres in a night.

Many a coastal Queenslander is accustomed to the summer 'mango seed drop' fruit bats do in their backyards. When bats eat fruits small seeds pass through their guts whilst ones larger than 4mm are carried in their mouths. What is not well known is that the rainforest seed drops they do, move seeds between isolated patches of rainforests thus providing important genetic links. But bats need to be present in large numbers to do this effectively – in numbers greater than those would threaten their extinction.

**Resting**
Fruit bats spend their daytime hanging in resting camps which are essential for their health and survival. The numbers in a camp fluctuate in response to the availability of food and can range from zero to tens of thousands. Several species may use the one camp.

Camps occur within range of food sources. They provide stop over points for migrating bats, and facilitate social interactions including breeding.

Where bats have been forced to roost close to our houses and recreational areas conflict results. We complain about their noise, the smell of their droppings, that they are killing roost trees and that they pose a disease threat to us and some of our animals.

**City bats**
Bats are on the move. Because of what we've done to their traditional food sources bats are starving and moving into our cities and towns. Sydney University fruit bat researcher Dr Kerryn Parry-Jones says 'They perceive it as being a better chance for their survival. But of course when they come into the cities, they come up against humans a lot more.

A lot of the winter foods for example, autumn and winter foods, are found on swampy coastal areas, which of course are being drained for development. We're causing problems by removing this food source, which will mean that the cities are more attractive. But then they have problems because they're in what we humans think are inappropriate positions like the Botanic Gardens in Melbourne and in Sydney, or they're next to a school or something like this, and people want to remove them. So they're put under stress again by being forcibly removed from various sites that they've come to.'

**Extreme weather**
In addition to the human interference, bats are also succumbing to extreme weather events. Storms, cyclones and droughts are taking a toll on their roosting trees and food sources. Heat waves are killing them in their thousands.

**Viruses and bats**
Some scientists believe these stresses are weakening bats' immune systems allowing the viruses they carry to increase and pass out in their body fluids - urine and salvia. They postulate that this could be why the Hendra virus and the Australian Bat Lyssavirus (ABL), a virus closely related to the classic rabies virus, have emerged in recent years. (Unfortunately, these viruses are causing the bats to be even more unpopular.)

Other scientists assert that the idea that the viruses 'spill out from the bats' is very hypothetical and there is little evidence in its support. Some suggest that the particular horses which acquired the Hendra virus might have had low immunity and as so few animals and humans have been infected the whole bat viral threat has been seen out of perspective. (In Australian since 1996 only three human deaths have been identified as due to the Hendra virus whilst only two have been identified as due to the Lyssavirus. No positive identifications have occurred prior to this date.

**What should we do?**
Despite their importance to forest regeneration we have ignored their plight so things are grim for bats. What should we do when conflict arises?

Some orchardists want to keep shooting them, but according to Dr Kerryn Parry-Jones, who recently saw one orchard's results for one night's shooting, this should not be an option. 'The head is such a small part of the bat; to try and get a headshot with a shotgun is virtually impossible. They come in with multiple broken bones in their wings, and shoulders, that sort of area. And we had about 200 bodies we collected, of which about 60 had to be euthanased. In other words they were collected alive. So they would have spent hours in

agony until they were collected. And it is a very cruel way of getting rid of any animal, even a pest animal. Exclusion netting and other non-lethal deterrents can be used to protect fruit orchards.' said Dr Parry-Jones.

Horse owners are fearful that bats could transmit viruses to their horses and themselves but simple measures like ensuring that food and water troughs are not under trees where bats might feed or rest can reduce the chance of this happening.

And attempting to change where they camp is not very good for the bats and not very successful either. Trying to disperse a camp like the Sydney Royal Botanic Gardens Trust is planning to do outside the breeding season is a costly and highly unreliable method that most likely will fail without expensive annual disruptions. In 2009 the Trust plans to disrupt a colony of 20,000 bats roosting in the gardens, which they fear are threatening heritage trees. They plan to use noise disturbances whilst the bats are sleeping. "Where do the Gardens think the bats are going to go? The food supplies are all within five kilometres, Hyde Park, Centennial Park, people's yards." said Dr Kerry Parry-Jones.

For the health of the bats, humans and horses and the forests bats regenerate let's hope a win- win solution can be found but time is running out.

**Update:**
The planned 2009 relocation of the Sydney Botanical Gardens bats along with those from two other NSW colonies at Maclean, and Singleton have been delayed pending further inquiry from federal government authorities.

**References:**
***Hendra and the bats***, Background Briefing 31 August 2008, Radio National, Australian Broadcasting Corporation,
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***Why are flying-foxes important*?**
http://www.sydneybats.org.au/cms/index.php?id=11,58,0,0,1,0

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***Bats outfoxed***, Robert Burton-Bradley, 24 September 2008
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***Living with flying-foxes*** http://www.epa.qld.gov.au/
Click on 'Publications' and then on the letter 'l'. Scroll down to find the article.

## 3. The War of the Viruses

Have you heard about any of these viruses - Hendra, Nipah, SARS and lyssavirus? They're relative new comers to the science world and they're using fruit bats from Africa to Australia as their attack aircraft. Some have jumped from bats to other animals to humans whilst others have jumped from bats to humans.

They've killed humans, pigs, and horses. Except for the lyssavirus, they are harmless to bats. The latest virus known to be transmitted by bats is the Melaka virus, first detected in that Malaysian city in March 2006. Although not lethal it has made humans very sick.

To date we've managed to contain all of these viral outbreaks but the viruses and the threat of new ones have us very, very worried.

What are the symptoms of these viruses? Where have they emerged? Why are emerging now? How have they been contained? These are questions that Australian scientists have tried to answer. And although they've had some success scientists are concerned for our future health.

**Hendra virus**
In the fourteen years since its first detection in the Brisbane suburb of Hendra in September 1994, this virus has been involved in 11 outbreaks. It has infected 39 horses and six humans. Three of those people died. All surviving horses were killed to avoid the virus resurfacing and spreading. We now know that there are different strains of the virus causing different symptoms.

To date two strains have emerged to infect horses and humans. When the recent variation surfaced in horses it caused different symptoms. Instead of the pneumonia like symptoms vets and horse owners had come to associate with the virus, this time it attacked the brain. This initially caught vets off guard.

Bats in Ghana, Madagascar and New Guinea have now tested positive for Hendra-like viruses. Research indicates that there are more types out there with possibly new symptoms just waiting to jump from bats to horses.

**Nipah virus**
Another virus to recently emerge is the Nipah virus named after the Sungai Nipah, one of the Malaysian villages, where it first surfaced in the late 1990's. It's more infectious than Hendra, easily transmitted between pigs, and possibly to other animals including cats. And like the Hendra virus it's being transported by bats and new strains are occurring. These have been responsible for outbreaks as far west as Bangladesh and India.

Virologist Dr Linfa Wang and his team from CSIRO's Australian Animal Health Laboratory (AAHL) in Geelong have studied the virus. **'**The Nipah outbreak, was after the major forest fire in Indonesia. It has been

hypothesized that a lot of bats had to fly a long distance to the Malaysia Peninsula, and the stress caused the immune system to change and the virus load goes up, which in turn increased the chance for the virus to spill over to the pig population, then to humans,' said Dr Wang.

The 1998-1999 Malaysian outbreaks caused the deaths of over 100 people and thousands of pigs. To curtail the infection almost one million pigs in infected areas were killed.

Nipah affects the brain causing symptoms similar to Japanese encephalitis.

**SARS**

The SARS (Sudden Acute Respiratory Syndrome) virus appeared in southern China towards the end of 2002. By mid- 2003 it had spread globally and almost caused a human pandemic. Over 8,000 people worldwide became sick and over 774 of these died. Only quick action by health authorities around the world contained the disease. The containment was such a success that by the end of July that year, the World Health Organisation (WHO) declared the outbreak to be over.

As its name suggests the virus attacks the respiratory system suddenly and severely although the symptoms are initially mild. It spreads quickly from human to human in the droplets from an infected person's coughs or sneezes. Diarrhoea may occur.

Like Hendra and Nipah viruses SARS has now been traced back to bats. Again, scientists from the AAHL were involved in the discovery.

'The first human case was in the Pearl River delta a small area in southern China. This is where a city was built almost overnight in wetlands, displacing a lot of local bats. That was the most rapid growing economic area, and the city of Shenzhen, which was sort of the epicentre of the SARS outbreak, and that whole city was built within the last two decades. Twenty years ago that was just a wetland and fishing farms. So you can imagine the balance of the wildlife environment has been completely wiped out.' said Dr Wang.

**Lyssavirus**

The Australian lyssavirus first surfaced in a black fruit bat near Ballina NSW in 1996. It has been found in fruit and insectivorous bats from Western Australia to Victoria. It kills bats and can be transmitted to humans. To date two Queensland women have died from the rabies like disease. Both were bat handlers and one had been bitten over two years before her death.

Bat Care Brisbane spokeswoman Louise Saunders said 'When the disease progresses the bats present with the classic eye-darting, not able to hang, fairly aggressive, and you just take added precautions when you've got those symptoms. They need to be euthanased fairly quickly because you can tell that they're in massive pain and just want to bite something so if you're in the way you'll get bitten. We try to tell all of our carers, you can't tell when an animal is infected so you've just got to be very careful.'

**Melaka virus**
The Melaka virus surfaced in the Malaysian town of its name in 2006 when the members of one family developed a serious cough and breathing trouble. Fearing bird flu doctors rushed samples to Kuala Lumpur for testing. Soon the Dr. Wang's team was involved in identifying the cause. Dr Wang saw something new and called it Melaka Virus. 'It's not lethal, but it makes people very sick and it's yet another virus that jumped from bats.' said Dr Wang. 'They would have fever and of course get very tired; it is just like you have a very nasty flu and a headache, cough, runny nose, all of these. But at least in one incident where children got infected they also got vomiting and diarrhoea.' he said.

**Why now?**
Why that is these viruses have emerged so recently?

Human development has caused enormous changes across Asia and Australia destroying much of the bats food sources and camping areas. In Asia, cities and roads have been built through swamps, and jungles have been cleared for timber harvesting and palm oil plantations. In Australia, we've cleared much of our eucalypt forests for agricultural and forestry purposes and drained coastal swamps for settlement.

Human activity has stressed the bats, their immune systems could have been affected and viruses have thrived and spilled out in their body fluids to other animals and humans.

**'**These viruses are continually evolving. That's the nature of their genetic material, so new strains with new symptoms will continue to occur.
The fear is, that like SARS there's a strain of Nipah virus or a related virus, still out there in bats that could suddenly start spreading fast and lethally between people and that a pandemic could result' said Dr Wang.

There are approximately 1000 bat species in the world. And they are harbouring viruses, which could spill over into other animals and humans with devastating consequences. It's not the bats that are at fault. We are. We've ignored their importance in regenerating forests and deprived them of much of their food sources and camping sites. Human pressure has taken its toll on their immune systems and viral spill overs have been the result.

**References:**

*Hendra and the bats*, Background Briefing, 31 Aug 2008, Radio National, Australian Broadcasting Corporation, http://www.abc.net.au/rn/backgroundbriefing/stories/2008/2348724.htm

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## 4. Safe practices – avoiding the Hendra virus and Lyssavirus

It is easy for humans to over react to new threats such as the Hendra virus and the rabies-like Lyssavirus, compared to our reactions to more familiar on-going dangers such as road transport. (In Australia, we have had only three human deaths from the Hendra virus and two from the Lyssavirus whilst in 2008 alone 1,463 deaths occurred due to road accidents.)

Some people have over-reacted to the threat of viruses found in flying-foxes to the extent that they would like to see them forced from their roosting and feeding areas, with little thought to the effect such an action would have on these animals or on the native trees they pollinate or whose seeds they spread. Simply put, without flying-foxes in numbers much greater than those needed for the survival of their species, Australia's eucalypt forests, rain forests and Melaleucas (paper bark trees) would not continue to exist. So when we consider these forests and the wildlife they support, we simply can't live without them but there are things we can do to minimise the already extremely low risk of humans and their animals contacting these diseases.

**Hendra virus**
The Hendra virus is one of the world's rarest diseases. It is known to have infected 38 horses and six humans, causing three fatalities. It is known to exist in flying-fox populations but the risk of horses being infected is very low. There is no evidence of direct infection from flying-fox to human or from human to human but it seems likely that flying-fox to horse infection occurs. So what can we do to minimise the risk of horses, and in turn humans, contracting this disease?

Based on current information the risk of horses and humans contracting the virus can be reduced by:

- Becoming familiar with the symptoms of the disease in horses:
    - Rapid onset of illness;
    - Fever;
    - Rapidly deteriorating health;
    - **Either** respiratory signs including –
        - Increased breathing rate;
        - Breathing distress;
        - Nasal discharge at death (sometimes frothy and/or blood stained;
    - **Or** nervous system signs including –
        - loss of balance, problems getting to feet;
        - loss of vision in one or both eyes;
        - head tilting or circling;
        - muscle twitching;
    - elevated heart rate (up to 90–100 beats/minute); and
    - facial swelling;
- Placing feed and water containers under cover if possible but not under trees, particularly, if they are trees which attract flying-foxes;
- Not supplying horses with feed such as fruit and vegetables or anything sweet such as molasses that flying-foxes might be attracted to;

- Temporarily removing horses from paddocks where flowering or fruiting trees have resulted in a temporary increase in flying-fox numbers. (Even dusk to dawn removal into a shed is better than doing nothing);
- Isolating sick horses from healthy horses, animals and people until a veterinary opinion has been obtained. Handling unaffected horses first and taking precautions when handling sick horses;
- Making sure gear exposed to any body fluid of horses is cleaned and disinfected before it is used on another horse. E.g. halters, lead ropes, twitches;
- Washing your hands with soap and water regularly during and after handling horses;
- If in contact with sick horses, showering with soap and shampoo and dressing in clean clothes and footwear before handling other horses;
- Seeking veterinary advice before bringing any sick horse back to your property;
- Not allowing visiting horse practitioners (farriers etc.) to work on sick horses. They should only work on healthy horses;

Source: ***Hendra virus: Important information for Horse owners***

**Lyssavirus**

This rabies-like virus has been found in the four kinds (species) of flying-foxes (fruit bats) that occur in Australia and in three species of insectivorous bats. Only two Australian human fatalities have been recorded from this virus.

Evidence to date suggests that a scratch or bite from an infected bat that breaks the skin is needed for infection to occur. It is believe that the virus cannot be passed to humans from bat urine or faeces, so roosting bats and those flying overhead pose no risk to humans. And it's believed that a dead infected bat poses no risk of passing the infection on if it has been dead from more than four hours. So what can we do to minimise the risk of humans contracting this virus?

Based on current information the risk of humans contracting this virus can be minimised by:

- Leaving all kinds of bats alone;
- If bitten or scratched by a bat, washing, but not scrubbing, the wound carefully with soap and water for at least five minutes and then contacting your local doctor. (Even people vaccinated for this virus should do this);
- Contacting your local parks and wildlife or bat care organisation or local vet on finding a sick or injured bat. E.g. do not try to remove a bat caught in barbed wire; and
- Thoroughly flushing your eyes, nose or mouth if you get bat saliva or blood in your mouth and then contacting medical authorities.

Source: ***Flying foxes and public health***

If humans stick to these practices fruit bats, insectivorous bats, humans and their animals can co-exist with little fear of either them or their animals contracting these viruses.

**References:**

***Hendra virus: Important information for Horse owners***
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***Flying foxes and public health***
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