LAND PROTECTION LEGISLATION (FLYING-FOX CONTROL) AMENDMENT BILL 2012

A submission to the Agriculture, Resources and Environment Committee

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A grey-headed flying-fox belly-dipping for cooling and rehydration. Photo (here & cover): Nick Edards

SUMMARY

The 28 groups listed on pages 2-3 submit that the *Land Protection Legislation (Flying-fox Control) Amendment Bill 2012,* introduced by Shane Knuth MP, is unjustified, unethical and legally flawed. The Bill should be rejected.

Mr Knuth's Bill proposes a solution that won't work for a problem that doesn't exist.

The Bill is intended to reduce the risks of people catching infectious diseases from flying-foxes. Transmission of disease from Australian flying-foxes to people is only known to have occurred once – in 1996. As long as people do not handle flying-foxes, having them roost near residences or forage in gardens or parks is safe. Killing or dispersing flying-foxes won't prevent the occasional unsafe interaction – for example, when well-intentioned people not vaccinated for Australian bat lyssavirus try to rescue a flying-fox from a barbed wire fence and get bitten – and won't prevent interactions between horses and flying-foxes.

The extreme measures proposed in the Bill could create health risks by increasing pathogen spillover in flying-foxes and bringing humans into close contact with injured or stressed flying-foxes. The Bill would result in widespread animal cruelty and further population decline of flying-foxes, including of two nationally threatened species.

Members of Parliament should be provided with scientific information about flying-foxes and human health risks, and inform themselves before voting on this Bill and before commenting publicly on flying-fox issues. Community leaders who propagate false information about flying-foxes and health risks can unnecessarily alarm their constituents and promote persecution of flying-foxes.

The groups recommend that the Queensland Government adopts a One Health policy, which recognises that human health and environmental health are interlinked, as the most sustainable approach to managing the risk of emerging zoonoses (infectious diseases that can be transmitted from animals to humans).

The groups recommend that the Queensland Government recognises the important role of wildlife rescue groups in public health and animal welfare, and provides financial support for their vital public service.

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1. About Queensland's flying-foxes

Queenslanders are blessed to live in a diverse natural environment with exciting wildlife. Flying-foxes offer some of our greatest wildlife spectacles, including in urban areas, and have a fascinating natural history. They also have a vital ecological role in pollinating the flowers and dispersing the seeds of many native trees. But they are subject to persecution and habitat destruction and face an uncertain future. A viable future for our "finger-winged night-workers" (as poet Les Murray describes them) depends on support and action by Queenslanders to protect them from multiple threats.

Mr Knuth's Bill would apply to five species of flying-fox native to Queensland, mostly to the four mainland species, including two nationally threatened species.

Common name	Species name	Status under Qld law	Status under Federal law
Grey-headed flying-fox	*Pteropus poliocephalus*	Protected – least concern	Listed –vulnerable
Spectacled flying-fox	*P. conspicillatus*	Protected – least concern	Listed – vulnerable
Black flying-fox	*P. alecto*	Protected – least concern	Not listed
Little red flying-fox	*P. scapulatus*	Protected – least concern	Not listed
Large-eared flying-fox[1]	*P. macrotis* ssp. *epularius*	Protected – least concern	Not listed

The four mainland flying-foxes

Grey-headed (left)

Spectacled (right)

Black (left)

Little red (right)

Photos: Halley Design

[1] This species is only on a couple of islands in the Torres Strait (and New Guinea).

LEGAL STATUS

As native mammals, all flying-foxes in Queensland are protected under the *Nature Conservation Act 1992*. They cannot be lawfully killed or harmed or dispersed unless this is permitted under a damage mitigation permit (DMP) issued by the Queensland Government. Spectacled and Grey-headed flying-foxes are also protected under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* as threatened species. They were listed as 'vulnerable' in 2002 after substantial population declines due to habitat destruction, culling and other threats.

It is only very recently – from 1974 to 1985 and since 1994 – that flying-foxes have received any protection under Queensland law. For most of Queensland's history as a colony and state, flying-foxes were classed as vermin and there were no limits on killing. They were subject to large-scale slaughter, with shooting raids on camps and bounties to encourage extermination. Hundreds of thousands were killed in some years.

THREATS

Although flying-foxes now receive much stronger legal protection than they did previously, they are subject to multiple threats in Queensland and elsewhere: ongoing habitat loss from urban and agricultural expansion, habitat fragmentation, legal and illegal killing, heat stress, tick paralysis, entanglement in barbed wire and loose backyard netting, and electrocution on powerlines. The Queensland Government's decision to allow shooting of flying-foxes in orchards will add to these threats.

Because flying-foxes are colonial animals – living together in roosts and flying out together at dusk for feeding – they create the impression of existing in immense numbers, and the media often refers to "flying-fox plagues" and "population explosions". [2,3] Their nomadic pursuit of irregular food sources adds to this illusion – tens or hundreds of thousands can suddenly turn up in one camp when there is large-scale flowering of eucalypts or bloodwoods.

But females are able to bear only one young a year and most do not successfully reproduce until they are three years old, so they have a low capacity for population increase. It is biologically impossible for flying-foxes to undergo population explosions and to reach plague proportions.

Because of a low reproductive rate, flying-foxes are vulnerable to population declines. Their current populations are only a fraction of the numbers that existed prior to European colonisation. Even maintaining their existing populations requires high survivorship of adults and juveniles. An imposed mortality of just 10% (in addition to natural mortality) can lead to rapid decline of a large population.[4] A study of Spectacled flying-foxes on the Atherton Tablelands found that more than 90% were dying before they reached seven years of age, and their population was in decline.[5]

In the Explanatory Notes for the Bill, Mr Knuth asserts, bereft of any evidence, that "flying-fox numbers have doubled in the last five years". Given the continued loss of habitat and ongoing pressure due to multiple other

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[2] Typical is the statement from a media release by Katter's Australian Party, in which it was claimed that " numbers had exploded since European settlement to reach near-plague proportions" (see http://www.ausparty.org.au/news/media-releases/download/41/time-to-restore-our-rights-in-battle-against-killer-bats)

[3] Another myth is that flying-foxes are "dirty". In fact, they have exemplary hygiene and spend hours grooming, so they are usually very clean. They may smell strong due to chemical signals they use. Males secrete a musk-like chemical to mark their breeding territories.

[4] McIlwee, A.P. and Martin, L. (2002). On the intrinsic cap*a*city for increase of Australian flying-foxes. (*Pteropus* spp., Megachiroptera). Australian Zoologist. 32: 76-100.

[5] Fox S, Luly J, Mitchell C, Maclean J, Westcott D. (2008). Demographic indications of decline in the spectacled flying fox (*Pteropus conspicillatus*) on the Atherton Tablelands of northern Queensland. *Wildlife Research* 35:417–424.

causes of mortality, it is more probable that flying-fox populations have declined rather than increased. Mr Knuth's claim of a doubling is absurd.

FLYING FORESTERS

Flying-foxes play a very important ecological role by pollinating the flowers and dispersing the seeds of many native plants.

> *Flying foxes contribute greatly to the local environment and economy. When they join the commuter rush at dusk, flying foxes are off to their job as forest-makers.*
>
> *Incurable sweet-tooths, flying foxes eat fruit, nectar and blossom. In the process, they pollinate flowers and disperse seeds of important native trees. Winging their way around the landscape, up to 100 km in a night, flying foxes are responsible for the upkeep of many forest species.*[6]

Flying-foxes are long-range pollinators, promoting regeneration and genetic flow within eucalypts and other Myrtaceous species at greater distances apart (> 5 km) than most or all other pollinators.[7] Several Myrtaceae species are adapted to flying-fox pollination, producing more nectar and pollen at night than by day.[8] Flying-foxes also disperse immense quantities of seeds. With individual flying-foxes able to disperse thousands of seeds in an evening, total nightly dispersions are likely to total billions of seeds.[9] Some plants rely on flying-foxes predominantly or solely for seed dispersal. Spectacled flying-foxes feed on the fruit of more than a dozen rainforest species for which no other seed dispersers are known and can spread ingested seeds up to 80 km away.[10] Such long-range capacity for spreading pollen and seeds is important to genetically re-link habitats fragmented by clearing and foster adaptation to changing climatic conditions.

Thus, declines in flying-fox populations have serious ecological consequences. Flying-foxes can become *functionally* extinct before they become rare as species, as populations decline below the threshold necessary to contribute significantly to seed dispersal and pollination.[11]

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[6] Australasian Bat Society and Queensland Government. Living with Flying-foxes. www.health.qld.gov.au/ph/documents/cdb/livingwithflyingfoxes.pdf.

[7] Eby, P. (1996) Interactions between the Grey-headed Flying-fox *Pteropus poliocephalus* (Chiroptera: Pteropodidae) and its diet plants - seasonal movements and seed dispersal. PhD Thesis, University of New England, Armidale, NSW.

Southerton S, Birt P, Porter J, Ford H. (2004) Review of gene movement by bats and birds and its potential significance for eucalypt plantation forestry. Australian Forestry 67: 44–53.

Birt, P. (2005) Mutualistic interactions between the nectar-feeding little red flying fox *Pteropus scapulatus* (Chiroptera: Pteropodidae) and eucalypts: habitat utilisation and pollination. PhD thesis. University of Queensland, Brisbane.

[8] Birt, P. (2005) Mutualistic interactions between the nectar-feeding little red flying fox *Pteropus scapulatus* (Chiroptera: Pteropodidae) and eucalypts: habitat utilisation and pollination. PhD thesis. University of Queensland, Brisbane

[9] It has been estimated that an individual flying-fox can disperse up to 60,000 seeds in one evening (see http://www.dse.vic.gov.au/plants-and-animals/flying-foxes-home-page/flying-foxes-about-flying-foxes). (This would apply to figs.)

[10] Westcott D, Dennis A, McKeown A., Bradford M, Margules C. (2001) The Spectacled Flying-fox, *Pteropus conspicillatus*, in the context of the world heritage values of the Wet Tropics World Heritage Area. CSIRO Sustainable Ecosystems and the Rainforest Cooperative Research Centre, Atherton, Queensland.

Queensland Department of Environment and Resource Management. (2010) National recovery plan for the spectacled flying fox *Pteropus conspicillatus*. Report to the Department of Sustainability, Environment, Water, Population and Communities, Canberra.

[11] McConkey K, Drake D. (2006) Flying foxes cease to function as seed dispersers long before they become rare. Ecology 87(2): 271-76.

THE IMPORTANCE OF URBAN HABITATS

Urban habitats are vital to flying-foxes, and cannot be excised from their range. Urban camps are part of an extensive network linking all parts of each species' range within Queensland and beyond. Some camps sustain long-term occupation when food is abundant or when females are raising young, and others function as temporary transit areas to more productive feeding sites. Individual flying-foxes can travel several thousand kilometres a year, moving from camp to camp in the search for blossom or fruit.[12] They need a high density of roost areas to maximise food access and facilitate movement for feeding and reproduction.

Flying-fox camps are increasingly part of the urban landscape. In large part this is because urban areas have encroached on or displaced traditional flying-fox camps. In part, it is because urban areas provide resources or protection for flying-foxes. Much of the most productive feeding habitats for flying-foxes have been cleared for agriculture or urban development. Although they are no replacement for the vast woodlands and forests now gone, well-fertilised and watered gardens and parks offer more blossom and fruit than is available in largely cleared farmland.

Camps are important sites for flying-foxes: places to sleep, court and breed, raise young, exchange information and provide refuge. Some are known to have been in use for more than a century. The long history of mostly unsuccessful dispersal attempts in Australia has demonstrated that flying-foxes have strong fidelity to their roost sites. Dispersal typically results in flying-foxes temporarily roosting in nearby, often more inconvenient, locations, and attempting to return to the original roost days or months or years after dispersal [13] Using more aggressive dispersal techniques won't improve the success rate of dispersals because they won't prevent the return of flying-foxes at a later date. This has been demonstrated by the return of flying-foxes to locations from where they have been dispersed by helicopters (Mataranka) or shooting (probably all historical camps, including Lissner Park in Charters Towers).

[12] Roberts B, Catterall C, Eby P, Kanowski J. (2012) Long-Distance and Frequent Movements of the Flying-Fox *Pteropus poliocephalus*: Implications for Management. PLoS ONE 7(8): e42532.

[13] Roberts B, Eby P, Catterall CP, Kanowski J, Bennett G. (2011) The outcomes and costs of relocating flying-fox camps: insights from the case of Maclean, Australia. In: Law B, Eby P, Lunney D, Lumsden L, editors. The biology and conservation of Australasian bats. Mosman, NSW: Royal Zoological Society of NSW. 277–287.

2. Problems with the Land Protection Legislation (Flying-fox Control) Amendment Bill 2012

A summary of the Bill

The Bill proposes to amend the *Land Protection (Pest and Stock Route Management) Act 2002* to allow landowners to:

- destroy a flying-fox
- disturb or drive away a flying-fox
- destroy or disturb a flying-fox roost.

The only justification required for these actions is "a reasonable belief" by a landowner that they are necessary to "reduce the risk of disease or harm" to a resident or stock in the local government area. The Bill also allows a Minister to direct a local government to take such actions.

In essence, the Bill would provide for 'open season' on flying-foxes in Queensland, a return to the unregulated dispersal and killing of the past.

The Bill is unjustified

According to Mr Knuth's Explanatory Notes, the rationale for the Bill is to protect human health from infectious disease:

> Flying-fox populations are known to carry viruses deadly to humans: the Australian Bat Lyssavirus which is closely related to common rabies lyssavirus; Salmonella; leptospirosis; Sars; and Hendra virus.

Following is information about each of these pathogens (not all are viruses, contrary to Mr Knuth's Notes). Just one of the pathogens is known to be transmitted by Australian flying-foxes directly to humans – Australian bat lyssavirus.

Australian Bat Lyssavirus: Just one person is known to have become infected due to contact with a flying-fox,[14] and there is now a prophylactic vaccination, which is administered free to anyone bitten or scratched by a flying-fox. This virus can only be transmitted when infected bat saliva comes into contact with human tissue through an open wound or membrane. It can be avoided by people not handling bats, unless they are vaccinated and trained to do so. Queensland Health advises: "There is no known risk of contracting ABL from bats flying overhead, contact with bat urine or faeces or from fruit they may have eaten. Living, playing or walking near bat roosting areas does not pose a risk of exposure to the virus."[15]

Salmonellosis: This is a bacterial infection usually contracted from infected food such as meat, eggs, milk, fruit and vegetables. There is no record of transmission from flying-foxes.

Leptospirosis: This is a bacterial infection, with an incidence in Australia of about 1 per 100,000 people. It can be treated with antibiotics. Leptospirosis is an occupational hazard for farmers, veterinarians, meat workers and others who work outdoors or with animals. Infection is through contact with water, food, or soil contaminated with urine from infected animals. Rodents are the most common source of infection, although

[14] The one other known human case of Australian bat lyssavirus was thought to be due to contact with a microbat, not a flying-fox.

[15] See http://www.health.qld.gov.au/ph/documents/cdb/livingwithflyingfoxes.pdf

most mammals are considered to be carriers. Flying foxes have recently been reported as likely carriers of the pathogen, but there has not been any recorded incidence of flying-foxes transmitting the disease to humans.

SARS (Severe Acute Respiratory Syndrome): This respiratory disease is caused by a virus that has not been detected in Australian flying-foxes. Closely related viruses have been found in three species of cave-dwelling horseshoe bats in China.

Hendra virus: Hendra Virus is transmitted to humans from sick horses, not from flying-foxes. As advised by Queensland Health, the best way to prevent this disease is management of horses. A vaccination for horses is under development and proposed for release in 2013.

The Bill will not reduce human health risks

In summary, allowing people to disperse or kill flying-foxes as proposed in Mr Knuth's Bill will not reduce the risk of human infection from any of the five pathogens listed in the Explanatory Notes because:

- The virus responsible for SARS is not found in Australian flying-foxes.
- The bacteria responsible for Salmonellosis and Leptospirosis are not known to have infected humans from flying-foxes.
- Hendra virus is not transmitted from flying-foxes to humans, and dispersal or killing won't prevent flying-foxes feeding in horse paddocks, where transmission to horses is thought to occur.
- Australian bat lyssavirus is only transmitted by a bite or scratch when the bat is sick and shedding virus, and disease can be prevented by a vaccination.

Mr Knuth's Explanatory Notes state that "It is necessary to place appropriate prioritization on the risk of contracting a fatal disease as a result of community exposure to flying foxes…". But with just one person known to have contracted a fatal disease from flying-foxes, an outcome that should not be repeated because of the availability of a prophylactic vaccination, "appropriate prioritisation" of health risks would result in a focus away from flying-foxes.

The table to the right ranks various causes of death in Australia, showing that flying-foxes are less of a risk than horses, cattle, bees, hay bales, windmills, air conditioners, car jacks and more than a dozen better known killers such as vehicles, firearms and unhealthy lifestyles.

CAUSE OF DEATH	AVERAGE DEATHS PER YEAR
Cardiovascular diseases Cancer	>10,000
Diabetes Suicide Vehicle crashes Infectious diseases	1001-10,000
Accidental poisoning Firearms Homicide Drowning Pedestrian deaths	101-1000
Boat accidents Choking on food Horses	11-100
Car jacks Tree felling Snakes Cattle Bees & wasps Lightning Dogs Sharks Windmills	1-10
Crocodiles Hay bales Air conditioners Spa baths Flying-foxes	<1

Various ranked causes of death in Australia, since 1990. See Appendix 2 for references.

Those who oppose Mr Knuth's Bill include wildlife carers, researchers and conservationists who have very close, regular contact with flying-foxes. Each year, thousands of injured and orphaned flying-foxes are rescued and nursed back to health or to independence. If anyone is at risk of catching an infection from flying-foxes, it is those who

interact closely with flying-foxes. But they know that the risks are extremely low, and that measures can be taken to prevent infection. Following is part of a statement released at a recent conference by more than 100 people who have a very close association with flying-foxes (Flying-fox Information & Conservation Network 2011):

> We are a group of scientists, conservationists and wildlife carers with a common interest in the welfare and conservation of flying-foxes. We have families, and many of us are dog and horse owners, so we also have a strong interest in the health of people and domestic animals.
>
> More than any other group in society we have an interest in any health risks associated with flying-foxes because we work very closely with them. If bats were a direct risk to human health, we would be at greatest risk. But wildlife carers and researchers do not become ill due to working with flying-foxes. Our pets have not been affected.
>
> We urge people to take an evidence-based approach to health risks. It is safe for people to live near bat camps.

The Bill could exacerbate human health risks

The Bill could actually increase the risk of human infection by increasing pathogen spillover from flying-foxes due to stress and by bringing humans into close contact with flying-foxes.

Health experts have warned that increasing stress in flying-foxes is likely to increase spillover of Hendra virus and therefore increase the risk of horses becoming infected if horse owners fail to adopt recommended precautions. (See Appendix 1 for an explanation.)

The majority of 'unsafe' contacts with flying-foxes (contacts by people not vaccinated against Australian bat lyssavirus) occur when compassionate people try to rescue injured or orphaned flying-foxes and accidentally get scratched or bitten. Allowing people to disperse or attempt to kill flying-foxes would inevitably increase the risk of this occurring.

It is not possible to evict flying-foxes from urban areas. Flying-foxes chased from one urban camp are likely to roost nearby – often in backyards or inconvenient locations – and seek to return to the original roost site weeks or months after dispersal.

THE BILL IS UNETHICAL

At the heart of this Bill is an extreme callousness about animal suffering that is, thankfully, no longer consistent with community norms and Australian laws. Most Queenslanders would agree with the recent statement by the Minister for Agriculture, Fisheries and Forestry, Hon. John McVeigh, that "it's important every Queenslander understands animal cruelty is never acceptable."[16] The Bill would lead to terrible animal cruelty resulting from:

- The slow death of flying-foxes from injuries due to shotgun wounds or other methods of attack
- The slow death of dependent young flying-foxes due to the killing of their mothers
- Stress and injuries caused by unmanaged dispersals.

The Bill is also contrary to modern conservation norms (and laws) by permitting the destruction of native species, two of which are threatened species, and all of which are keystone species, playing a vital role in

[16] http://www.brisbanetimes.com.au/queensland/state-toughens-dugong-anticruelty-laws-20120619-20lu6.html

woodland and forest regeneration by pollination and seed dispersal. There is no limit to the numbers of flying-foxes that could be killed, except for those that may be protected under federal law.

The Bill is also unethical in promoting unwarranted fear of flying-foxes. The rationale for the Bill is based on false assertions about health risks. The proponent of the Bill, Mr Knuth, is neither a medical expert nor a flying-fox expert. He has either failed to undertake basic research on health risks or has deliberately ignored readily available information, including that posted on the Internet by medical experts in Queensland Health and Biosecurity Queensland.

The consequences of the propagation of false information about health risks are serious for both humans and flying-foxes. People have become unnecessarily fearful of flying-foxes, and flying-foxes suffer the consequences of that fear. Fear motivates callousness to animal suffering, and illegal killing and dispersal. Wildlife rescue groups receive several calls each week to remove injured flying-foxes from backyards where they have been left to suffer for days, with the callers concerned only about the health of themselves, their family or pets. There have been increasing reports of flying-foxes being bashed to death in backyards.

The proponent of this Bill should be reprimanded by Parliament for his irresponsibility in promoting unwarranted health fears and indirectly encouraging animal cruelty.

THE BILL IS LEGALLY FLAWED

The Bill is not consistent with the purposes of the Land Protection (Pests and Stock Routes) Act 2002, which is intended to facilitate management of declared pest animals such as foxes and rabbits. The Act is not intended to apply to native animals such as flying-foxes, even if they are regarded by some people as pests. Like other native vertebrate animals, flying-fox species in Queensland are protected animals under the Nature Conservation Act 1992. Currently, the Land Protection (Pests and Stock Routes) Act 2002 specifically excludes from the definition of 'animal' any "protected animal under the Nature Conservation Act 1992". However, Mr Knuth's Bill proposes to create an exception for flying-foxes by including them within the definition of animals in the Land Protection (Pests and Stock Routes) Act 2002, despite the acknowledged conflict with their status as protected wildlife under the Nature Conservation Act 1992. However, the Bill's proposed amendment of the definition of animal does not mean that flying-foxes become pest animals for the purposes of the Land Protection (Pests and Stock Routes) Act 2002. Flying-foxes are not 'declared pests' and do not fit the criteria for declaration as pests.

Native animals which cause economic damage or threaten human health or wellbeing can be managed under damage mitigation permits under the Nature Conservation Act 1992. Many such permits have been issued to disperse flying foxes over the past few decades, generally without long-term success. Mr Knuth's Bill would simply allow dispersal to occur in an unregulated manner without any better chance of success.

Two Queensland flying-fox species are listed as vulnerable under the federal Environment Protection and Biodiversity Conservation Act 1999. The Federal Government has previously permitted some dispersals and some culling but the unregulated killing and dispersal proposed under the Knuth Bill is inconsistent with protecting threatened species and would not be sanctioned. It would be inconsistent with Australia's international obligations under the Convention on Biological Diversity.

3. EFFECTIVE AND ETHICAL APPROACHES TO HUMAN HEALTH

To keep safe from the pathogens listed by Mr Knuth as justifying his Bill does not require dispersal or killing of flying-foxes. Humans can live safely with flying-foxes by taking simple precautionary measures, including:

- Not handling flying-foxes unless vaccinated against Australian bat lyssavirus and trained to do so.
- If bitten or scratched by a flying-fox, washing and disinfecting the affected site and seeking medical advice (a prophylactic vaccination for Australian bat lyssavirus will be administered) – see the Queensland Health website.[17]
- Keeping horses away from areas where flying-foxes may be feeding and ensuring contact with horses is hygienic – see the DAFF website for advice for horse owners.[18]
- Taking standards precautions as for any animal faeces or bodily fluids – eg. avoid contact and wash and disinfect if there is contact, wash fruit before eating, use a first flush filter on water tanks.

THE ONE HEALTH APPROACH – LINKING HUMAN AND ENVIRONMENTAL HEALTH

Hendra virus and Australian bat lyssavirus are two of dozens of new human diseases worldwide caused by the cross-over of pathogens from a wide variety of animals (diseases known as zoonoses), with Nipah virus, SARS, HIV, Ebola, bovine spongiform encephalopathy, White Nile virus, monkeypox, Rift Valley fever and avian influenza among them (most not from bats). It is not a new phenomenon – bubonic plague spread from rats – but the rate is increasing. Zoonoses are responsible for more than three-quarters of *emerging* infectious diseases compared to about 60% of infectious diseases of humans overall.[19]

The reason for the surge in new zoonoses is thought to be increasing interactions between humans and animals, including wild animals, with drivers including environmental destruction, industrial farming, trade in wildlife and climate change. Mounting evidence indicates that biodiversity loss frequently increases disease transmission.[20] The lessons that health experts are drawing from this are encapsulated in the concept of 'one health' – that ecological and human health are linked, and that human health is reliant on promoting, improving and defending the health and well-being of all species.

The Manhattan Principles on 'One World, One Health'

The following principles are among 12 endorsed by a symposium of health experts and international health organisations in 2004.[21]

1. Recognize the essential link between human, domestic animal and wildlife health and the threat disease poses to people, their food supplies and economies, and the biodiversity essential to maintaining the healthy environments and functioning ecosystems we all require.

2. Recognize that decisions regarding land and water use have real implications for health. Alterations in the resilience of ecosystems and shifts in patterns of disease emergence and spread manifest themselves when we fail to recognize this relationship.

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[17] http://access.health.qld.gov.au/hid/InfectionsandParasites/ViralInfections/australianBatLyssavirus_fs.asp

[18] http://www.daff.qld.gov.au/4790_2900.htm

[19] Taylor L, Latham S, Woolhouse M. (2001) Risk Factors for Human Disease Emergence. Philos Trans R Soc Lond B Biol Sci 356(1411): 983-989.

Jones K, Patel N, Levy M, Storeygard A, Balk D, Gittleman J, et al. (2008) Global trends in emerging infectious diseases. Nature: 451: 990-3

[20] Keesing F, Belden L, Daszak P, Dobson A, Harvell D, Holt R, et al. (2010) Impacts of biodiversity on the emergence and transmission of infectious diseases. Nature 468: 647-652.

[21] See Appendix 1 at http://www.fao.org/docrep/011/aj137e/aj137e00.htm.

4. Recognize that public health programs can greatly contribute to conservation efforts.

5. Devise adaptive, holistic and forward-looking approaches to the prevention, surveillance, monitoring, control and mitigation of emerging and resurging diseases that take the complex interconnections among species into full account.

6. Seek opportunities to fully integrate biodiversity conservation perspectives and human needs (including those related to domestic animal health) when developing solutions to infectious disease threats.

8. Restrict the mass culling of free-ranging wildlife species for disease control to situations where there is a multidisciplinary, international scientific consensus that a wildlife population poses an urgent, significant threat to public health, food security, or wildlife health more broadly.

12. Invest in educating and raising awareness among the world's people and in influencing the policy process to increase recognition that we must better understand the relationships between health and ecosystem integrity to succeed in improving prospects for a healthier planet.

The one health concept is highly applicable to flying-foxes. Since 1994, three viruses are thought to have crossed from Australian flying-foxes to other species, including to humans. Although they are very rare events, the recent clustered emergence of these diseases suggests that environmental changes have increased the risks of pathogen spillover and interactions with susceptible species.

Virus	**Postulated pathway to human infection from flying-foxes**	**Number of known spillover events from flying-foxes (date of first event)**	**Number of humans infected (number of human deaths)**
Hendra virus	FF to horse to human	38 (1994)	7 (4)
Australian bat lyssavirus	FF to human	1 (1996)	1 (1)
Menangle virus	FF to pig to human	1 (1997)	2 (0)

There is no doubt that flying-fox populations are under a great deal of environmental pressure. They have lost vast amounts of habitat, including much of their most productive foraging areas (the most fertile areas have been preferentially cleared). They regularly suffer food shortages in some areas. They have been slaughtered in very large numbers in orchards, with tens of thousands killed in the years during which the new diseases emerged, and driven from many roost sites.

Researchers have postulated a link between stress in flying-foxes and Hendra virus spillover to horses. Plowright and colleagues (2008) showed that significantly higher proportions of little red flying-foxes had antibodies to Hendra virus during pregnancy, lactation and a food shortage.[22] They said that other stressors such as "anthropogenic habitat loss, habitat alteration, roost disturbance, urbanization and persecution by hunters ..., all of which are known to alter food availability and cause nutritional stress in *Pteropus* populations ...may drive HeV spillover events." In other words, actions detrimental to flying-foxes can also ultimately be detrimental to human health.

The measures promoted in Mr Knuth's Bill – destruction and dispersal of flying-foxes and their roost habitat – will exacerbate the factors thought to drive spillover events.

[22] Plowright R.K., Sokolow, S.H., Gorman, M.E., Daszak, P., and Foley, J.E. 2008. Causal inference in disease ecology: investigating ecological drivers of disease emergence. Frontiers in Ecology and the Environment, DOI: 10.1890/070086.

Based on the best understanding of disease emergence, public health will be best served by measures that reduce the risks of spillovers and promote the conservation and well-being of flying-foxes. This includes protecting and restoring foraging habitat, protecting their camps and reducing persecution and other stresses.

THE VITAL ROLE OF WILDLIFE RESCUE GROUPS, VETERINARIANS AND WILDLIFE HOSPITALS

In Queensland, there are about 30 voluntary community groups that rescue and rehabilitate several thousand injured and orphaned flying-foxes each year. There are also dozens of veterinarians in private practice and wildlife hospitals who treat injured flying-foxes, usually as a free service.

The community groups respond to calls from the public directly or via the RSPCA or state government agencies to rescue flying-foxes that are:

- entangled in barbed wire fences or loose netting around backyard fruit trees,
- injured by powerlines, dog attacks, or collisions with vehicles,
- orphaned by the death of their mother,
- paralysed by ticks (on the Atherton Tablelands), or
- starving due to food shortages.



Rescue and care groups, and the private veterinarians and wildlife hospitals that treat injured flying-foxes, perform an immensely valuable service for animal welfare and conservation. They relieve the suffering of large numbers of animals, return many to the wild and conduct public education about flying-foxes. The majority of people who witness the rescue of a flying-fox are transformed by the experience, with irrational fears about bats overwhelmed by empathy for their suffering and delight in their beauty.

Flying-fox rescue groups also make a great voluntary contribution to public health, in the following ways:

- By providing a free rescue service, rescue groups reduce the motivation for members of the public to handle flying-foxes to conduct their own rescues – the majority of bites and scratches occur when untrained compassionate people try to rescue flying-foxes from fences or nets.
- By promoting safe backyard netting and alternatives to barbed wire, rescue groups reduce the numbers of flying-fox entanglements and reduce the risk of interactions between flying-foxes and humans.
- In talks to the public and schools, in the media, at public events, and in many interactions with the public, rescue groups conduct health education by promoting safe behaviour with flying-foxes.
- Many groups have contributed to and participated in health-focused research by providing data and animals for research, alerting authorities to events with health implications.

Without these groups the government would have to expend considerably more resources on:

- Prophylactic post-exposure vaccination for Australian bat lyssavirus, with each treatment costing between $2000 and $3000.
- Removal of injured and orphaned flying-foxes from people's gardens and public places, and treatment or euthanasia
- Education to promote safe behaviour around flying-foxes

Rescue and care of flying-foxes is a demanding task. The worst aspect for many carers is witnessing extreme animal suffering. The job has become increasingly difficult due to growing fears of people about disease risks, promoted by inaccurate media reports and exaggerated claims by community leaders. Fear of flying-foxes leads to callousness about animal suffering and often also leads to abuse of those who strive to protect flying-foxes.

Frequent food shortages, a greater prevalence of unsafe netting and barbed wire fences, and other factors have increased the number of flying-foxes requiring rescue. But because of the stresses of the job, the number of rescuers is dropping and the burden on those remaining is increasing.

For public health, animal welfare and conservation reasons, there is a strong public good justification for government support for flying-fox rescue groups and wildlife hospitals. The LNP promised $800,000 over four years for the rescue and care of injured koalas. Funding is also justified for flying-fox rescue and care services. The Queensland Wildlife Rehabilitation Council (the peak body for wildlife rehabilitation groups) has advocated a fair allocation of funding for wildlife rescue services, and recommended that funding for rehabilitation of threatened species such as flying-foxes, koalas and quolls should be made available in recognition of the role that rescue groups play in protection, education and service delivery.

4. RECOMMENDATIONS

The endorsing groups recommend that the Agriculture, Resources and Environment Committee adopt the following recommendations:

- That the Queensland Parliament rejects the *Land Protection Legislation (Flying-fox Control) Amendment Bill 2012*
- That all Members of Parliament be provided with accurate scientific information about flying-foxes and health risks, and inform themselves before voting on the Bill and before commenting publicly on flying-fox issues
- That the Queensland Government develops a 'One Health' policy for flying-foxes that:
  - recognises the links between human health, environmental health and flying-fox conservation
  - promotes flying-fox conservation measures as beneficial to human health
  - provides for public education about flying-foxes to overcome myths and unwarranted fears
- That the Queensland Government supports the important work of flying-foxes rescue groups

Photo: Nick Edards

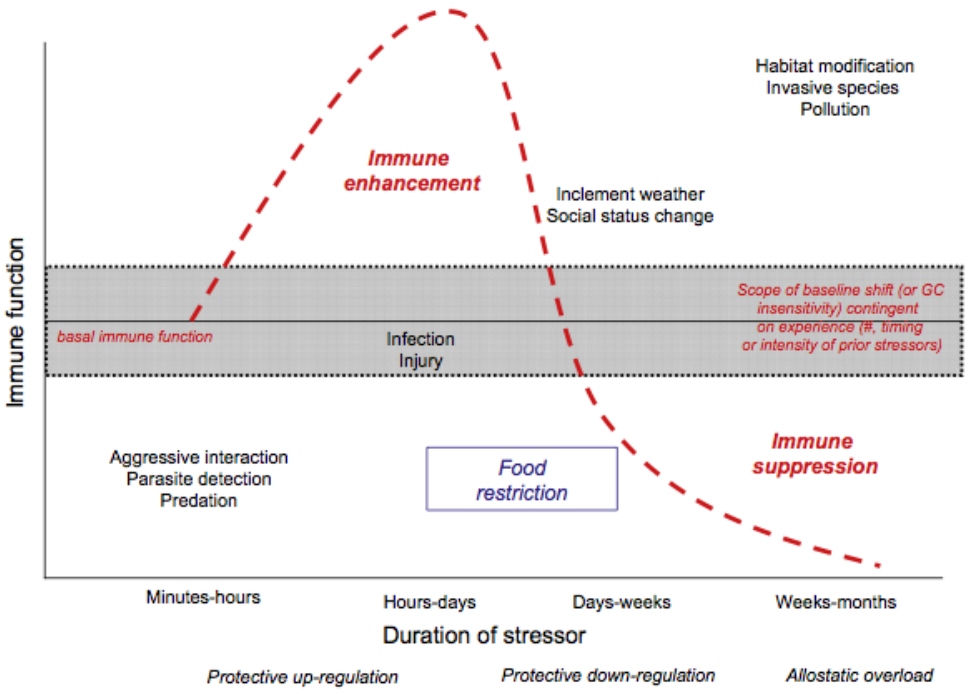
APPENDIX 1. STRESS AND VIRUS SPILLOVER

Plowright et al. (2008) showed that significantly higher proportions of little red flying-foxes had antibodies to Hendra virus during pregnancy, lactation and a food shortage. They proposed that other stressors (events or stimuli that cause stress) such as "anthropogenic habitat loss, habitat alteration, roost disturbance, urbanization and persecution by hunters ..., all of which are known to alter food availability and cause nutritional stress in *Pteropus* populations ...may drive HeV spillover events."

The impacts of different stressors on immunity in wild animals have been barely studied (Martin 2009). Immune responses to stress are complicated and depend on the type of stress, particularly whether it is acute or chronic.

Glucocortocoids (such as corticosterone) are hormones whose blood concentrations are increased during times of stress. One of the roles of glucocorticoids is to help supply adequate amounts of energy during strenuous times (Berger et al. 2005). Temporarily elevated plasma levels of glucocorticoids may enhance immune function whereas chronically elevated concentrations may suppress the immune system (Acevedo-Whitehouse and Duffus 2009; Martin 2009; Dhabhar and McEwen 1997). Stress hormones tend to initially stimulate inflammatory processes, followed by immune processes involving T cell activity and then by those involving B cell activity. But persistent stimulation suppresses all three systems (although inflammatory defences may be exacerbated) – the hormones can suppress maturation, differentiation and proliferation of all immune cells and trigger death of immune cells.

The following diagram from Martin (2009) illustrates this pattern: elevated immune activity under acute stress lasting minutes to days (eg. in response to predation and aggressive encounters), then suppression when stressors last days to months (eg. inclement weather, habitat modification). The time for an acute stressor to become chronic is likely to vary with species and stressor types. Assuming that this pattern applies to flying-foxes, it is likely that a short period of disturbance would enhance immunity (if the animals weren't already under stress or immune-compromised) but disturbance exceeding a certain threshold of time would result in immune suppression.



The likely reason for down-regulation of immunity is that immune activity is energetically costly, so is incompatible with other physiological states or behaviours that are also energetically demanding, such as reproduction (Martin 2009; Berger et al. 2005), and surviving inclement weather or food shortages. The costs of mounting an immune response can be severe: Hanssen et al. (2004) found it could compromise survival in common eiders (sea-ducks).

Examples of stress hormones causing immunosuppression have been found in breeding male marine iguanas (Berger et al. 2005), in wild birds and domestic fowl during cold temperatures and lack of food (Acevedo-Whitehouse and Duffus 2009 citing various) and in various species under restraint or captivity (Martin 2009, Briggs et al. 1997).

Dispersals of flying-foxes are designed to cause stress – stress substantial and prolonged enough to cause flying-foxes to leave roost sites to which they are likely to have strong fidelity. Dispersal attempts frequently occur over several days, weeks or even months and may occur every year for several years. They often occur when females are pregnant.

The only study found involving a similar stressor is that by Arlettaz et al. (2007) on the impacts of disturbing black grouse wintering in ice in the Swiss Alps. They disturbed the birds once daily for four days and measured the level of corticosterone metabolites in their faeces as an indicator of stress. Metabolite concentrations increased daily by an average of 20%, corresponding to a total increase of 60% over the four days of the experiment

Based on the evidence summarised here that:

- flying-foxes under reproductive or nutritional stress have a higher risk of Hendra virus infection,
- animals with chronically elevated stress hormones (due to reproduction, cold weather, food deprivation) have reduce immune capacity, and
- disturbance can elevate stress hormones,

it is reasonable to conclude that flying-foxes subject to dispersal activities for more than a short time (of unknown duration) are likely to suffer immune suppression and be more susceptible to infections. This is particularly so if they are already under stress due to pregnancy, lactation or food shortages. This is of concern not only for the potential to increase the risk of Hendra virus spillover but for detrimental impacts on the welfare and conservation of flying-foxes.

Note also that exposure to petrochemicals can also suppress immunity (Briggs et al. 1997 and others cited), so use of smoke generated by diesel burning during dispersals may exacerbate adverse immune impacts.

The likely effects of culling and dispersal on Hendra virus transmission

Hendra virus is present in all four mainland Australian flying-fox species. Together they number in the millions and inhabit vast areas of Australia. Flying-foxes fly out from camps each night to feed in flowering or fruiting trees. They can travel 100 km in one night of feeding. It is not possible to banish them from urban areas or farms or wherever horses are located.

Killing some proportion of flying-foxes won't stop other flying-foxes roosting and feeding in areas near horses. Dispersing flying-foxes or destroying their roost sites won't stop them roosting and feeding in areas near horses.

Shooting some flying-foxes will cause others to fly away and roost elsewhere, possibly spreading the risk to new areas. Likewise, disturbing flying-foxes will probably cause them to roost in several nearby locations or to relocate to a new area, potentially spreading the disease risk. Within a few days or weeks, flying-foxes are likely to return to the original roost site unless disturbance (and stress) continues.

The immune system of those exposed to prolonged disturbance or disturbed when already stressed (eg. due to pregnancy or food shortages) is likely to be suppressed, which is likely to increase the amount of Hendra virus in infected flying-foxes, which would increase the amount of virus they shed into the environment.

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Arlettaz R, Patthey P, Baltic M, Leu T, Schaub M, Palme R, Jenni-Eiermann S. 2007. Spreading free-riding snow sports represent a novel serious threat for wildlife. Proceedings of the Royal Society B. 274: 1219–1224.

Berger S, Martin L, Wikelski M, Romero M, Kalko E, Vitousek M, Rfdl T. 2005. Corticosterone suppresses immune activity in territorial Galapagos marine iguanas during reproduction. Hormones and Behavior 47: 419–429.

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APPENDIX 2. STATISTICS AND REFERENCES FOR VARIOUS CAUSES OF DEATH

Most of the data is for deaths since 1990. In a very few cases where there was lack of recent data, statistics from 1980-1990 have been used.

Major sources of data (for which endnotes below are abbreviated) are:

(1) Australian Bureau of Statistics, Causes of Death, Australia (annual data available for the period 1990-2009 on the ABS website, http://www.abs.gov.au/);

(2) Australian Bureau of Statistics, Year Book Australia, (annual data available for 1990-2009 on the ABS website, http://www.abs.gov.au/);

(3) National Coroners Information Service report into Deaths Involving Animals, May 2006. See www.ncis.org.au/web_pages/Broadsheet2_Animal%20related.pdf.

(4) National Coroners Information System. 2007. A sample of consumer product related deaths. Deaths reported from 01/07/2000–30/06/2007. See www.ncis.org.au/Product%20related%20fatalities%20national%20version.pdf.

(5) Pollock K, Fragar L, Morton C. 2007. Traumatic deaths in Australian agriculture – The facts. Rural Industries Research and Development Corporation and Australian Centre for Agricultural Health and Safety

(6) Franklin R, Mitchell R, Driscoll T, Fragar L. 2000. Farm-related fatalities in Australia, 1989-1992. Moree: ACAHS, NOHSC & RIRDC

Cardiovascular diseases

Approx. average deaths/year: 47,000

Time period: 1990-1992, 1996, 2000-2008

Information source/s:

- ABS. Causes of Death, Australia, various years.
- ABS. Year Book Australia, various years.

Cancer

Approx. average deaths/year: 36,000

Time period: 1990-1993, 1998-2005, 2007-2008

Information source/s:

- ABS. Causes of Death, Australia, various years.
- ABS. Year Book Australia, various years.

Diabetes

Approx. average deaths/year: 3000

Time period: 1990-1993, 1998-2003, 2007-2008

Information source/s:

- ABS. Causes of Death, Australia, various years-
- ABS. Year Book Australia, various years.

Suicide

Approx. average deaths/year: 2260

Time period: 1990-93, 1997-2008

Information source/s:

- ABS. Causes of Death, Australia, various years
- Harrison JE, Pointer S, Elnour AA. 2009. A review of suicide statistics in Australia. Injury research and statistics series no. 49. Adelaide: AIHW

Vehicle crashes

Approx. average deaths/year: 1890

Time period: 1990-2001, 2007-2008

Information source/s:

- ABS. Year Book Australia, various years.

Infectious diseases

Approx. average deaths/year: 1700

Time period: 1998-2001, 2006-2008

Information source/s:

- ABS. Causes of Death, Australia, various years.
- ABS. Year Book Australia, various years.

Accidental poisoning

Approx. average deaths/year: 740

Time period: 2000, 2002-2004, 2007-2008

Information source/s:

- ABS. Year Book Australia, various years.

Firearms (deliberate & accidental)

Approx. average deaths/year: 460

Time period: 1990-2002

Information source/s:

- Kreisfeld R. 2005. Firearm deaths and hospitalisations in Australia. See http://www.nisu.flinders.edu.au/briefs/firearm_deaths_2005.php

Homicide

Approx. average deaths/year: 310

Time period: 1990-2006

Information source/s:

- Australian Institute of Criminology, National Homicide Monitoring Program 1989-90 to 2005-06. See http://www.abcdiamond.com/australia/murder-crime-in-australia/

Drowning

Approx. average deaths/year: 280

Time period: 1992, 1998-2007

Information source/s:

- ABS. Year Book Australia, various years.
- Franklin R, Scarr J, Pearn H. 2010. Reducing drowning deaths: the continued challenge of immersion fatalities in Australia. Medical Journal of Australia 192(3): 123-26

Pedestrians struck by vehicles

Approx. average deaths/year: 300

Time period: 1997-2002, 2004-05, 2007-08

Information source/s:

- ABS. Year Book Australia, various years.

Boat accidents

Approx. average deaths/year: 40

Time period: 1999-2004

Information source/s:

- O'Connor P. 2008. National Assessment of Boating Fatalities in Australia 1999-2004. National Marine Safety Committee Inc

Choking on food

Approx. average deaths/year: 37

Time period: 1999, 2002-2005, 2007

Information source/s:

- ABS. Causes of Death, Australia, various years.
- Henley G, Harrison JE. 2009. Injury deaths, Australia 2004–05. Injury research and statistics series no 51. Adelaide: AIHW
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- Kreisfeld R, Newson R, Harrison J. 2004. Injury deaths, Australia 2002. Injury Research and Statistics Series Number 23. Adelaide: AIHW
- Kreisfeld R, Harrison J. 2005. Injury deaths, Australia, 1999. Injury Research and Statistics Series Number 24. Adelaide: AIHW

Horses

Approx. average deaths/year: 15

Time period: 1979-1998, 2000-2006

Information source/s:

- NCIS. 2006. Report into deaths involving animals
- Cripps RA. 2000. Horse-related injury in Australia. Adelaide: AIHW. See http://www.nisu.flinders.edu.au/pubs/bulletin24/bulletin24.html

Car jacks

Approx. average deaths/year: 4.1

Time period: 2000-2007

Information source/s:

- NCIS. 2007. A sample of consumer product related deaths.

Tree felling

Approx. average deaths/year: 3.4

Time period: 1989-1992, 2001-2004

Information source/s:

- Pollock et al. 2007. Traumatic deaths in Australian agriculture.
- Franklin et al. 2000. Farm-related fatalities in Australia, 1989-1992.

Snakes

Approx. average deaths/year: 3

Time period: 1979-2006

Information source/s:

- NCIS. 2006. Report into deaths involving animals
- McGain F, Rofe G, Sutherland S, Harrison J, Hawdon G, Winkel K. 2003. Snakebite Mortality in Australia. University of Melbourne. See www.nchirt.qut.edu.au/consultancy/amdig/workshops/documents/2003WinkelSlides.pdf

Cattle

Approx. average deaths/year: 2.2

Time period: 1989-1992, 2000-2006

Information source/s:

- NCIS. 2006. Report into deaths involving animals
- Pollock K, Fragar L, Morton C. 2007. Traumatic deaths in Australian agriculture – The facts. Rural Industries Research and Development Corporation and Australian Centre for Agricultural Health and Safety

Bees & wasps

Approx. average deaths/year: 1.9

Time period: 1979-1998, 2000-2006

Information source/s:

- NCIS. 2006. Report into deaths involving animals
- McGain F, Winkel K. 2000. Bee and wasp sting related fatalities in Australia. International Society on Toxinology 13th World Congress on Animal Plant and Microbial Toxins. See http://www.avru.org/files/imported/compendium/gallery/DR0000052.pdf

Lightning

Approx. average deaths/year: 1.7

Time period: 1980-1990, 2001-2004

Information source/s:

- Pointer S, Harrison J. 2007. Electrical injury and death. National Injury Surveillance Unit. See www.nisu.flinders.edu.au/pubs/reports/2007/injcat99.pdf

Dogs

Approx. average deaths/year: 1.6

Time period: 1990-2006

Information source/s:

- NCIS. 2006. Report into deaths involving animals.
- Kreisfeld R, Bordeaux S. 1998. Injury resulting from dog bites. See http://www.nisu.flinders.edu.au/pubs/shortreps/canines.html#dyear%20
- Kreisfeld R, Harrison J. 2005. Dog-related injuries. See http://www.nisu.flinders.edu.au/pubs/reports/2005/injcat75.php

Sharks

Approx. average deaths/year: 1.2

Time period: 1990-2010

Information source/s:

- Australian Shark Attack File. See http://www.taronga.org.au/animals-conservation/conservation-science/australian-shark-attack-file/australian-shark-attack-file
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Windmills

Approx. average deaths/year: 1

Time period: 1989-1992, 2001-2004

Information source/s:

- Pollock et al. 2007. Traumatic deaths in Australian agriculture.
- Franklin et al. 2000. Farm-related fatalities in Australia, 1989-1992.

Crocodiles

Approx. average deaths/year: 0.9

Time period: 1980-1990, 2000-2009

Information source/s:

- NCIS. 2006. Report into deaths involving animals
- Sydney Morning Herald 2009. See http://www.smh.com.au/national/recent-crocodile-deaths-in-australia-20090411-a3b2.html

Hay bales

Approx. average deaths/year: 0.9

Time period: 1989-1992, 2001-2004

Information source/s:

- Pollock et al. 2007. Traumatic deaths in Australian agriculture.
- Franklin et al. 2000. Farm-related fatalities in Australia, 1989-1992.

Air conditioners

Approx. average deaths/year: 0.4

Time period: 2000-2007

Information source/s:

- NCIS. 2007. A sample of consumer product related deaths.

Spa baths

Approx. average deaths/year: 0.3

Time period: 2000-2007

Information source/s:

- NCIS. 2007. A sample of consumer product related deaths.

Flying-foxes

Approx. average deaths/year: 0.05

Time period: 1990-2009 (1 death in 1998)

Information source/s:

- Hanna J, Carney I, Smith G, et al. 2000. Australian bat lyssavirus infection: a second human case, with a long incubation period. Medical Journal of Australia 172:597-9. See http://www.mja.com.au/public/issues/172_12_190600/hanna/hanna.html#refbody11. The only other case was due to an encounter with a microbat

Australian bat lyssavirus. See http://www.csiro.au/science/Australian-bat-lyssavirus.html