



Red Squirrels United

Red Squirrels and Leprosy

Briefing note

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Executive summary

What is leprosy?

Leprosy is an infectious disease caused by bacteria that damage the skin and nerves. It can lead to lesions, swellings, loss of muscle sensation and permanent disability if left untreated. Disease transmission is not fully understood, but it is likely to be spread through direct contact with saliva, nasal secretions or skin cells of infected individuals. It is curable with multidrug therapy.

Do red squirrels carry leprosy?

Leprosy was detected in red squirrels from England, Scotland and the Republic of Ireland caused by the bacteria *Mycobacterium lepromatosis* and *Mycobacterium leprae*, which also cause the disease in humans. Leprosy is believed to have been present in the squirrel population for centuries, though it was not discovered until 2014. Some infected animals show no visible symptoms and when lesions are visible, they can look similar to those caused by squirrelpox virus. It is not yet known whether grey squirrels carry the bacteria.

What is the risk to humans?

Whilst the risk to people from squirrel leprosy is negligible, awareness and mitigation of risk is vital. Direct physical contact should be avoided where possible. Open wounds should be covered and hands should be cleaned thoroughly after physical contact to minimise any risk of transmission. All surfaces that have been in contact with an animal, whether it shows signs of infection or not, should be disinfected with a wide spectrum disinfectant such as Virkon.

What are the next steps?

Although leprosy has affected humans for millenia, we still have much to learn about disease transmission and host-bacteria interactions. The World Health Organisation has a global leprosy strategy to control the disease worldwide and avoid disabilities in humans living in endemic countries. Current research on red squirrels at the University of Edinburgh aims to understand the prevalence of infection across the UK, its impact on squirrel populations and how it might affect conservation efforts.



What is leprosy?

Leprosy is a curable infectious disease caused by the bacterium *Mycobacterium leprae*, discovered in 1873¹. In 2008, a second bacterium, *Mycobacterium lepromatosis* was also identified to cause the disease². These bacteria infect primates including humans³, chimpanzees⁴ sooty mangabey monkeys⁵ and cynomolgus macaque⁶. More recently they were found in two non-primates: the nine-banded armadillo⁷ and red squirrel².

Leprosy-causing bacteria predominantly damage the skin and superficial nerves leading to lesions in cooler areas of the body such as the skin of the eyelids, ears, nose and limb extremities, and the nasal membranes. They also cause swellings, loss of muscle sensation and sense of touch. If left untreated the infection can lead to permanent disability.

The severity of the symptoms can vary among individuals⁶, as some people are thought to have some immunity against *M. leprae*⁸. Levels of immunity vary across populations due to genetic factors and ancestral exposure to the bacteria⁹. Long term health outcomes of infected individuals were greatly improved with the advent of multidrug therapy (MDT), which cures the disease, and the use of anti-inflammatory therapies to treat symptoms⁹.

M. leprae is generally thought to be transmitted through saliva or nasal droplets produced by infected individuals, either through direct contact or inhalation when an infected individual sneezes or coughs¹⁰. However, there is increasing evidence that the bacteria can be spread through direct contact with the skin of an infected individual, particularly where the recipient has an abrasion or open wound^{10,11}. Lab tests have shown that *M. leprae* can survive outside the body from 7 days up to 5 months depending on environmental conditions¹², however, leprosy is not a particularly infectious disease¹³. The full routes of bacterial transmission are not yet fully understood.

Worldwide, the prevalence rate of leprosy has dropped by 99% since the widespread use of multidrug therapy began, from 5.2 million cases in 1985 to 175,554 cases in 2014^{14,15}. The prevalence of leprosy in high-income countries is extremely low¹³. Rates of new cases of leprosy being detected are 3.2 per 100,000 people in 2015 and 94% of these cases occur in only 14 countries including India (60% of all new cases), Brazil (13% of all new cases) and Indonesia (8% of all new cases)¹⁴.

In England and Wales, leprosy cases occur at low prevalence and are decreasing¹³. Only 139 cases were reported between 2003 and 2012, mostly in men aged 15-45 years old who were born in India, suggesting they contracted the disease there before emigrating¹³. The last indigenous case of human leprosy in the UK was reported in 1954 when a Polish man, who had previously



spent several years in Brazil, passed it on to his daughter in the UK¹⁶. However, due to its rarity, it is possible that there are further cases in the UK that are going undiagnosed¹³.

Do red squirrels carry leprosy?

Increasing numbers of red squirrels were found in the UK with lesions on their head and limbs, initially thought to be linked to squirrel pox virus. In 2014, leprosy was first discovered in red squirrels in Scotland. Six red squirrels were found with lesions and tested positive for *M. lepromatosis*¹⁷. It is unknown how long the bacteria have infected red squirrel, but it could have been present in populations for centuries. On Brownsea Island, individuals with clinical signs have been recorded since the 1980s, though the post mortems carried out by the government's veterinary agency did not identify the disease causing them¹⁸.

In 2015, further post mortems in southern England identified three out of four red squirrels from the Isle of Wight and one from Brownsea Island were infected with *M. lepromatosis*¹⁹, while seven red squirrels out of 23 from Brownsea Island were infected with *M. leprae*¹⁸.

In 2016, a wider study discovered that red squirrels in England, Scotland and the Republic of Ireland are infected with *M. lepromatosis*², while those on Brownsea Island are infected with *M. leprae* (see appendix for a map of sampling sites and infection presence). Although these bacteria cause leprosy in humans, there is currently no direct evidence to suggest humans can contract leprosy from squirrels.

Only four grey squirrels from Penicuik, Midlothian, Scotland were tested for presence of leprosy bacteria in their tissues, but all tested negative². It is not possible to infer from a low number of individuals sampled from one location whether grey squirrels are infected with leprosy-causing bacteria across the UK.

Leprosy is just one of several challenges faced by red squirrels. Their numbers have drastically decreased since the invasion of the grey squirrel from North America in the late 1800s. It is thought there are now less than 140,000 red squirrels in the wild. They have also been affected by habitat loss and squirrelpox virus. The more we understand about these challenges, the better we can help protect populations for the future.



How do I minimise the risk to humans?

For the public

The risk to members of the public from squirrel leprosy is negligible and areas with infected squirrels remain open to the public as usual. It is recommended that people avoid touching any wild animals. If a member of the public sees a visibly sick live animal they should not attempt to touch it, but report it to the landowner of the site.

If you find a dead squirrel, you can report it to Garden Wildlife Health²⁰. If you find a dead squirrel that you think is carrying a disease it can be sent for post-mortem to improve our understanding of squirrel disease and welfare. In England, contact Paul Duff (01768 885295) at the Animal and Plant Health Agency. In Scotland, it should be sent to Anna Meredith (0131 650 7650 or anna.meredith@ed.ac.uk) at the Royal (Dick) School of Veterinary Studies²¹. In Wales, contact Craig Shuttleworth (07966150847 or craig@redsquirrels.info) at Red Squirrels Trust Wales on who will arrange collection of the body. In Northern Ireland, contact Conor McKinney at Ulster Wildlife (028 9045 4094 or conor.mckinney@ulsterwildlife.org). If touching a carcass, you should always wear disposable gloves or use a plastic bag to pick up the body.

As red squirrel leprosy was only discovered in 2014, it is too soon to know if there a direct risk to pets, however reports of leprosy in pets are extremely rare and it is thought a pet would need to fully consume an infected individual to risk contracting the disease²². An unknown species of Mycobacteria is known to infect dogs and cause lesions similar to those produced by the leprosy bacteria, but in all cases the lesions disappeared within 6 months, with or without medical intervention²³.

For community volunteers and staff members

If you are trapping, shooting or feeding squirrels and coming into direct contact with squirrels or equipment that squirrels may have been in contact with, due care should be taken and risk assessments should be completed before any work is carried out.

Direct physical contact should be avoided where possible, even if individuals are thought to be healthy, as research suggests 21% of animals without clinical symptoms may carry the bacteria². If physical contact is required, open wounds should be covered before handling any part of an animal or any item of equipment it may have come into contact with. Traps should be kept in good working order to minimise risk of injury that may cause open wounds. If practicable, gloves should be worn when handling traps.



If handling live squirrels, thick gloves should be worn to minimise the risk of scratches or bites. If handling dead squirrels, latex or nitrile gloves should be worn to prevent direct contact. If dissecting animals, a clean, sterile area should be used and appropriate personal protective equipment (PPE) should be worn, including gloves and a lab coat. Equipment such as scalpels and dissecting pins should be disinfected after use.

After handling animals or equipment, hands should be washed thoroughly where possible, or disinfectant hand gel used until running water is available. Thick gloves should be washed and all equipment and surfaces should be cleaned and disinfected. Disposable gloves should be discarded in general waste.

Virkon is recommended to clean and disinfect work surfaces and equipment. It is approved by the Department for Environment, Food and Rural Affairs (DEFRA) and has the widest proven spectrum of any disinfectant, proven effective against all virus families infecting animals, as well as fungi and bacteria including Mycobacteria, which cause leprosy. Virkon can control diseases transmitted via surfaces or instruments contaminated by infected blood, body fluids, faeces or saliva²⁴. It is sold in powdered or tablet form and should be used as a 1% solution. Note that when it is pink, it is active. When the solution loses its colour, it should be discarded and a fresh solution should be used.

If you feel ill after handling a wild animal, you should go straight to your GP and inform them of possible zoonotic infection. Early detection and treatment with multidrug therapy are important for controlling the spread of leprosy²⁵. The bacteria multiply slowly and it can take 5-20 years for symptoms of leprosy to appear, so you should bear this in mind even after you finish having direct contact with wild animals and always inform your doctor that you have come into close contact with wild animals in the past. Early detection is important as physical and neurological damage caused as the disease progresses may be irreversible, even if the disease is cured.

Early symptoms of leprosy include spots on the skin that may be a slightly different colour to the rest of the skin. These spots may become numb and have lost hair. They often appear on the arms, legs or back. Sometimes the only symptom may be numbness in a finger or toe²⁶. Leprosy is curable, and treatment in the early stages averts disability¹⁵.

Although there is no current evidence to suggest leprosy can be directly transmitted from red squirrels to humans, armadillos in the southern United States are infected with leprosy, and there were 13 cases of individuals who had direct contact with armadillos (either handling them, preparing or consuming their flesh) who reported infection with *M. leprae*⁷. As these individuals had



not been abroad, it was thought they could not have acquired the disease from travel in areas with infected humans. This strongly suggests they contracted the disease from the armadillos^{7,27}.

What are the next steps?

Leprosy has affected humans for thousands of years, but it is still poorly understood⁹. The World Health Organisation has developed the Global Leprosy Strategy for 2016-2020, aiming to reinvigorate control efforts for the disease and avoid disabilities in infected people, particularly children, in endemic countries²⁵.

There is currently no plan to treat or vaccinate red squirrels as this is prohibitive in terms of cost and animal welfare. No vaccine for leprosy exists and whilst it is treatable via a course of oral antibiotics it would require keeping wild animals in captivity for at least six months.

Research is being carried out by the University of Edinburgh to determine how leprosy is affecting red squirrels on Brownsea Island, to understand how it is spread and to investigate whether the bacteria have been transmitted to other rodent species on the island. This is supported by the National Trust and Dorset Wildlife Trust. The university also began a UK-wide study in 2016 to investigate the scale of the threat, identify ways that conservationists can tackle the disease and address risks of the disease being passed between wild species.

References

Please see below for further background reading. Where documentation is freely available online, the URL is included.

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