Science for Saving Species

Research findings factsheet

Project 7.4

Threatened Species Recovery Hub

National Environmental Science Programme

The toll of cat-dependent diseases on Australian agriculture

In brief

Cat-dependent diseases cost Australian agriculture at least $12 million annually. The sheep industry is the worst impacted.

Four pathogens *Toxoplasma gondii*, *Sarcocystis gigantea*, *S. medusiformis* and *Toxocara cati* were introduced to Australia when cats were introduced here, because they depend on cats for part of their lifecycle. All of these pathogens produce eggs that are passed in cat faeces. The eggs persist in soil, pasture and water, and are subsequently ingested by stock. These pathogens cause a range of animal health impacts including spontaneous abortions, still births, neonatal deaths and visible cysts in meat, which reduce its saleability.

Reducing numbers of pet and feral cats living in rural areas could help reduce infection rates in livestock. Breaking transmission pathways, for example, by keeping pet cats securely contained and preventing cats from accessing farms, would also lower infection risks.

Main aim of the research

We aimed to describe the nature, scale and cost of lost production from cat-dependent diseases that affect livestock in Australia.

Background

Cats were introduced to Australia in 1788 by European settlers and spread rapidly. They now occur across 99.9% of Australia's land area, and are only absent from areas fenced to exclude cats and some islands. Australia's cat population varies in size in response to weather but is around 6.6 million in an average year. Of these, 3.8 million are pet cats, 0.7 million are feral cats in urban areas and 2.1 million are feral cats in natural environments. The number of pet cats and feral cats in and near towns in Australia is growing, and cat densities in these areas can be very high.

Feral cats, and pet cats that are allowed to roam outside, can carry a range of pathogens that cause disease in livestock. The cat-dependent pathogens that affect livestock in Australia are:

- *Toxoplasma gondii*: a protozoan parasite that reproduces sexually in cat guts, and cycles asexually through any warm-blooded animal.
- *Sarcocystis gigantea* and *S. medusiformis*: protozoan parasites that reproduce sexually in cat guts, and cycle asexually through sheep.
- *Toxocara cati*: a parasitic roundworm of cats, that can also infect other mammals.

There has been substantial research on the infection rates and impacts of *T. gondii* and *Sarcocystis* spp. on livestock around the world, but information for Australia is patchy. Information on infection rates and impacts from *T. cati* infections is even scarcer. Our study compiled all available information across these diseases to produce more comprehensive estimates of the incidence and production losses from these diseases in Australia.

Feral cats, and pet cats that are allowed to roam outside, can carry a range of pathogens that can cause disease in livestock. Photo: Jaana Dielenberg

The University Of Queensland AUSTRALIA · Australian National University · Charles Darwin University Australia · The University of Adelaide · The University of Sydney · The University of Melbourne

Cat-dependent pathogens that affect livestock in Australia

Toxoplasma gondii

Any species of cat can become infected with *T. gondii* by eating infected prey or carrion. The parasite reproduces sexually in the cat gut, releasing a large number of oocysts (an egg-type life stage) in the cat's faeces, over a period of 1–2 weeks. Under favourable conditions, these oocysts can remain viable in the environment for at least 18 months.

Livestock become infected with *T. gondii* by incidentally ingesting oocysts when grazing or drinking contaminated water. The parasite replicates rapidly and migrates through the body, eventually enclosing in a cyst, where it remains indefinitely. *T. gondii* rarely causes disease in horses, cattle, pigs, ducks, turkeys, geese and chickens, but small ruminants, including sheep and goats, can experience fever and/or diarrhoea for up to two weeks. If female goats or sheep are infected with *T. gondii* for the first time while pregnant, they may spontaneously abort, or give birth to a kid/lamb that is dead or dies soon after birth. *T. gondii* infections are one of the main causes of infectious abortion in sheep in Australia and New Zealand, parts of Europe and the US.

Sarcocystis gigantea and *S. medusiformis*

Sarcocystis reproduce sexually in the gut of domestic cats (*Felis catus*), releasing sporocysts (an egg-type life stage) via the cat's faeces. Sheep are infected by unknowingly ingesting sporocysts when grazing or drinking contaminated water. The parasites migrate through the sheep tissue, forming large and visible sarcocysts, mostly in the muscles of the oesophagus, tongue, diaphragm and abdomen. During meat preparation, these "macroscopic sarcocysts" (Figure 1) are trimmed from infected carcasses (for aesthetic reasons), causing direct loss to sheep producers. The infected carcasses may also have the bones removed to ensure the removal of sarcocysts throughout the musculature of the carcass. This also lowers the value of the meat product. In rare cases, heavy infections can result in individual carcasses or shipments being rejected, either at the meat processing facility or the shipment's destination. Carcass rejection and trimming is more common for mature sheep, as the cysts take up to four years to reach full size and the risk of infection is cumulative.

Figure 1: Sarcocystis gigantea *and* S. medusiformis *infection in sheep leads to the formation of visible sarcocysts, shown here on sheep oesophagi. Photo: Patrick Taggart*

Toxocara cati

T. cati (Figure 2) reproduces sexually in cats, and their eggs are released in the cat's faeces. The eggs develop over a two-month period into larvae with a resistant shell that can remain viable and infective for years in soil or on vegetation under favourable conditions. Livestock accidentally ingest the roundworm larvae.

Infected livestock can develop lesions in their meat, as a result of larval migration within the body. However, the extent of *T. cati* infections in Australian livestock is unclear, and it is impossible to separate out the health effects and treatment costs of this roundworm from those of other worm parasites. Consequently, we could not attempt to estimate lost production from cat roundworm in our study.

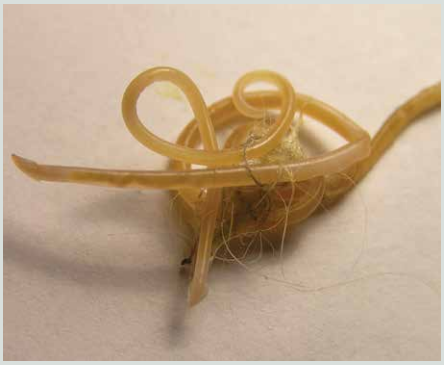

Figure 2: Toxocara cati. *Photo: Beentree/ Wikimedia Commons, CC BY SA 4.0*

About the research

We collated information on rates of infection and disease in sheep from Australia, and overseas.

To estimate the cost of lost lamb production from *T. gondii* infection, we sourced estimates for the national abortion rate in sheep, and the proportion of these that are caused by *T. gondii* infection, and combined this with information on the number of lambs produced each year and their market value. We confined our analysis to sheep, as there is no information on *T. gondii* infection and disease rates in goats.

To estimate the cost of *Sarcocystis* infection to production, we sourced data on slaughter figures and the proportion of sheep carcasses affected by macroscopic sarcocystosis reported by each state/territory, with information on average trim weight for infected carcasses and meat value.

Toxoplasma gondii *infections are one of the main causes of infectious abortion in sheep in Australia and New Zealand. Photo: Sam Carter, Unsplash*

What we found

Toxoplasma gondii

Australia produces about 22 million lambs for consumption annually. However, 1.75% of sheep pregnancies end via spontaneous abortion. A review of many studies concluded that on average, 17% of sheep abortions are triggered by *T. gondii* infections. This means that 62,300 unborn lambs are lost each year because of *T. gondii* infections. The market value for a lamb is $160, so the overall lost production cost is $9.97 million. This is an estimate, and the true cost of lost production could lie between $5.9 and $16.5 million. These figures do not include lost production from lamb deaths soon after birth, for which we have no information.

Figure 3: The prevalence of Toxoplasma gondii *in feral cats across Australia. The highest concentrations (green areas) are in the cooler, wetter south-east and in urban centres*

Geographic variation in the risk of infection from *T. gondii.*

In a related project, we surveyed the incidence of *T. gondii* in feral cats across Australia, using molecular analysis and cat tissue samples from many different researchers. *T. gondii* infection was more common in feral cats living in cooler, wetter areas, where oocysts are likely to survive for longer in the environment (Figure 3). In hotter places (central and northern Australia), *T. gondii* was present in feral cats living in towns and cities (where garden watering increases moisture), but uncommon or absent in feral cats living out in the bush. Work in other countries has also shown that *T. gondii* is more common in feral cats living around farms, partly because feral cat densities are higher near farms, where they have access to rich food supplies. This information can be used to identify priority areas for feral cat control efforts and reduce lost production costs due to *T. gondii*.

Sarcocystis gigantea and *S. medusiformis*

The size of the sheep flock varies between states, as does the incidence of macroscopic sarcocystosis. Victoria and New South Wales have the largest sheep flocks, but South Australia and Tasmania have higher rates of sarcocystosis infection in their sheep. Overall, we estimate a loss of $1.77 million per year from meat trimming and carcass rejection as a result of macroscopic sarcocystosis in sheep. South Australia bears the greatest cost, at $1.2 million annually. The pathogen also causes additional costs because of the need for meat inspection and labour to bone out infected meat; we did not attempt to estimate these costs.

Implications

We estimate that the economic cost of three cat-dependent pathogens, *T. gondii, S. gigantea* and *S. medusiformis,* to the agriculture sector in Australia is $11.7 million annually (range $7.67 to $18.3 million). This is probably an underestimate, due to under-diagnosis and under-reporting of both diseases, and because we did not include associated costs such as inspection or additional labour at meat processing facilities, post-birth lamb mortality due to *T. gondii* infection, or the administrative frameworks set up to regulate the meat industry.

Of the two pathogens, *T. gondii* has the largest impact, costing $9.97 million each year compared to $1.77 million for *Sarcosystis* species. Studies in other countries with comparable lamb production industries, like New Zealand and the UK, report production losses of similar magnitude.

The overall cost is not borne evenly across Australia: sheep growing regions in South Australia (including Kangaroo Island) and Tasmania

Further Information

Sarah Legge – sarahmarialegge@gmail.com
John Woinarski – john.woinarski@cdu.edu.au
John Read – john.read@adelaide.edu.au
Pat Taggart – patrick.taggart@adelaide.edu.au
Chris Dickman – chris.dickman@sydney.edu.au

Implications (continued)

experience higher rates of *T. gondii*-triggered lamb losses than others. Similarly, the density of *Sarcocystis*-positive farms is 15 times greater on Kangaroo Island compared to the adjacent mainland, and visible cysts have been reported on two-thirds of slaughtered adult sheep from the island.

The prevalence of *Sarcocystis* and *T. gondii* in sheep flocks is correlated, probably because the parasites thrive in similar environmental conditions and share a common host (the cat). Sheep living in areas with high cat densities have higher incidences of these cat-dependent diseases, because they are more exposed to the pathogens.

Management options

Although cats have a reputation for keeping some agricultural "pest" animals, such as introduced rodents and rabbits, in check, there is no evidence that they are effective at this task. Instead, populations of introduced rodents and rabbits support inflated densities of feral cats, and higher densities of cats are associated with higher rates of livestock disease due to cat-dependent pathogens.

Reducing the costs of disease in livestock caused by cat-dependent pathogens means reducing the density of cats and breaking transmission pathways. Management options include:

- Limiting the access of both feral and pet cats to farm sites, for example, by using fencing. *T. gondii* infection rates in European livestock fell markedly following measures to exclude cats from these areas.
- There is some evidence that applying agricultural lime to pastures may reduce the viability of *Sarcocystis* sporocysts and *T. gondii* oocysts in the environment, hence reducing infection rates in livestock.
- Reducing the population of feral cats living in agricultural areas, for example, by:
  - Limiting the ability of feral cats to live off refuse and other food of human origin: fencing off rubbish dumps, managing bins to prevent refuse spills, not feeding stray cats, burying, removing or destroying carcasses.
  - Encourage landholders and farmers to make use of free pest control programs, available through sporting shooters organisations,or some local governments.
  - Desexing all pet cats before they reach sexual maturity, to prevent unwanted litters that may become feral.
- Reducing the population of roaming pet cats, for example, by:
  - Encouraging people to consider an alternative pet species.
  - Encouraging people to contain their cats 24/7 indoors or in a secure outdoor area. This will reduce the risk that pet cats become infected with pathogens, as well as reducing the risk that infected cats shed the pathogens into the environment.
  - Asking local governments to introduce by-laws to support responsible cat ownership practices, such as cat containment and desexing, which can reduce the leakage of pet cats into the feral cat population.

Cited material

Dickson, J. A. (2018). The distribution of *Toxoplasma gondii* in Australia. BsC (Hons) Thesis. (University of Melbourne: Melbourne.)

Legge, S., Taggart, P., Dickman, C., Read, J., & Woinarski, J. C. Z. (2020). Cat-dependent diseases cost Australia $6 billion per year through impacts on human health and livestock production. Wildlife Research, 47, 731–746.

Taggart, P. L., McAllister, M. M., Rutley, D., and Caraguel, C. G. B. (2020). Oesophageal sarcocystosis observed at slaughter provides a reliable and efficient proximate measure of *Toxoplasma gondii* seroprevalence in sheep. *Australian Veterinary Journal*, in press. DOI: 10.1111/avj.12941

Threatened Species Recovery Hub
National Environmental Science Programme

This project is supported through funding from the Australian Government's National Environmental Science Program.