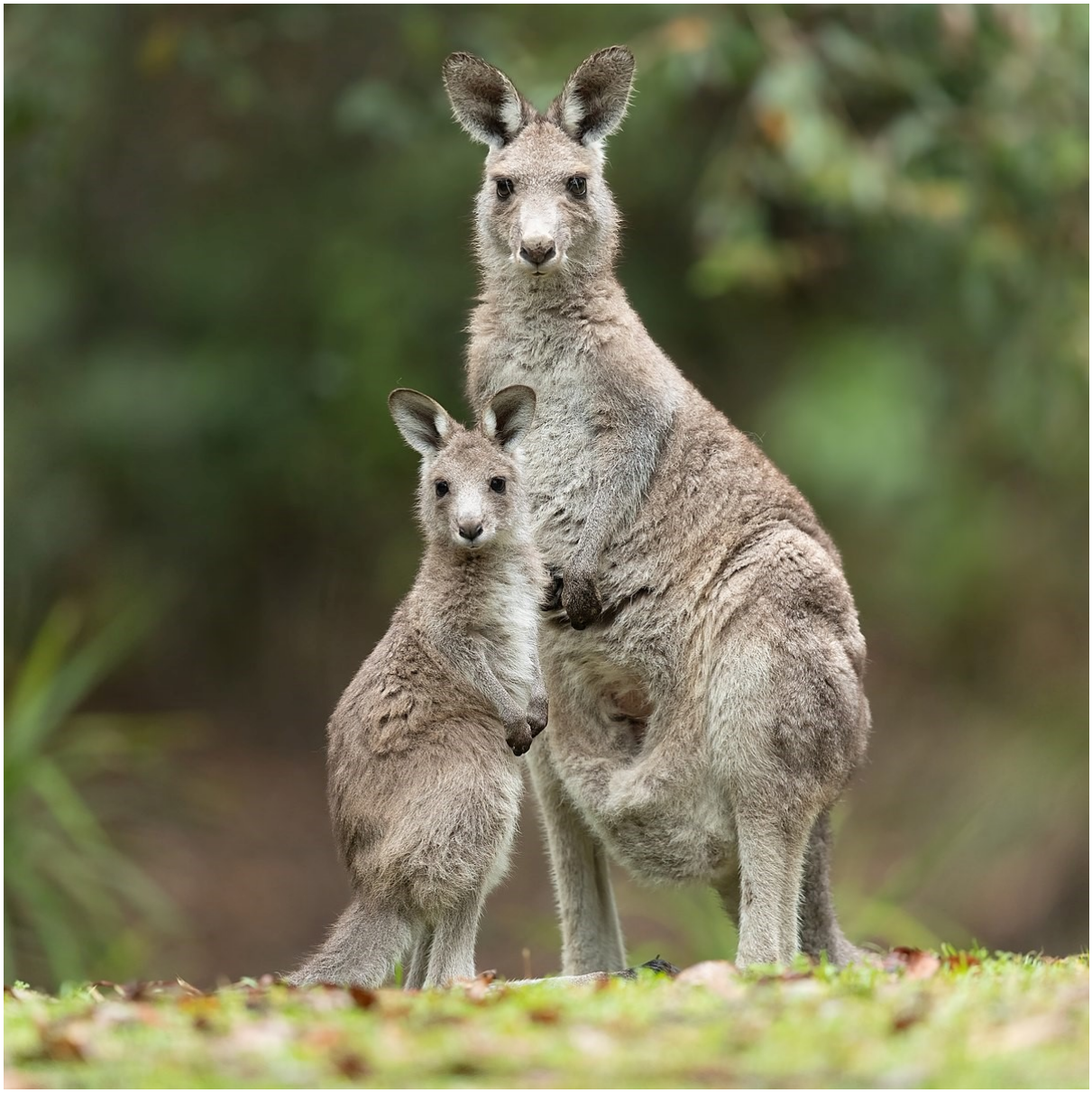
REPORT ON FOOD SAFETY IN THE COMMERICAL KANGAROO INDUSTRY



AUSTRALIAN KANGAROO ALLIANCE

November 2025

Contents

WHO WE ARE

Australian Kangaroo Alliance advocates for all species of macropods with particular focus on the species of kangaroo and wallaby that are targeted by:

- The commercial kangaroo meat and skins industry which slaughters 1.6 million adult and an estimated 400,000 dependent young kangaroos every year.
- The state-based permitting systems which allow for the essentially unregulated slaughter of hundreds of thousands of kangaroos and wallabies across Australia every in the name of "damage mitigation".

AKA conducts research and provides submissions and reports on the operations and activities that take place under these government funded programs, highlighting chronic failures of governance and oversight, chronic failures to address serious animal welfare concerns and food safety issues as well as questions about the sustainability of the kangaroo industry.

The AKA's mission is to inform and educate the Australian public, Australian and overseas policy and lawmakers and Australian and overseas markets and consumers of kangaroo products of the significant animal welfare harms, food safety concerns and ecological damage these activities raise and to advocate for a transition to tolerance and co-existence models of kangaroo management.

INTRODUCTION

Meat safety and disease risk

Food-borne disease outbreaks remain a major global health challenge and cross-contamination from raw meat due to poor handling is a major cause of those outbreaks *(Blagojevic et al 2021)*.

Consumers have a fundamental expectation that the meat they and their pets consume is safe to eat, and that animal industries such as the kangaroo industry strictly comply with food safety standards at every stage of meat production.

The kangaroo industry promotes itself to domestic and overseas markets as having strict food hygiene standards and kangaroo meat as a healthy "wild-caught" meat.

This is not the case. The kangaroo meat industry has had a long history of problems with food hygiene which it has consistently failed to address in any meaningful way, exposing consumers of kangaroo meat (both human and pets) to the risk of contracting not only known pathogens that kangaroos carry but to an emerging zoonotic disease.

This report assesses the claims made by the kangaroo industry and the food safety risks posed by the industry's operations. We conclude that the only effective way to eliminate these risks is to put an end to the commercial slaughter of kangaroos for meat and skins.

The commercial kangaroo industry and disease transmission risks

An average of 1.6-2 million adult kangaroos is slaughtered every year in the commercial kangaroo industry. A further estimated 400,000 joeys are killed as industry waste.

Each one of the carcases of these animals must be gutted, transported, chilled and processed. In addition, each one of these processing stages involves the extensive manual handling of kangaroo carcasses. In this report, we describe the unsanitary conditions in which these activities take place and how industry operators routinely breach food safety regulations and laws. We also describe the failures of all levels of government in Australia to provide proper oversight and enforcements of these laws.

Every one of the millions of interactions between human beings and kangaroos and kangaroo carcasses in the commercial kangaroo industry supply chain increases the risk of contamination resulting in public health risks or a zoonotic spill-over event from an unknown pathogen.

EXECUTIVE SUMMARY

- *Kangaroos and wallabies can harbor a wide range of parasitic, bacterial, viral, and fungal diseases that are not apparent in a normal-looking animal.*
- *In addition, toxoplasmosis and salmonellosis are two bacterial infections that affect kangaroos, and which also have significant public health implications.*
- *Contamination can occur through spillage of the intestines onto muscle tissue during the process of field dressing (evisceration) or from unsanitary transportation and storage of the carcasses in chillers.*
- *We challenge the claims by the kangaroo industry that it operates under strict health and safety standards and identify the public health risks created and posed by commercial kangaroo industry practices.*
- *The wildlife trade and in particular, industries that trade in bush meat such as the kangaroo industry is a major source of emerging diseases and pandemics.*
- *This means that consumers of kangaroo meat (both human and pets) are exposed to the increased risk of contracting not only the known pathogens but an emerging zoonotic disease.*
- *There have been numerous unexplained mass mortality events recorded in kangaroo populations over the past 50 years which state wildlife and food safety authorities have failed to investigate.*
- *We highlight the many breaches of food safety standards that have occurred and the broader risks of zoonotic and pandemics by the large-scale slaughter and trade in wildlife and the lack of transparency and public reporting of these issues.*
- *We note that food safety concerns (along with animal welfare concerns) have resulted in the loss of a major international market-the Russian Federation-for kangaroo meat for human and pet food consumption and ongoing refusal of market access to others including China.*
- *We contend that because of the scale of the slaughter of kangaroos, the unhygienic industry practices that occur are impossible to regulate and that the kangaroo industry and its products will continue to present a significant threat to public health so long as the industry continues to operate.*
- *The photos included in this report are a small selection of the thousands of photos compiled by Kangaroo Industry-Dirty Graphic Truth Facebook page using material posted to social media sites by kangaroo shooters. These photos do not depict aberrant behaviour. They reflect the reality on the ground in the commercial kangaroo industry.*

CLAIMS MADE BY THE KANGAROO INDUSTRY

The kangaroo industry promotes itself to domestic and overseas markets as having strict food hygiene standards and kangaroo meat as a healthy "wild-caught" meat.

According to the kangaroo industry (KIAA-now Australian Wild Game Industry Council; AWGIC) website and its marketing communications, the kangaroo industry claims that:

"Accountable

Every step of the process is monitored, from harvest to export. Harvested animals and the processing facilities undergo regular third-party inspections to meet Australia's strict food safety and welfare standards".

Nothing could be further from the truth. The meat handling processes in the kangaroo industry involves extensive and alarmingly unhygienic practices that should be of concern to industry regulators and consumers *(Ben-Ami 2009)*.

The evidence we provide in this report sheds light on those unhygienic practices and the long history of significant breaches of food safety standards in the kangaroo industry.

The evidence suggests that the chronic problems with quality control within the industry are due to a range of reasons including:

- Non-compliant practices of kangaroo shooters.
- Cultural attitudes to kangaroo meat (as an inferior and cheap meat) in rural areas; and
- The downward pressure on standards from the fact most kangaroo meat of processed in pet food industry *(Young 2017)*.

Strategic RD &E plan 2021-2026

Food hygiene and safety is a high priority for the kangaroo meat industry because it remains, along with animal welfare concerns, a major obstacle to consumer and market acceptance of kangaroo products.

The most recent Agrifutures kangaroo industry strategic RD &E plan (2021-2026) sets out the research and development priorities for the kangaroo industry over the next 5 years. One of the main priorities is to "demonstrate the food safety credentials of the industry" *(Agrifutures 2021)*.

The need to demonstrate food safety credentials reflects justified industry concerns about the long history of breaches of food hygiene standards within the kangaroo industry, the most prominent of which caused the loss of the Russia market in 2009.

Lack of transparency

While preparing this report, we found there is a serious lack of transparency from the kangaroo industry and the federal and state government food safety agencies in the reporting of hygiene breaches in the production of kangaroo meat.

Like every other aspect of the kangaroo industry, there is a dearth of publicly available information upon which to assess whether the claims made by the kangaroo industry about the safety of the products it markets to consumers and export markets.

There is a lack of transparency in the public reporting of testing, testing results and breaches of food safety and hygiene standards by state food safety agencies.

It is worth noting that the compliance breaches we have identified below have largely been uncovered because of FOI requests and independent investigations by animal welfare groups rather than the public reporting or release of testing data and results by the federal and state agencies charged with responsibility for overseeing food safety in the kangaroo industry.

It is beyond the scope of this report to undertake a wide-ranging investigation of the regulatory regime and compliance activities of the food safety agencies responsible for overseeing the kangaroo industry.

Instead, we have relied on the available public reporting and research. It is reasonable to assume that the incidents identified in this report below likely represent just a small portion of the incidents of food safety breaches that have occurred.

FOOD SAFETY ISSUES IN THE KANGAROO INDUSTRY

The kangaroo industry promotes itself to domestic and overseas markets as having high food hygiene standards and kangaroo meat as a healthy "wild-caught" meat.

Nothing could be further from the truth.

The challenge of understanding meat quality and factors that control it in the kangaroo is a major issue for the industry (*Speigel, Wynn 2014)*.

History of food safety breaches in the commercial kangaroo industry

The kangaroo meat industry has had a long history of problems with hygiene, which it has not been willing to acknowledge or address *(Young 2017)*.

Food hygiene has been a persistent issue for the kangaroo meat industry since it first commenced in the 1950s when early exports of rotten and contaminated meat to Germany were rejected in the 1950's.

The industry lost the Russian Federation market in 2009 (which represented 70% of all kangaroo meat exports at the time) following testing in Russia that found abnormal coliform bacteria accumulations *(Bardon 2008)*.

These accumulations are a commonly used indicator of poor sanitary quality in food and water *(Spellman 2003)*.

There were further attempts to resume the trade with Russia in 2012 and 2014. Again, food hygiene issues were a major issue and exports to Russia ended completely in 2014.

These were not isolated incidents. There is a long history of investigations and incidents of breaches of state food hygiene standards over the past 70 years which we have documented in the table below.

Breaches of Food safety standards 1950-2021

1950s	The export of kangaroo meat for human consumption took place in the 1950s and 1960s, but this was fleeting due to poor quality controls reported at the time *(MacFarlane, 1971; Corrigan, 1988; Jarman, 1994)*.

1967	A survey of Salmonella contamination of imported meats IN Japan during 1965 - 1966 reported salmonella contamination rates as high as 44.9% *(Suzuki et al. 1967)*
1981	Meat substitution scandal where horse and kangaroo meat were sold both domestically and internationally as beef. The Royal Commission report which examined the scandal recommended kangaroo in pet food be marked with blue dye to prevent substitution *(Woodward Royal Commission Report 1982)*
1991	Qld study found 11% (9/81) of processed kangaroo carcasses were infected with Salmonella 49% (40/81) of the same carcasses were infected with e. coli *(Bensink et al 1991)*
1994	Department of Health attributed undercooked kangaroo meat as the cause of outbreak of toxoplasmosis, but cause could not be confirmed only that it was "theoretically" the most likely cause *(Robson et al 1995)*
2002	EU issued 2 Rapid Alert System for Food and Feed (RASFF) advice for e.coli in frozen kangaroo meat in the Netherlands and for salmonella in chilled kangaroo meat in Denmark *(Mjadwesch-Kangaroos at Risk)*
2002	South Australian study of kangaroo products purchased at retail outlets found 31% (11/35) kangaroo steaks 49% (17/35) kangaroo mince Were infected with salmonella *(Delroy et al 2008)*
2002-2004	South Australia survey of 5 processing plants found 1% (4/385) kangaroo carcasses infected with salmonella 18% (9/50) of minced kangaroo meat samples collected in 2002 were found to be contaminated by salmonella (6 of the contaminated samples came from the same processor) 70% (70/120) of the minced kangaroo meat samples collected in 2002 were contaminated with e. coli *(Holds et al 2008)*
2003-2006	Queensland survey found 0.84% (7/836) of kangaroo carcasses infected with salmonella 13.9% (116/836) of kangaroo carcasses infected with ecoli 68.7% (574/836) of kangaroo carcasses contained aerobic bacteria *(Eglezos et al 2007)*
2009	WA study found 15.5% (34/219) of Western Grey Kangaroos culled from around Perth were positive for toxoplasmosis *(Parameswaran et al 2009)*

2009	Russia banned kangaroo meat imports due to contamination with high levels of coliform bacteria accumulations *(Bardon 2008)*
2009	independently assessed samples *(Silliker 2008)* obtained by Animal Liberation NSW from biopsies performed on carcasses located in remote kangaroo chillers in Queensland found the levels of generic Escherichia coli were so high that they warranted Australian Quarantine and Inspection Service (AQIS) alerts known as "E. coli ALERTs" *(Australian Quarantine and Inspection Service 2008)*
2012	Independent testing of supermarket samples of kangaroo meat by Animal Liberation NSW found 8/26 samples contained ECOLI and salmonella *(ABC Landline episode 27/8/12)*
2011	WA study found 3.6% (23/245) of faecal samples taken from 645 western grey kangaroo carcasses culled at 6 out of 10 different locations were infected with salmonella *(Potter et al 2011)*
2012	Qld study of wild eastern grey kangaroos in SE Qld found 8.6% (13/151) were infected with e.coli confirming that kangaroos are a carrier of pathogenic e. coli *(Rupan et al 2012)*
2012	Further Russian ban on imports due to contamination concerns (see 2009)
2014	USA product (Jump Your Bones brand "Roo bites") recall of dried pet food products due to risk of Salmonella contamination *(Food Safety News-online 31/12/14)*
2014	Russia imposes permanent ban on all kangaroo meat products due to further evidence of salmonella contamination in imports
2015	NSW-FOI release of documents revealed that in 2014 alone NSW Food Authority found numerous food hygiene breaches in the kangaroo industry (16/156 inspections) including chillers contaminated with old blood, dirty floors, walls and ceilings, lack of water for cleaning and hand washing, carcasses hung from rusty hooks and live animals permitted to roam around the chiller area (*Carter 2015 NSW Kangaroo Meat Fails Test for Fundamental* Food Safety *Australian Institute of Food Safety, Australian Food Safety News (March 10, 2015)*
2016	Literature review conducted by Victorian Chief Veterinarian Officer confirms long history of contamination of kangaroo meat and calls for further research and steps to mitigate the risks posed by game meat to food safety and human health. *(Victoria Chief Veterinarian Office Review of Diseases and pathogens of Invasive Animals that may Present Food Safety and Human Health Risks attached to Primesafe submission to a*

	2017 Victorian Parliamentary Inquiry into Control of Invasive Animals on Crown Land)
2016	*Primesafe Submission to Victorian Parliamentary Inquiry into the Control of Invasive Animals on Crown Land 2016* states: "In general, there is very limited food safety information available about wild game meat harvested in Australia for human consumption. The public health concern regarding game meat is from clinical and sub-clinical disease and microorganism infection related to the environment and the subsequent processing of wild game animals"
2016-2017	Mass mortality event occurs in western NSW. Over 100,000 kangaroos die because of an unknown pathogen/disease. The deaths are not investigated by NSW government agencies *(The Australian 27/12/17)*
2017	The European Commission's RASFF database shows that between 2012 and 2017, EU Member States reported ten incidents of shigatoxin-producing Escherichia coli and one case of Salmonella enterica contamination being detected in frozen or chilled kangaroo meat imported from Australia. It should also be noted that Russia has already prohibited the import of kangaroo meat as a result of public health concerns *(HSI submission to DFAT regarding the Australia-EU Free Trade Agreement negotiations 2019*).
2020	US based pet food company Real Pet Food recalled bags of dry pet food due to potential Salmonella contamination *(Rozsa -Salon Article 21/11/20)*
2021	*NSW Food Authority report –Meat Food Safety Scheme* Aside from bacterial hazards, a recent review of diseases and pathogens of invasive animals in Australia *(DEDJTR, 2016)* identified a wide range of pathogenic viruses, parasitic helminths and protozoa that may present additional food safety and human health risks. Relevant published studies are also scarce on the presence of pathogens, including parasites and viruses, in live game meat animals and to what extent this may result in contamination. Surveys and targeted research would provide necessary data to inform future risk assessments concerning game meats.

LOSS OF INTERNATIONAL MARKETS DUE TO FOOD SAFETY CONCERNS

The industry lost the Russian Federation market in 2009 (which represented 70% of all kangaroo meat exports at the time) following testing in Russia that found abnormal coliform bacteria accumulations *(Bardon 2008)*.

These accumulations are a commonly used indicator of poor sanitary quality in food and water *(Spellman 2003)*.

There were further attempts to resume the trade with Russia in 2012 and 2014. Again, food hygiene issues were a major issue and exports to Russia ended completely in 2014.

Minutes of biannual meetings of the Kangaroo Management Advisory Panel from 2012 to 2024 indicate the degree to which food safety concerns (along with animal welfare issues) have been and remain a major obstacle to access to international markets over the past 15 years.

Industry leaders, farmers and NSW government officials and scientists, along with the RSPCA and AVA attend these meetings. Extracts taken from these meetings confirm that international export market refusal on the grounds of food safety (and animal welfare):

- 3/13-The loss of the Russian market occurred due to food safety concerns and that kangaroo shooters are unsupervised at the point of kill and China will not take imports because of animal welfare concerns
- 10/13-Russia only taking limited exports. China again refusing to take kangaroo products due to animal welfare concerns
- 3/14-The Russia relationship is "not looking good". For the 10th year in a row, China has not signed up for exports. Victoria must start a kangaroo industry "otherwise markets could be destroyed"
- 11/14-FTA being negotiated with China. Other exporters are worried about issues associated with the kangaroo industry (animal welfare and food safety) on the negotiations. Trying to market to Russia, China and India but they won't take kangaroo.
- 3/15-Russian exported have ended. Met with Prime Minister to encourage talks with India. Biggest obstacle with China is animal welfare.
- 10/15-California ban on kangaroo products. China reluctant to take. Belgium number one export market for meat in Europe. 5/16. Minimum growth in domestic markets
- 5/16-Industry has been on a "downward spiral" since loss of Russia in 2009. 18 exporters down to 3. A processor (GMP) has ceased operating in WA. Big issue is metal fragments in carcasses being picked up by processors
- 11/16 Domestic market is "tough". Europe leather sales are down and are in decline generally. China "no closer" but Singapore, Thailand and Indonesia on board. NSW floods have cost the industry millions of dollars-weeks of nil supply
- 3/17-Domestic markets are fine. Exports are "soft". Californian ban in place. Adidas have dropped k leather
- 11/17- Population count down by 3 million this year due to drought. Processors say dangerous to see kangaroo industry as "normal business"-it is controversial and sensitive. Domestic markets are stable. Export markets are flat.
- 3/18-Greg Curran reported over 100,000 kangaroo deaths from disease in Western Region. No samples taken. If drought continues expect another 40% drop (in population)
- 11/18-Decrease of kangaroo population in NSW 2 million in 1 year. Red kangaroo populations dropped by 42%. Harvest suspended in 2 zones. Struggling to get meaningful aboriginal engagement. Illegal and non-commercial shooting "weekend warriors "a huge risk to the industry

- 4/19 Emaciated carcasses being sent to processors. Weights down. Supply issues. 25% increase in number of females being shot. RSPCA says orphaned joeys are huge problem-nowhere released joeys are safe. 30 a day not headshot is not new. No compliance activity in the field due to safety concerns. Marketing efforts “ethical choice”. Project grant to improve the image of the kangaroo industry
- 4/20-RSPCA concerned about the animal welfare response to the 2020 bushfires. Concerns kangaroos fleeing fires are getting shot. COVID is impacting processors. New draft Code of Practice-9000 responses, mostly from opponents.
- 11/20 RSPCA has received complaints about ongoing shooting despite bushfires. Overseas markets are under pressure and in decline-reducing purchases. Processors can’t get supply due to low numbers resulting from drought. Agencies still going all out to support and promote industry.
- 11/21-Export market difficult because of increased costs of containers, outward freight costs and shortages skilled workers. Maffra incident where poisoned beef, horse and kangaroo meat killed several pets.
- 11/22-Challenging year for the industry. Flooding in NSW and Qld limited shooting. Other areas no shooting at all. Take will be lower. RSPCA decision to remove kangaroo products from stores die to animal welfare concerns especially slaughter methods used on dependent young and lack of oversight.
- 5/23-Red kangaroos in poor condition despite access to feed. Harvester found one red with excessive amount of worms-reported to Emergency Animal Diseases. Puma and Nike recent announcements to stop using k leather. Need to prove killing is humane and build public trust.
- 11/23-Trying to get Vets for Climate Change to support industry on basis of the benefits of feeding kangaroo meat to pets. Weakening demand for kangaroo. Recent closure of Walgett processing plant and other processors limiting operations as well as closure of chillers. Due to a combination of factors-drop in prices of beef and lamb, limited freezer capacity, increased wage, fuel and energy costs, challenging conditions overseas, drop in price meat to $1 per kg, drop in buying sites from 90 to 35.
- 3/24-Demand for kangaroo meat facing challenges but domestic markets are stable. KIAA has been re-named Australian Wild Game Industry Council (AWGIC). Profits down due to increasing costs and low price $1 per kg. Poor demand causing closure of chillers. Lack of shooters in some areas. RSPCA policy review completed, and they still oppose commercial exploitation of wildlife.

CONTAMINATION RISKS

Microbial contamination

Despite the extensive scientific progress and technological developments achieved in meat production over recent decades, microbial contamination that causes foodborne illness remains a serious concern *(Midgley, Small 2006)*.

Microbial contamination is of even more concern in the production of “game meat”.

Wild game food safety standards

Game meats are widely defined as animal products obtained from free-ranging, non-domesticated wildlife.

It is well established that game meats frequently cause illness in consumers, especially when care has not been taken while eviscerating and handling the carcasses *(Alwynelle 2006)*.

Kangaroo meat is classified as game meat. It is also referred to as "wild-caught", and "wild harvested". This is an obvious attempt to "greenwash" kangaroo meat and to increase its appeal to high end restaurants, retailers and consumers.

Wild game meat must be produced in accordance with the *Australian Standard for the Hygienic Production of Wild Game Meat for Human Consumption–AS 4464:2007* (the Standard).

The Standard requires that all activities by "field harvesters" and others involved in the production and processing of wild game to comply with human consumption standards.

Threats from Diseases Bacteria and Parasites in Kangaroos

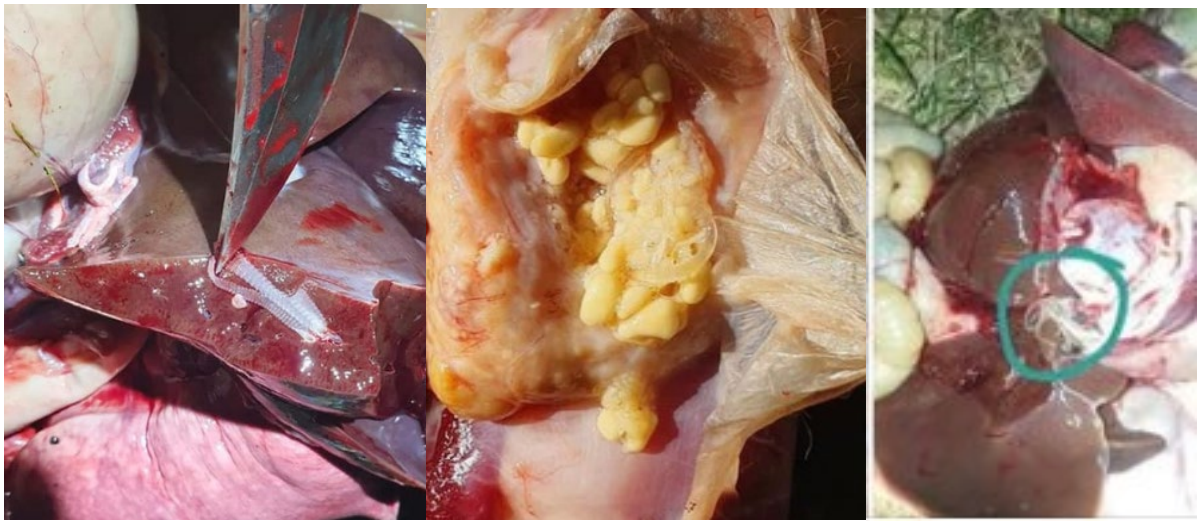
Kangaroos and wallabies can harbor a wide range of parasitic, bacterial, viral, and fungal diseases that are not apparent in a normal-looking animal *(Obendorf 2001)*.

Grey kangaroos, for example, may be infected with 30,000 nematodes from 20 different species *(Speare et al., 1989),* which are predominantly found in the gastrointestinal tract.

Other worm species are found in kangaroo carcasses with the large parasite *Pelecitus roemeri* often associated with the stifle joints.

The prevalence of these infestations is associated with the activity of intermediate hosts such as tabanid flies, which in turn, are influenced by geographical location and season *(CSIRO, 2009)*.

Other possible contamination can come from parasitic worms, such as trichinosis (e.g., Trichinella spiralis), taeniasis (roundworms and tapeworms), and echinococcosis *(Speigel, Wynn 2014)*.



Toxoplasmosis and salmonellosis are two bacterial infections that affect kangaroos, and which also have significant public health implications *(Ben-Ami 2009)*.

Toxoplasmosis

T. gondii is a food-borne pathogen that can have significant health implications for humans as well as for pets.

There is a potential risk for outbreaks associated with food-borne pathogens, especially because kangaroo meat is often consumed raw *(Parameswaran et al 2009a)*.

Research in 2014 into these potential risks had recommended that further monitoring of kangaroo health and diseases such as the incidence of toxoplasmosis was needed to ensure minimal risk of carcasses from bacterial spoilage *(Speigel, Wynn 2014)*. It is unclear if this recommendation was acted on.

Research on the prevalence of T. gondii in macropods, which included a literature review of science on the issue published in 2021, *(Borkens 2021)* found that:

- All hunted macropod species (commercial as well as non-commercial hunt) showed a positive seroprevalence for *T. gondii*.
- The parasite showed a high level of genetic variability in macropods.
- Genetically variable strains had caused outbreaks of toxoplasmosis in other countries in the past that were attributed to undercooked game meat *(Schumacher et al 2020)*;
- Cases of toxoplasmosis had already been successfully traced back to insufficiently cooked kangaroo meat in the past *(Robson et al 1994) (Obendorf 2004)*.

That same research also noted that despite the fact that *T. gondii* had the potential to become a serious public health threat, the impact of this pathogen on human health had not been addressed either in the scientific literature or in official governmental codes and laws, noting that neither Australia nor New Zealand had requirements for food safety checks to detect foodborne pathogens *(Borkens 2021)*.

Salmonella

Macropods are known to harbour *Salmonella* bacteria, which may result in disease *(Speare et al., 1989) (Bensink et al 1991) (Potter et al 2011) (DK Draper et al 2025)*.

Macropods may also harbour *Salmonella* without displaying clinical signs of disease *(Samuel 1982) (WHA factsheet 2018)*.

There is evidence that as many as one in two kangaroo carcasses may harbour the salmonella bacterium *(Shultz et al. 1996)*.

There is a potential risk of *Salmonella* infection in both people and pets through the handling, processing and/ or consumption of infected kangaroo meat, as carcasses may become contaminated during harvesting and processing *(Ben-Ami 2009) (DK Draper et al 2025)*.

Types of contamination

There are three main types of contamination:

- Microbiological – e.g. any microorganisms or bacteria that gets on the meat from unclean hands, dirty equipment, faeces, ingesta or the skin of the animal during field harvesting operations.
- Physical – e.g. dirt, dust, hair, leaves, faeces, ingesta.
- Chemical – e.g. agricultural chemicals used on farms, or cleaning chemicals not properly rinsed off equipment that could get into the meat.

How contamination occurs

Kangaroo industry operations involve conditions and practices that create risks of microbial and physical contamination.

The slaughter and processing of game/wild animals can cause meat contamination during killing and dressing in the field from various sources such as faecal material, skins, processing tools and equipment, human contact, environmental conditions and carcass to carcass where insufficient space is left between dressed carcasses in processing facilities *(Nkosi 2021)*.

The types of microorganisms and extent of contamination present on carcasses are influenced by the sanitation procedures used, compliance with hygienic practices, the application of food safety interventions, the type and extent of product handling and processing and the conditions of storage and distribution *(Davidson, Sofos et al 2005)*.

POTENTIAL SOURCES OF CONTAMINATION IN THE KANGAROO INDUSTRY

Kangaroos are shot in the wild at night. The animals are dragged or carried to the shooter's vehicle. The bodies are hung on the back of utility vehicles where the carcasses are then "dressed" ie eviscerated and butchered.

There are multiple sources of potential contamination at every stage of this process.

Shooting coupled with exsanguination and evisceration have the potential to leave open wounds and cuts on the body of the kangaroo, exposing the meat to microbial contamination.

During the field dressing process, making incorrect cuts can allow faeces, urine, fur, dirt and dust to spill onto muscle tissue and onto other kangaroo carcasses.

Contamination can also occur because of overcrowding of kangaroo carcasses on the vehicle where carcasses are in contact both before and during the field dressing process. The photographic evidence we have reviewed suggests that the overcrowding of carcasses is standard practice in the kangaroo industry.

Kangaroo shooters routinely have their pet or even pig hunting dogs present during shooting activities and shoot and field dress multiple non-native species of animals alongside kangaroos. These practices pose serious cross-contamination risks.

Dressed carcasses are then stored for many hours in open air trucks where they are exposed to dust, dirt, flies and high temperatures until they can be transported to remote chillers or "field depots".

The carcasses are then stored in the chillers for up to two weeks before being collected and transported to a meat processing plant. Both the unsanitary conditions inside these

chillers and the overcrowding of carcasses is yet another potential source of direct contamination.

The overcrowding of carcasses in the field depot prevents them cooling down to the correct temperature more quickly and prevents the exposed surfaces from drying out more quickly, reducing the growth rate of micro-organisms

Apart from direct contamination, other possible causes of microbial in the kangaroo industry are *(Sibraa 2004)*:

- Failure to use potable water during or after gutting in the field.
- The inadequate long-term chilling of carcasses; and
- Inappropriate sanitation and effluent management.

All these potential causes of contamination are particularly acute in summer when higher ambient temperatures lead to the possibility of inefficient chilling of carcasses *(Speigel, Wynn 2014)*.

Questions about food hygiene also arise at processing plants where the carcasses are skinned and the meat sprayed with acetic and lactic acids, treatments which do not appear on consumer advice labels *(Ben-Ami 2009)*.

Cross contamination- the presence of dogs during shooting field dressing

A potential source of contamination is the presence of dogs during kangaroo shooting and processing activities.

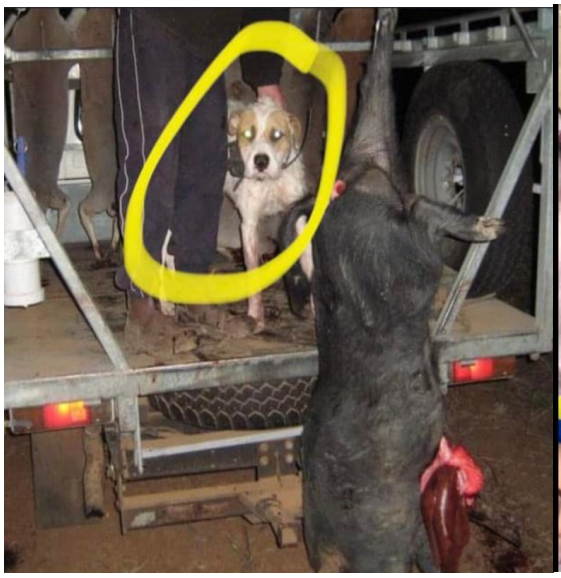
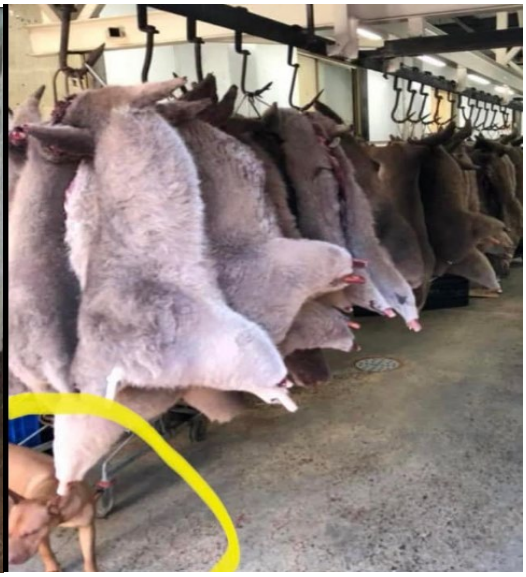
The National Kangaroo Harvesters Field Dressing Manual (2010) makes it clear that dogs should not be present during shooting or field dressing activities for this reason. It specifies:

"You must never have dogs with you when you are shooting. Apart from disturbing the kangaroos, dogs could contaminate the carcasses and transfer disease organisms onto the carcasses."

This prohibition is because poorly managed dogs can cause injury to wildlife and be a serious welfare concern and be a source of contamination to field dressed carcasses "if any of their bodily fluids (saliva, urine etc) come into contact with the meat".

This prohibition is largely ignored. There is extensive publicly available evidence in the form of photographs and social media posts by licensed professional kangaroo shooters of the presence of dogs during all of these activities.

Many of the dogs depicted in these photographs are clearly pig-hunting dogs wearing protective coats. Some of the wild pig carcasses in these photographs show signs consistent with dog bites and injuries.

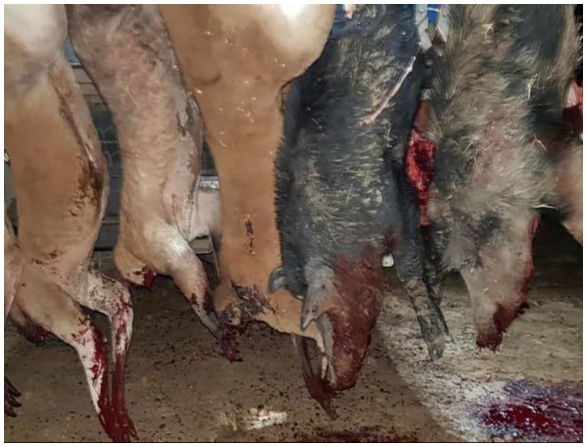



Cross-contamination through contact with other species

Many kangaroo shooters shoot other species as well as kangaroos during nighttime shoots.

Contamination can also occur when dingoes, pigs, deer and other non-native species shot during kangaroo shooting are not separated from kangaroo carcasses during field dressing or in storage at chillers.

Again, there is a significant body of photographic images that confirm many kangaroo shooters do not follow even the most basic hygiene requirements either during the field dressing process or during storage of carcasses at chillers.

KANGAROO INDUSTRY SUPPLY CHAIN PRACTICES

For the kangaroo industry the challenges of disease control and hygiene regulation are exacerbated by the scale of the industry, the remote locations where harvesting takes place, and the conditions under which harvesting occurs *(Ben-Ami 2009)*.

As can be seen from the table above, the kangaroo industry has consistently failed to overcome those challenges, despite requirements for training and accreditation in food hygiene practices and government food safety agency regulation.

Repeated independent and government investigation have identified extensive and alarmingly unhygienic practices, unacceptable levels of bacterial accumulations in kangaroo carcasses in chillers and chillers found to be in poor condition, unsuitable for holding meats destined for both human consumption and the pet meat industry *(Ben-Ami 2009)*.

This is because the practices that take place in the field are unregulated and there is inadequate inspection and compliance monitoring of conditions within chillers and processing facilities.

Training requirements and Standards

Following the suspension of exports of kangaroo meat to the Russian Federation in 2009, the Queensland Government established a Kangaroo Industry Development Committee (KIDC).

The KIDC, which was comprised of representatives from the kangaroo industry and state government agriculture and food safety agencies, developed and rolled out a national training program to improve the training and skills of shooters in order "to meet international requirements".

This national training program emphasised the need for compliance with AS food safety standards. It consisted of "refresher" training for all licensed kangaroo shooters in relation to field dressing hygiene practices and the development of a field dressing manual *(RIRDC 2011)*.

Current training requirements for kangaroo shooters incorporate this training but remain limited to short online course and open book test to gain accreditation in field dressing kangaroos *(Mjadwesch-Kangaroos at Risk)*.

While training in field dressing is a requirement for obtaining a kangaroo shooters licence and some minimal (mostly online) basic training in the butchering and field dressing process is provided, these practices remain unregulated in the field.

Without oversight and enforcement, it is impossible for the regulating authorities to ensure that hygiene standards and hygienic practices are being followed.

Pre-death inspections

In theory, kangaroo shooters operate under strict guidelines which exist to prevent the harvesting of unhealthy individuals *(Ben-Ami 2009)*.

The Australian Standard 4464:2007 for Hygienic Production of Game Meat for Human Consumption stipulates that kangaroo shooters must carry out pre-death inspections of target movement to determine whether there is any indication of sickness *(CSIRO 2007)*.

According to the Standard, *"no animal should be harvested if it can be seen that it has an abnormal gait; is weak or lethargic; lacks alertness; sits in an unusual way; holds its head at an unusual angle; has any discharge from the nose or mouth; has any skin abnormalities; and/or is poorly fleshed, or is otherwise apparently injured or suffering from an abnormality that may render meat derived from it unwholesome"*.

In practice, the kind of detailed visual inspection required by the AS standard is almost impossible because the shooting of kangaroos occurs at night and from long distances *(Ben-Ami 2009)*.

Further, the shooting of a kangaroo requires that it must first be transfixed (made to stand still) making any observation of target movement impossible by a spotlight *(Sibraa 2004)*.

The result is that such pre-death inspections by shooters are of little value in identifying diseased individuals *(Ben-Ami 2009)*.

Post death inspections

Visual meat inspection procedures following harvesting and processing are also far from effective.

Unless gross lesions are apparent in the meat or samples are taken for testing, most infections are difficult or impossible to detect.

If the animal is ill and the meat becomes fevered after death the dark colouring of kangaroo meat further reduces any chance of picking up on any visual indications of the condition *(Obendorf 2001)*.

Vehicle Hygiene-requirements

Kangaroo shooters are required to ensure that their vehicles comply with the requirements are set out in *Australian Standard AS4464 – 2007.*

The Standard requires that kangaroo shooters must ensure that their vehicles and equipment:

- Are cleaned and sanitised whenever necessary to prevent contamination of wild game meat and wild game meat products.
- Are clean before operations begin each day and are cleaned at the end of operations each day.
- Are kept in a good state of repair.

Although each state has requirements that kangaroo shooter vehicles are inspected and accredited by the food safety authority under as part of their licensing requirements, those inspections are largely done via photographic evidence submitted by the kangaroo shooter (for example *Kangaroo Field Processor Factsheet, DEW (SA) 2021*).

Ongoing inspections of kangaroo shooter vehicles are carried out by state food safety authorities. Most are notified in advance giving the shooter ample opportunity to ensure the vehicle is compliant *(Young 2017)*.

In any case, given the scale of kangaroo industry operations across Australia and the remote locations at which kangaroo shooting takes place and the fact the responsible agencies are under-resourced, regular inspection and ensuring compliance is impossible.

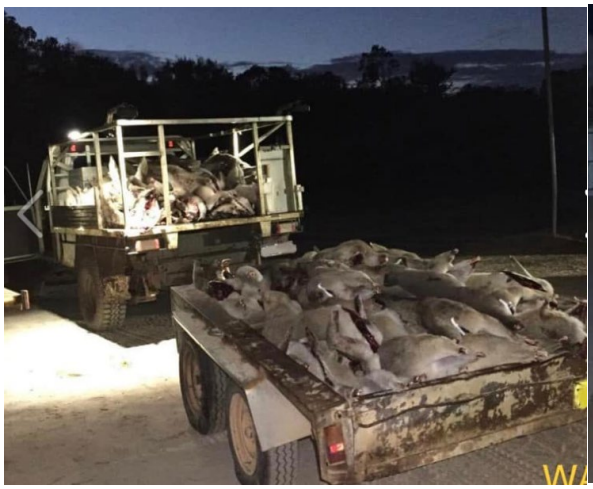
Vehicle hygiene-the reality

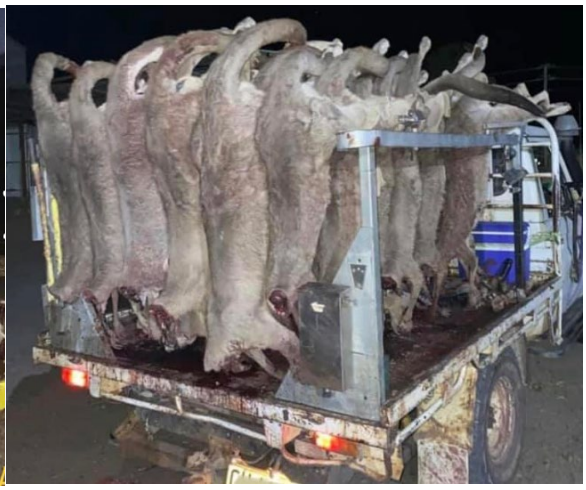
The vehicles used in commercial kangaroo industry operations are effectively mobile wet markets with all the attendant risks of contamination and exposure to pathogens that involves.

We have evidence, including hundreds of photographs and videos posted by kangaroo industry shooters that support this assertion. More than that, this evidence suggests that the filthy and unsanitary conditions of the vehicles depicted represent routine and widespread practices within the kangaroo industry.

This evidence includes videos of shooters using a chainsaw to remove the limbs and heads of kangaroos hanging on hooks attached to the vehicles, the hanging and evisceration of kangaroo carcasses alongside and often touching multiple non-native species, the presence of pig hunting and other dogs on the trays of the vehicles and amongst carcasses hung on the vehicles and vehicles covered in dirt and blood.

We provide a small sample of the photographic evidence of these practices below.





Field dressing

Kangaroo shooters are required to comply with the requirements are set out in Australian Standard AS4464 – 2007 in carrying out the field dressing of kangaroos.

Kangaroos are shot and killed in remote locations and under conditions where contamination of kangaroo meat is practically unavoidable.

This is because kangaroo shooting takes place in remote, outdoor settings with limited access to sanitation and hygienic infrastructure. These are not sanitary processing environments.

The process of field dressing (gutting) involves bleeding the kangaroo, opening its abdomen and removing and discarding the stomach and intestines.

It is during this process that contamination is most likely to occur due to the accidental spillage of faecal or other matter from the intestines onto the meat and skin or onto other kangaroo carcasses.

The National Kangaroo Harvesters Field Dressing Manual (RIRDC 2010) identifies the possible sources of contamination in the field dressing process as follows:

- Not using the spear cutting method (cutting from inside to out) when opening the skin and dragging bits of hair, dirt and other extraneous matter onto the meat.
- Not freeing the bung correctly and allowing faeces to spill onto the meat surface in the pelvic channel or around the anus.
- Not freeing the weasand correctly and allowing ingesta to spill inside the chest cavity or over the brisket meat.
- Making incorrect dressing cuts and exposing unnecessary amounts of meat surfaces. These can then be contaminated from hair, dust, etc or contact from the skin/fur of other carcasses.
- Not gutting out correctly and leaving remnants of organs that should have been removed.
- Allowing condensation (containing dust and dirt) to drip down off the ceiling of field depots onto the meat.
- Overcrowding of carcasses on the harvesting vehicle
- Hanging carcasses of the outside of the harvester vehicle.

Field dressing kangaroo carcasses during high nighttime temperatures and in wet conditions may also exacerbate the potential for contamination *(Eglezos et al., 2007)*.

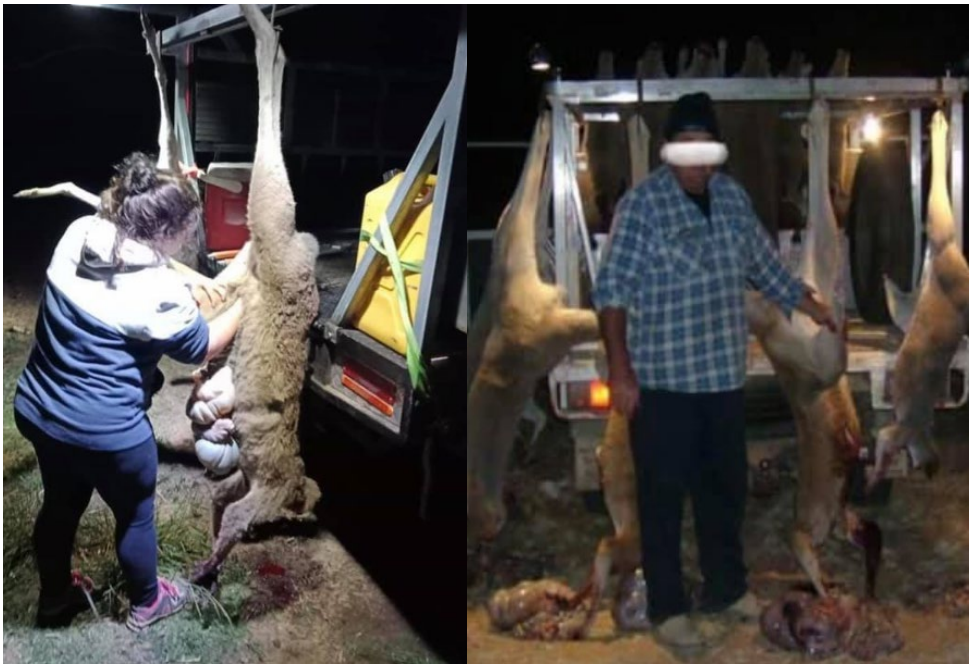
There is significant evidence that some, if not all the requirements set out in the Standard and the Training Manual are routinely breached in the kangaroo industry.

The photographs below depict the reality of field dressing process in the kangaroo industry.

Field dressing is carried out without any of the protective equipment designed to protect against contamination or from exposure to pathogens such as clean clothes, plastic aprons, cut resistant or even rubber or plastic protective gloves, safety glasses or hair nets.

It is not clear if the knives and other implements such as the loppers and knives used are cleaned or sterilised between each carcass due to lack of sterilisation equipment and potable water in the field. Many of the videos we have obtained depict the shooter moving from carcass to carcass using the same implements on each carcass.

As we have indicated, we have videotape evidence that clearly unauthorised equipment like chainsaws is also used to remove heads and limbs from carcasses during the field dressing process.



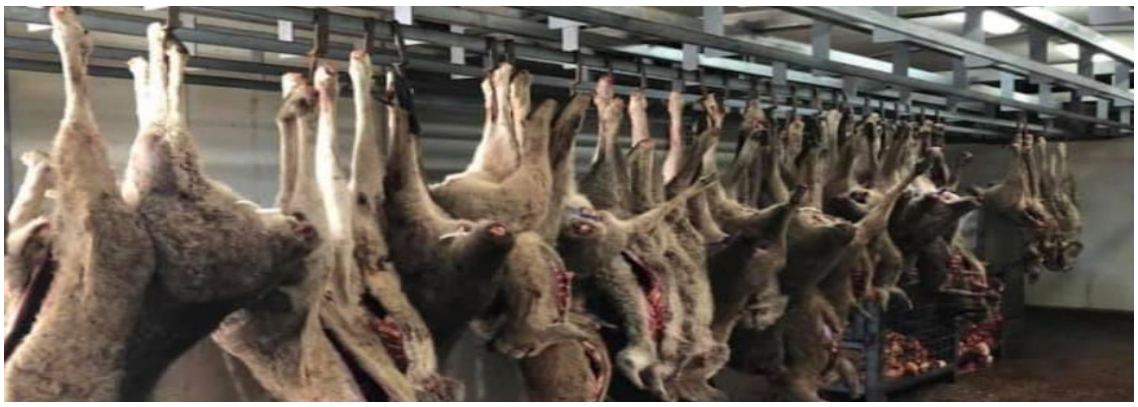
Skins

Skins which are often covered in dirt and blood following slaughter and field dressing are a potential source of contamination throughout the early stages of processing.

Skins are left in place from the time after evisceration in the field to the transfer of carcasses to field-chillers, onto chilled transport container/trucks and into holding chillers at game meat processing plants.

The process of field dressing of carcasses and then the retention of a bacterial-loaded skin on the carcass for days in a fully loaded chiller is a practice that presents a major challenge to the industry to modify *(Spiegel, Wynn 2014)*.

Food safety researchers have suggested that complete skin removal and then spraying the newly exposed carcass with a water-repellent coating could improve microbial safety significantly *(Spiegel, Wynn 2014)*. As far as we are aware, these recommendations have not been adopted within the industry.



Carcass and offal disposal

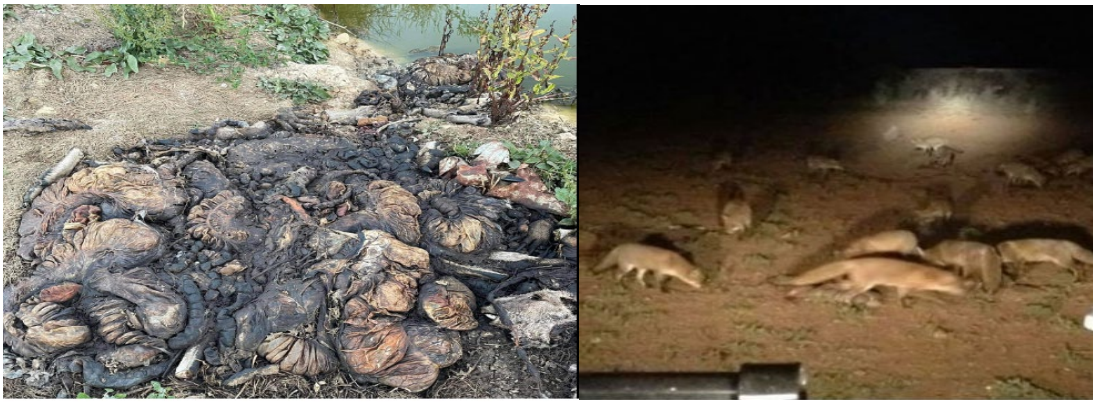
An important biosecurity and wildlife disease control measure is the proper removal of harvested animals (including viscera and other remains) to limit potential infection, spread, principally by mammals *(Vincente et al 2011)*.

Discarded kangaroo body parts are almost always left at the site of the field dressing process as waste. These remains include viscera as well as the removed heads, feet and paws.

This waste attracts foxes and cats as well as vermin. This practice creates a food source for foxes that maintains fox populations. Sustaining fox populations not only increases the threat of predation for vulnerable native species in the areas where kangaroo shooting takes place but creates significant risks of disease transmission to native species, primarily through the transmission of sarcoptic mange.

Native Australian mammals affected by mange include common wombat *(Hartley and English 2005; Skerratt 2005)*, southern hairy-nosed wombat*, koala (Obendorf 1983),* agile wallaby (*McLelland and Youl 2005)*, swamp wallaby *(Holz et al. 2011), southern brown bandicoot (Wicks et al. 2007),* dingo *(Thomson et al. 1992),* long-nosed potoroo, brushtail possum and common ringtail possum *(Wildlife Health Alert 2021)*.

Foxes are also a health risk to humans and pets through the risk of transmission of not just mange (scabies) but parvo and distemper.



TRANSPORTATION AND TIME DELAYS

As well as the food hygiene problems associated with the shooting of unhealthy individuals, and the field dressing process, further risks of bacterial infection arise due to the often-excessive periods of time between the time the animal is shot and processed and the time the carcass is placed in cold storage.

The Standard sets out the requirements for the transportation and cold storage of meat carcasses as follows:

- The carcass with heart, lungs, liver, spleen and kidneys are left intact (for the purpose of mandatory inspection at the processing facility)

- The carcass must be placed under refrigeration within two (2) hours of the animal being shot.
- Where the animal is shot after sunset and before sunrise, not more than two (2) hours after sunrise to prevent contamination *(CSIRO 2007)*.

These timeframes do not reflect the reality that kangaroos are shot and killed in remote locations and that kangaroos are hung (skin on) on an open-air truck at ambient temperatures for up to 8-10 hours and sometimes longer before being transported to remote chillers.

These long delays between slaughter and cold storing provide ample opportunity for bacterial contamination.

The transportation of the carcasses also presents risks as carcasses are exposed to dust, heat and flies during transport over long distances to remote field depots or chillers.

As with every other step in the process of slaughter, dressing and transport of kangaroo carcasses, there is minimal oversight of these activities to ensure that meat submitted after the time limit of two hours of daylight is rejected and condemned *(Obendorf 2001; Administrative Appeals Tribunal 2008b)*.

REMOTE CHILLERS

The kangaroo industry's cold chain practices depend on hundreds privately owned and operated remote chillers (also referred to as field depots). These chillers usually supply a single game meat processor.

Field chillers are usually 40' converted refrigerated shipping containers which have been converted into cold storage units by installing overhanging rails from which kangaroo carcasses to be hung.

Some chillers can hold up to 200 kangaroo carcasses *(VPP submission to the Victorian Inquiry into the Control of invasive species on Crown Land 2016)*.

Field chillers can be fixed or portable but more often are fixed. Because of the need for a constant power source most chillers are either located in areas that are connected to the electricity grid. They can also be powered by a diesel generator.

Once unloaded at the chiller, kangaroo carcasses are stored for up to 14 days before being picked up by the processor and transported to a processing plant for skinning and boning.

Temperature monitoring in chillers

The temperature of cold storage has important consequences for food safety.

There is a requirement in the Standard that once placed under refrigeration, the carcass must be reduced to a deep muscle temperature of no more than 7 degree Celsius within 12 hours and maintained at that level until presented for inspection at the processing facility.

Temp recording equipment (data loggers) are inserted in carcasses at the chiller to monitor temperatures during the period in which they remain in the chiller.

The operation of chillers

Chillers require constant power and need regular monitoring and maintenance to ensure break downs and malfunctions which could affect the internal temperatures remain constant.

Chiller operators that provide cold storage for wild game meat are required to comply with *AQIS Meat Notice Number: 2009/18-Additional Requirements for Wild Game Meat Processing for Export*.

This notice was introduced after the loss of the Russia market in 2009. It reinforces requirements for temperature control, temperature data logging and record keeping.

This Notice has since been supplemented by the publication of state food agency manuals setting out additional requirements for weekly hygiene inspections that include not just the premises but fixtures and fittings, equipment and utensils, the keeping of records regarding inspections and any maintenance works undertaken, the training of staff in personal and food hygiene standards and the control of pests and vermin such as flies, insects and rats (*for example, NSW Wild Game Meat Field Depot Operators Manual published October 2018*).

Despite these standards, there have been several studies and investigations that have exposed clear breaches of basic sanitation and food hygiene requirements within chillers since 2009.

The photographic evidence we have obtained suggests that despite the imposition of more stringent food safety requirements in the last decade, compliance remains an ongoing issue.

Hygiene standards at and within chillers

In theory, chillers and equipment at the field depot should facilitate hygienic production, not be a source of contamination of wild game material *(CSIRO 2007)*.

"A Shot in the Dark" (Ben-Ami 2009) provides the following account of the conditions in chillers by an AQIS meat inspector in South Australia in the 1990's.

That account indicates that during a South Australian Kangaroo Management Program public meeting Eddie Anndriessen, an AQIS meat inspector, stated that in a follow-up inspection of 15 chillers throughout South Australia which took place two years after the initial inspection, he found:

- "Not a single chiller box (Macro Meats and other processors SA, sic) that was up to standard, with most being unclean or uncleanable.
- a high incidence of fly-struck meat was being transported to Adelaide.
- airflow floors were not being cleaned thoroughly.
- there was congealed blood and muck inside the chiller.
- most of the dirty water was washed out from the front with the bones, instead of being plumbed to a drain.
- there was no connection to potable water,
- only one chiller box had chemicals for cleaning; and
- There were still kangaroo feet in the surrounds from two years ago" *(The South Australian Kangaroo Management Program 1998)*.

Evidence of microbial contamination at chillers in SA -2002 and 2004

Research carried out in South Australia in 2002 and 2004 which involved the testing of kangaroo carcasses and minced meat at meat processing plants found evidence of high levels of salmonella contamination in the abdominal cavities stored in chillers *(Holds et al 2008*).

This research identified the practice of collecting carcasses together and pushing grouped carcasses into the chiller likely leads to cross contamination of carcasses from the abdominal cavities of others *(Holds et al 2008)*.

Evidence of food safety breaches in chillers- NSW/Qld investigation 2008-9

Evidence collected by Animal Liberation NSW in 2008 from various remote chillers in NSW and Queensland also provided evidence of poor sanitation in and around remote chillers *(Sibraa 2009).*

The evidence collected during that investigation demonstrated that chillers were often left in an unhygienic state and that kangaroo shooters used a range of practices which violated both the *National Code of Practice for the Humane Shooting of Kangaroos and Wallabies for Commercial Purposes* and the *Australian Standard for the Hygienic Production of Game Meat for Human Consumption (CSIRO 2007)*.

The investigation uncovered evidence documented such practices as:

- Hanging carcasses touching the floor.
- Fresh blood on the floor.
- Old dried blood that had not been washed away on the floor
- Carcasses over-packed and touching one another.
- No sterile zone due to only one point of entry into the chillers.
- Tags on carcasses showing that they are 12 and 13 days old; and
- Implements used for bludgeoning joeys (young kangaroos) caked in blood.

Evidence of contamination of carcasses

The ALNSW investigation referred to above involved not just documenting the potential breaches of food safety standards at the chillers themselves, but the testing of samples taken from kangaroo carcasses found in those facilities.

Following AQIS guidelines (Australian Quarantine and Inspection Service 2008a) microbial testing of meat samples obtained from these chillers found generic E. coli levels greater than 500 colony forming units per cm2 (cfu/cm2) in five of the ten carcasses obtained from two separate chillers in the vicinity of Charleville (7 December 2008) and Mitchell (8 December 2008) in Queensland. An E. coli level of 500 cfu/cm2 is deemed unacceptable and enough to initiate an AQIS "E. coli ALERT" *(Ben-Ami 2009)*.

The sampled chillers were located over 300 km apart, indicating that samples were independent and that the problem was widespread and not just local issue.

Evidence of contamination-testing of supermarket samples in NSW and Qld 2009

In 2009 animal rights groups also purchased kangaroo meat for human consumption from Coles, Woolworths and IGA supermarkets in Sydney, Melbourne and Brisbane and had the samples tested by an independent laboratory.

Laboratory testing conducted by Biotech laboratories on 25 kangaroo meat samples taken from Australian supermarkets showed eight of the 26 kangaroo samples tested positive for the bacteria salmonella, and 11 samples showed high levels of E. coli bacteria-that is 75% contamination with Salmonella and/or E. coli. Samples of lamb from the same supermarkets were clean.

Compliance breaches in relation to chiller hygiene in NSW 2013-2014

Following the loss of the Russia market in 2009, the kangaroo industry undertook a review of its food safety practices and put in place a range of additional requirements for field dressing and chiller hygiene in 2010 and 2011.

This additional mandatory training appears to have had little impact on the prevalence of sub-standard food safety practices in the kangaroo industry.

The NSW Food Safety authority carried out 156 multiple inspections between 11/13 and 11/14 which found 16 separate compliance breaches all of which posed an unacceptable risk of contamination and infection to consumers.

These violations included:

- Storage of live animals next to dead ones.
- Animals processed over dirty, bloody and faeces ridden trays.
- Chillers with dirty walls, floors and ceilings.
- The hanging of carcasses on rusty hooks.
- Cattle grazing around chillers.
- Lack of cleaning and water facilities.

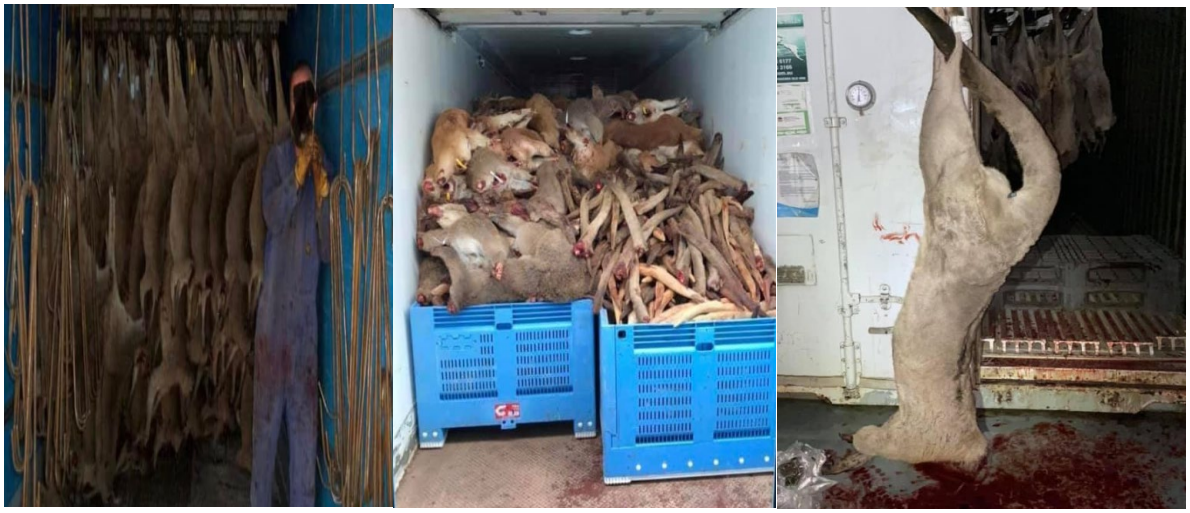
These are all the same issues that were identified in the ALNSW investigation some 5 years earlier in 2008.

In reporting on these findings in 2015, the NSW Food Safety Authority indicated that the kangaroo meat industry in NSW had been unable to meet or maintain the basic standards of food hygiene required when selling food to consumers.

Current food practices in the kangaroo industry-continuing non-compliance

Photographic evidence (such as the photographs below taken in 2022 and 2023) of current practices in and around chillers from various kangaroo shooters groups in NSW, Qld and SA shows continuing non-compliance with evidence of over-crowding, the use of rusty hooks, filthy conditions within the chillers and the presence of dogs and children in these facilities.

There is no evidence that conditions in these chillers have changed since food safety and contamination issues were identified in 2008 or that state wildlife or food safety authorities have taken any steps to enforce minimum food safety standards in the kangaroo industry.



Processers and processing

On arrival at the kangaroo meat processing plant the kangaroo carcass is subject to mandatory inspection, usually by a third-party meat inspector.

Before the animal is weighed, a meat inspector or quality assurance manager checks the information on the relevant tags (from both the company and the state government) is completed correctly and makes a visual check of the carcass to ensure it is to standard (including ensuring that the only gunshot wound is to the head) *(Young 2017)*.

If standard, the carcase is approved for processing (skinning, boning and packing).

Any carcasses that are not to standard are set aside and subject to a postmortem examination by an AQIS veterinary officer.

LEAD BULLETS AND RISKS OF LEAD CONTAMINATION

Research undertaken since 2018 *(Hampton et al 2018; Lohr et al 2020; Hampton et al 2002; Hampton et al 2023; Jones et al 2024)* has investigated the potential impacts the widespread use of lead-based (Pb-based) bullets including in the commercial kangaroo industry.

This research indicated that:

- The risks of lead contamination posed by Pb-based bullets (rifles) had not been fully recognised or investigated in Australia.
- Pb-based rifle bullets frequently fragment, contaminating the tissue of shot animals.
- The large scale commercial and non-commercial shooting of kangaroos involved the use of millions of lead bullets every year.
- Consuming this Pb-contaminated tissue risks harmful Pb exposure and, thus, the health of wildlife scavengers (carrion eaters) and humans and their companion animals who consume harvested meat (game eaters).

The research noted that there had been very little examination of this issue, noting it was a significant gap in knowledge that required urgent further research given the potential impacts of exposure.

There is evidence this is an issue in the kangaroo industry. Minutes of meeting of KMAP (NSW) dated 30/5/16 noted that industry representatives suggested that there was a major issue with processors rejecting carcasses that contained metal fragments in kangaroos that had been shot previously:

"Non-commercial culling was discussed, and issues were raised that people were doing the wrong thing and it was affecting the commercial industry. One of the biggest issues was buckshot in a carcass from an unsuccessful non-commercial shot".

DECONTAMINATION

Several current and potential food safety interventions are available to meat processors to decontaminate meat carcasses.

Food safety authorities emphasise that no intervention can be expected to render a highly contaminated product "clean" and that these interventions should not be seen as a substitute for hygiene management during the slaughter or dressing processes *(Nkosi 2021)*.

Most of the available treatments result in an overall reduction in the microbial load on or in the product and as such result in a decline in the subpopulation representing foodborne pathogens rather than specifically designed to address a single foodborne pathogen *(Midgely, Small 2006)*.

Solutions of organic acids such as lactic (LA) and acetic acids (AA) are the most frequently used chemical interventions in commercial plants for both beef and lamb dressing. The position is less clear in relation to the use of these interventions in game meat.

There is clear evidence that LA and AA can reduce microbial colonies in beef, poultry, porcine and other meat products; what remains in question in general is their application in game meat *(Nkosi et al 2021)*.

Kangaroo carcasses

Most treatments require physical contact with the carcass surface, and an even coverage of the surface. Meat carcasses are difficult to decontaminate by reason of their shape and structure *(Midgely, Small 2006)*.

Kangaroo carcasses are no different. They are an irregular shape, so there is the possibility that one part of the carcass will be over-exposed to the treatment, while another part may be unaffected by the treatment, rendering the treatment ineffective.

The use of lactic acid and acetic acid in the kangaroo industry

The extent to which lactic acid is used in the kangaroo industry is unclear, but it is an approved treatment for game meat in the EU. Australian authorities recently sought approval for its use in kangaroo meat exported to the EU.

On 20/1/20, the Department of Agriculture (Exports Division) made an application to the EU to use lactic acid during processing for the reduction of pathogens on wild game carcases (including kangaroo carcases).

The European Food Safety Authority (EFSA) panel which evaluated the application found that while lactic acid use was safe there were real questions about whether it was an

effective treatment in game meat processing, including in kangaroo carcasses (EFSA 2022).

Acetic acid has been routinely used as a decontamination agent in the kangaroo industry, but it is unclear to what extent. It is not used on kangaroo meat destined for the European market as it is not an approved decontaminant for game meat under EU Food Safety regulations.

There have been persistent allegations that acetic acid is routinely used to cleanse kangaroo meat of contamination and mask putrefaction.

The kangaroo industry has denied these allegations despite evidence that a major processor in South Australia provided its kangaroo shooters with instructions to spray acetic acid on kangaroo carcases as a way of combatting contamination concerns in 2012 *(Mjadwesch-Kangaroos at Risk)*.

This letter of instruction was the subject of questioning in the Senate in 2012 and 2015.

Senator Heffernan raised several questions regarding this letter of instruction and the use and safety of acetic acid in the kangaroo industry in the Rural and Regional Affairs and Transport Committee (Supplementary Budget Estimates in October 2012).

The Department of Agriculture, Fisheries and Forestry (DAFF) confirmed that although the use of acetic acid was an approved processing aid (as an acidifier), it could not provide specifics of which industries this treatment.

The use of acetic acid in the kangaroo industry was again raised by Senator Lee Rhiannon, in the Senate Estimates on 2 June 2015. In response, Food Standards AS/NZ advised that it was not aware of the extent to which this treatment was used in kangaroo meat, stating that the use of AA was regulated by the states.

We have been unable to locate any evidence regarding the extent to which either lactic acid or acetic acid is currently used as a decontaminant in the kangaroo industry.

This is of concern because if it is being used widely, this treatment should be disclosed on packaging to alert consumers to its use on kangaroo meat.

Gamma irradiation

The most recent Agrifutures RD &E strategic plan for the kangaroo industry indicates the kangaroo industry will be investigating the effects of gamma irradiation as a treatment for kangaroo meat … *"as required for market access and to promote the hygiene practices and food safety credentials of the kangaroo meat chain"*.

The treatment was reviewed by the Federal Agriculture Department in 2013. A subsequent Biosecurity Advice on 6/11/14 confirmed approval for its use as a decontaminant and set out the required doses for various meat products. The Advice did not include advice for the use of gamma radiation for kangaroo meat.

The kangaroo industry's ongoing investigation of the use of lactic acid and gamma irradiation is an indication that notwithstanding its claims about the high standards it maintains, food safety remains a major concern for the industry.

OVERSIGHT AND AUDITS

Food/meat safety (both for human consumption and pet food) in the kangaroo industry is monitored by the government food safety agencies that operate in each state.

The state food safety agencies carry out periodical audits to monitor the quality assurance systems at game meat and pet meat processing facilities and to confirm compliance with the Standard.

The annual reports for these state agencies only report overall figures for the audits and inspections they carry out. They do not provide specific reporting in relation to levels and types the inspection, monitoring, auditing, surveillance, breaches, investigations or enforcement activities that take place specifically in the kangaroo industry, its field operations or processing.

Without issuing FOI applications to each of these agencies, it is not possible to obtain a detailed picture of compliance within the kangaroo industry.

EXPORT CONTROLS

AQIS (Australian Quarantine and Inspection Service) was the Australian government agency responsible for enforcing Australian quarantine laws, as part of the Department of Agriculture until 2012.

The Department of Agriculture, Fisheries and Forestry (DAFF) currently regulate the export activities of the kangaroo meat industry by:

- Registering processing facilities for export.
- Overseeing production to ensure food safety; and
- Providing export certification for kangaroo meat products.

In a response to the ban by the Russian Federation on kangaroo meat imports AQIS issued updated guidelines for microbiological testing of game carcasses.

These guidelines required that one in every 600 carcasses be tested for E. coli. A sampling rate of one in 600 carcasses, as specified by AQIS (Australian Quarantine and Inspection Service 2008b), can easily overlook many carcasses not fit for human consumption and import *(Ben-Ami 2009)*.

Research conducted in 2014 questioned whether this frequency of testing was sufficient to ensure that contaminated carcasses are picked up and rejected for human and pet food consumption.

That research also suggested that more rigorous methodologies may need to be considered for the kangaroo industry, as a single incident of food poisoning through the ingestion of meat contaminated with salmonella had the potential to decimate the kangaroo meat export market overnight *(Speigel, Wynn 2014)*.

ZOONOTIC DISEASE EMERGENCE AND RISKS

Wildlife species constitute a vast and uncharted reservoir of zoonotic pathogens. Studies have shown that between 60-75% of all new human viruses originate in animals and of those 72% originate in wildlife *(Taylor et al 2001, Jones et al 2008)*.

A 2017 study in the journal Nature identified Eastern Australia is a global hotspot for emerging infectious diseases *(Murray et al 2017)*.

The emergence of zoonotic diseases (those transmitted from animals to humans) has increased dramatically over the last few decades *(Wilcox and Gubler 2005) (Cunningham et al 2017, IFAW report 2020)*.

These emerging infectious diseases (EIDs) represent an increasing and highly significant risk to global health *(Jones et al 2008)*.

Over the past two decades, emerging zoonotic diseases have included HIV, SARS, Ebola and Covid 19. In Australia, Hendra Virus, West Nile Virus, Australian Bat Lyssavirus, Q Fever and Buruli Ulcer have all emerged as potential public health threats.

Zoonotic Disease and the Wildlife Trade

The wildlife trade, agricultural expansion and intensification as well as deforestation and urbanization are bringing people into closer contact with novel pathogens from wildlife *(Keesing 2010, di Marco et al 2020; Tazerji et al 2022)*.

At the same time, biodiversity loss is impairing the health and resilience of ecosystems and reducing the protective effects of biodiversity against emerging infectious diseases *(Keesing 2010; Keesing et al 2021)*.

The trade in wildlife is among the most significant risk factors for the emergence of EIDs *(Swift et al 2007; Hilderink and de Winter 2021)*.

Australia is a major participant in the international trade in wildlife through its endorsement and support of the commercial kangaroo meat and skins industry and export trade involving tonnes of kangaroo products to numerous countries across the world.

Whatever the kangaroo industry and the federal and state government agencies that support and promote the industry claim about the food safety standards within the industry and the precautions taken to prevent contamination and the spread of disease (which we argue are inadequate and in any case are routinely breached) this industry and the scale of the trade in kangaroo meat and skins creates ideal conditions for pathogenic emergence and zoonotic transmission.

Scale of the trade in kangaroo meat and skins-Transmission risks

An average of 1.6-2 million adult kangaroos is slaughtered every year in the commercial industry. A further estimated 400,000 joeys are killed as industry waste.

Every one of the millions of interactions between human beings and kangaroos and kangaroo carcasses in the commercial kangaroo industry supply chain increases the risk of a zoonotic spill-over event from an unknown pathogen.

Mass mortality events in kangaroo populations

Mass mortality events (MMEs) in kangaroo populations are reasonably common and occur within areas in which the commercial kangaroo industry operate.

Ben-Ami (2009) provides a detailed examination of the historical mass mortality events that had taken over the decades up to 2009.

Wildlife Health Australia has examined multiple further unexplained mass mortality events in kangaroo populations that took place up to 2015 *(WHA Factsheet 2016)*.

None of these mass mortality events have ever been fully investigated or causes detected.

Unidentified pathogens-mass mortality in kangaroo populations in NSW 2016-2017

MMEs continue to occur on a regular basis. According to the minutes of the meeting of the Kangaroo Management Advisory Panel on 28/3/18, Greg Curran, a former Department of Primary Industries vet in Broken Hill had reported that over 100,000 kangaroos died from an unknown disease in the Western region of NSW between 2016 and 2017 but that no samples were taken and there was no investigation or confirmation of the cause of the deaths.

Earlier reports about this large-scale mass mortality event were covered in the media in 2016 and 2017.

Dr Curran told the ABC on 1/12/16 that neither the kangaroo industry nor the government agencies responsible had been prepared to investigate the cause of the deaths. A DPI spokesperson quoted in the same article confirmed that the DPI had suspended the investigation into the deaths on the basis that the event has ceased. This is inconsistent with evidence that the mass deaths continued throughout 2017.

Dr Curran told the Australian in an interview a year later on 27/12/17 that the kangaroo deaths were continuing and that the affected kangaroos "had been found with massive haemorrhaging, total or partial blindness, internal bleeding around the joints and stilted movement and inflammation". He re-iterated that this was an unknown disease-not a genetic problem-and that authorities had not been able to find a bacteria, virus, parasite or poison or any other known cause for the deaths.

Disease surveillance and monitoring in kangaroos

The key requisite for any disease control in wildlife is that of establishing a proper disease and population surveillance and monitoring scheme *(Gortazar et al 2015)*.

What is clear from the episode in 2016-2017 is that not only is there no surveillance in place for kangaroo populations to detect the emergence of disease but that even concerns raised by a senior government vet that the deaths were due to a novel pathogen, investigations of the disease were suppressed by the responsible government agencies.

The failure to take any action in relation to these mass deaths is hard to explain unless those government agencies had determined that such an investigation could damage the commercial kangaroo industry.

The fact that the pathogens that have caused these mass death events in kangaroo populations remain unidentified should be of significant concern to consumers of kangaroo products who are exposed to the increased risk of contracting not only the known pathogens but an emerging zoonotic disease because of the unhygienic practices involved in butchering, transporting and processing kangaroo carcasses and meat described in this Chapter.

ENDING THE TRADE IN WILDLIFE FOR MEAT AND SKINS

The World Health Authority called for an end to the sale and trade in wildlife for food in April 2020 because of the high risk it poses for the spread of pathogens and their potential impact on public health.

According to Kate Jones, Chair of ecology and biodiversity at University College, London, to prevent the emergence of further pandemics:

"There needs to be a cultural shift from a community level up about how we treat animals, our understanding of the dangers and biosecurity risks that we're exposing ourselves to. That means leaving ecosystems intact, not destroying them. It means thinking in a more long-term way."

While the commercial kangaroo meat and skins industry and its government supporters routinely understate these issues, the significant public health risks posed by the kangaroo industry are real and need to be taken seriously.

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