Ectoparasite in sheep and beef cattle – a recent review

Summary report

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Project summary

Objectives

This review of the current scientific literature was undertaken to summarise what we know now about: (1) the biology and distribution of ectoparasites that effect sheep and cattle in New Zealand, (2) the tools currently available for management and control of these parasites, and (3) the potential of emerging challenges (e.g., new ectoparasite species, climate change and chemical resistance) that may require changes to current management practices.

The ectoparasites included in this review are sheep ked, scrotal mange mite, cattle tick, sheep lice, and blowflies.

Rationale

Ectoparasites are still an on-going challenge for our sheep and cattle farmers because they can negatively affect animal health and welfare and incur financial cost to farmers due to losses in animal productivity and performance, and the cost of chemicals and labour used to prevent and/or treat infestations. However, emerging management tools and technologies may provide farmers with opportunities to stay in control despite challenges such as climate change and chemical resistance.

Methodology

This report is a summarised version of a scientific literature review prepared by the authors. Collated information was sourced primarily from New Zealand-based research, but also other countries (e.g. Australia) where the information is relevant to the New Zealand livestock sector.

This summary is organised into two parts:

- Part 1. Is an easy-to-read tabular format covering the biology, distribution and currently available management tool(s) for each ectoparasite type. This part begins on the next page.
- Part 2. Focuses on the challenges and opportunities for livestock producers going forward.

Part 1 - Biology, distribution and currently available management tool(s) by ectoparasite type

Sheep ked –

What is it and where can it be found?	Sheep ked is a wingless fly that is sometimes mistakenly called sheep tick. The time from egg to adult (35-40 days) is spent on the sheep; adults live for approximately 80-100 days. It is more frequently seen in winter and early spring; less in summer. It is now rare in most parts of New Zealand due to the use of modern insecticides and increased frequency of shearing.
What are the key animal health, welfare and productivity issues?	The ked pierces the hosts' skin and then feeds on their blood. It can cause irritation resulting in increased scratching, wool loss and damage and skin damage.
What are the best current management tool(s)?	Keds can be managed similarly to lice (see below) through shearing followed by insecticide treatment. Shearing before lambing can also prevent the risk of lambs becoming infested. Insecticides for ked control include low volume pour-ons (back-line treatments), sprays or dips which include as active ingredients synthetic pyrethroids, organophosphates, spinosad or macrocyclic lactones (i.e., avermectins and milbemycins; also useful for lice and internal worms). Regardless of the time of year, it is preferable to apply insecticide treatments after shearing, this way ked numbers have already been reduced by physical removal with the fleece and the chemicals are more easily able to penetrate to skin level. To achieve effective control, the activity of the products used needs to be persistent as the pupation period (i.e., development of a feeding larva into an adult) can be up to 5 weeks.
Where to find more information	Oswald, A., 2019. Ectoparasites of sheep in New Zealand and their control, 2nd ed. New Zealand Veterinary Association, Wellington.

Scrotal mange mite –

What is it and where can it be found?	Scrotal mange mite is found predominantly around the lower limbs, scrotum and udder of sheep and cattle. It occurs throughout New Zealand with populations fluctuating with the season -- increasing over autumn/winter, declining in spring with lowest numbers seen in summer.
What are the key animal health, welfare and productivity issues?	Mites feed on skin debris and secretions, and infested animals often react to this irritation by producing clear, thin, watery fluid (serous exudate) which dries into scabs (although the skin is not damaged). When scabs form on the scrotum of rams, semen quality may be impaired.
What are the best current	Mite-affected areas can be treated by applying formulations that include organophosphates or macrocyclic lactones.

management tool(s)?	Injectable or pour-on formulations that include macrocyclic lactones and have a label claim for chorioptic mange are only available for cattle but not for sheep. When mite scabs are healed and dry, mites are often found underneath these scabs. In this situation, to allow for better chemical penetration and more effective treatment of the mites, it may be necessary to remove the scabs first. Application of glycerine or warm soapy water can be used to soften the scabs to help with removal.
Where to find more information	Oswald, A., 2019. Ectoparasites of sheep in New Zealand and their control, 2nd ed. New Zealand Veterinary Association, Wellington.

Cattle tick –

What is it and where can it be found?	This is the only one of New Zealand's endemic tick species that affects livestock. Although referred to as "cattle tick", it can infest other livestock (e.g. deer, sheep, goats) and birds. It is commonly found on the head, ears, udder and lower body extremities of livestock. Eggs are deposited by the adult female tick on pasture, producing about 2,000 eggs over a 2-3 week period. After about 60-90 days (depending on temperature and humidity) six-legged larvae hatch and find host animals to feed upon. Once fully engorged, a larva detaches from its host, moults twice to become an adult and (if female) to lay its eggs (repeating the cycle). Ticks spend approximately 80% of its life cycle off the host and not feeding. Cattle tick is distributed over a large part of the North Island and the northern part of the South Island, including scattered populations in Canterbury and West Coast regions. It requires warm temperatures and high humidity for development (optimal conditions differing at different development stage) and survival.
What are the key animal health, welfare and productivity issues?	Cattle ticks harm their host through skin damage when feeding – both mechanical damage with their mouthparts and the injection of saliva containing pharmacologically active ingredients -- and blood loss. Tick infestation of animals can impair productivity and welfare as a result of reduced weight gain, anaemia, failure to thrive, irritation and even death. Ticks infected with their own parasites (i.e., microscopic, single-celled protozoa) can transmit these into their host animal when feeding. Protozoa-infected animals experience anaemia, resulting in weakness, lethargy, reduced milk production and liveweight gain, and even death. Protozoa-infected host animals can in turn infect the feeding tick maintaining an infection circle.
What are the best current management tool(s)?	Cattle ticks are prolific, but control is possible. Chemicals and pasture management are the main methods for management. It is recommended to apply chemical treatments when the ticks are at their larval stage because the ticks are more susceptible and this can suppress future generations. However, total eradication of ticks is impossible due to the wide range of hosts that help disperse and maintain tick populations. *Chemical management options:* • For sheep, saturation dipping with an acaricides insecticide is recommended. Alternatively, formulations containing propetamphos (an organophosphate) can be used for treating ticks on sheep in New Zealand, but it has a withholding period for milk and meat. • For cattle, acaricides-containing insecticides are generally available as pour-on formulations. Pour-on application has poor retention and may protect livestock for 2-3 weeks only. Repeated treatment is thus needed during periods of greatest tick activity.

	• Another option that can be used for cattle and deer are formulations with Flumethrin (a systemic pyrethroid). Again, this insecticide is applied as a pour-on, but it does not have a withholding period for meat or milk. *Pasture and grazing management options:* • There is a higher risk of tick infestation in long pasture, so maintain pasture grasses as short as possible while still maintaining optimum feed availability and satisfying the nutritional requirements of the animal. • 'Vacuum grazing' involves grazing aged sheep or cattle for 2-3 days, dipping them, then repeating this process with the same animals or fresh stock until tick numbers are depleted (e.g. 10 days or 3 changes of livestock). • Anecdotally, rotational grazing also appears effective at interrupting tick development and hence ticks are less problematic on dairy farms. Ticks can survive up to 12 months without feeding, so spelling pastures is not a feasible option as a control method. However, current climate conditions in New Zealand generally only allows for one generation of ticks per year, so while they are able to live on pastures for a long time, there is an opportunity for the lifecycle to be interrupted.
Where to find more information	Oswald, A., 2019. Ectoparasites of sheep in New Zealand and their control, 2nd ed. New Zealand Veterinary Association, Wellington.

Lice (including chewing or biting lice and sucking lice) –

What is it and where can it be found?	Lice are commonly found throughout New Zealand; but whether there is greater or lower prevalence in different regions is unknown. Different species of lice are host-specific in that lice complete their entire life cycle on either sheep or cattle, but never both. ***Chewing and biting lice*** feed mainly on epidermal scales, scurf, and dermal secretions. *In sheep:* • These lice are yellow-brown wingless insects, approximately 1.5-2mm long. They are found mainly on the back, flanks towards the belly and the neck of the host animal; but when the fleece is sufficiently long, it can be found anywhere on the skin surface. • The complete life cycle of the louse (egg to egg) takes about 34-36 days. Adult females lay about 30 eggs in her lifetime (2 eggs every 3 days), attaching them to the wool fibres close to the skin to achieve the optimal temperature (35-40°C) and dry conditions to successfully hatch. Temperatures below 32°C or above 45°C or high humidity levels will kill the eggs. The eggs need to incubate for about 10 days. • Many factors can influence the prevalence of these lice, including breed, lambing, timing of shearing and dipping. Louse populations on unshorn sheep generally build up in autumn, peak late winter, and decline in summer. However, this pattern is influenced by wool length (shearing can reduce louse numbers up to 70%) and reduced solar radiation in cooler months. Louse populations decline in summer, but some sheep can remain infested with highest louse numbers. *In cattle:* • Infestations have been recorded on both dairy and beef cattle breeds but are more commonly observed on beef cattle. Infestations are more abundant on animals less than one year of age and older and in animals that are compromised by disease or poor nutrition.

	• An adult female louse is about 1.7mm in length and usually found on the top line of the back of the host animal, especially the withers and poll area. Lice populations are greater in late winter and spring. In summer, however, surviving lice can be found on the head and tail. • The complete lifecycle is 27-32 days. Adult females lay an average of 1 egg per day, which hatch within 7-10 days.
	Sucking lice feed on fluids and blood. In sheep, they are generally found on the face and legs of the animal, while in cattle, the lice are usually found on the top line of the back of the animal. Sucking lice are more commonly observed on dairy cattle breeds compared to beef breeds. Infestations are more abundant on animals less than one year of age and older and in animals that are compromised by disease or poor nutrition. The complete lifecycle is 21-31 days. Adult females are about 2.4 mm in length and lay an average of 1 egg per day. Eggs hatch within 10-12 days. Populations are greater in mid-winter and during this time they are mainly found on the anterior half of the body, particularly the neck. In summer, surviving lice can be found on the shaded areas of skin (e.g. under the jaw).
What are the key animal health, welfare and productivity issues?	Although ***chewing and biting lice*** in ***sheep*** do not appear to affect body weight, lambing percentages or lamb weight at weaning, they can negatively affect animal welfare and processing. Louse infestation increases itching behaviours (e.g., rubbing, biting and scratching with the feet) and pronounced biting can be observed. Although *lice* do not directly damage the skin of their hosts, itching on hard objects (e.g. fence posts) could potentially lead to skin damage. Infested animals will also have poorer quality wool. Cockle (a pelt defect appearing as multiple lumps in the leather after processing) is a result of a host animal immune response and is another potential result of lice infestation. Heavy louse burdens in sheep can coincide with other conditions, such as poor nutrition (e.g., nutritional stress through summer, or poor weight gain at after weaning) and/or health (e.g., scouring lambs, ewes with ovine progressive pneumonia). Little is known about the productivity and welfare impacts of ***cattle*** from ***chewing and biting lice*** or ***sucking lice***. Research has shown that despite skin irritation potentially disrupting normal feeding and resting behaviours, weight gain was similar between infected and non-infected cattle. Further, there have been no reports that increased rubbing due to irritation affects hide quality.
What are the best current management tool(s)?	The main control methods for ***lice in sheep*** are shearing (which physically removes up to 70% of lice) and the use of insecticides. Treatment of ***cattle*** is limited to the use of insecticides. Insecticides include pour-ons, sprays or dips. The active ingredients registered for lice control in New Zealand are in three groups: (a) synthetic pyrethroids, (b) organophosphates and (c) macrocyclic lactones (e.g. Invermectin). There is now a new insecticide that belongs to the isoxazolines family that is registered for the control of lice in sheep in New Zealand. This lice treatment is administered orally and has the benefit that it is not affected by wool length or weather. *General principles for chemical control of lice:* • Confirm there is a lice problem – check the mid-line of the back and shoulders and under the neck for presence of lice. There is a higher chance of detecting lice on lighter animals. • Best time to treat lice – is when lice numbers are at their lowest; this will be in summer (cattle and sheep) and/or immediately after shearing (sheep). Also, it is harder for the chemicals to penetrate to skin level when sheep are unshorn or when cattle have a thick winter coat or animals are covered in mud. • Target the most susceptible lifecycle stage – check the chemical label and treat as recommended; different chemicals will work best at different stage(s) of the parasite’s life cycle

	• Do not mix treated and untreated animals – lice can migrate from one animal to another.
Where to find more information	B+LNZ's *Managing lice* factsheet https://beeflambnz.com/knowledge-hub/PDF/managing-lice.pdf and *Managing flystrike and lice: A practical guide for farmers* https://beeflambnz.com/knowledge-hub/PDF/managing-flystrike-and-lice.pdf Oswald, A., 2019. Ectoparasites of sheep in New Zealand and their control, 2nd ed. New Zealand Veterinary Association, Wellington.

Blow flies –

What is it and where can it be found?	Blowflies are associated with flystrike in sheep, a major animal health and welfare concern resulting in substantial economic losses to livestock industries worldwide. The life cycle of the primary flystrike species takes 11 to 55 days (depending on ambient temperatures) from eggs to adult flies. Blowflies are typically more active during peak summer temperatures and cease activity in the colder winter months. They generally overwinter in the topsoil in a prepupal form. Primary flystrike species which start flystrike through damaging the host's skin include: • Australian sheep blowfly (predominant species) - is found throughout New Zealand except for the southern part of the South Island. Its average activity season is September to June (North Island) and October until May (South Island). • European green blowfly – is found throughout the North Island and in the South Island north of Central Otago. Its average activity season is from about November until April (North Island) with the season being shorter in the South Island. • Golden blowfly – is also found throughout the North Island and in the South Island north of Central Otago. It is more active between October and March (North Island) and December to February (South Island) After flystrike is stared, other flies (e.g., hairy maggot fly and other native/introduce fly species) are attracted to lay their eggs and contribute to the seriousness of the condition.
What are the key animal health, welfare and productivity issues?	Several factors can predispose sheep to flystrike, such as odour, presence of a wound / lesion, faecal soiling (e.g. dags), wetting of wool and bacterial contamination. Flystrike is most commonly found at the rear end of the body of the sheep as this area has enhanced faecal soiling. Less commonly, sheep can be struck on other parts of the body and also on feet affected by footrot. These health conditions cause strong smells and visual cues that attract blowflies. Finding a likely host, adult females lay their eggs on the fleece. In time, maggots hatch and begin mechanical and proteolytic damage and toxification. At this point other flies are attracted to the site. Fly struck sheep will initially show irritation behaviours (e.g., restlessness), which can lead to anorexia, body weight loss, wool loss, pelt damage, reduced number of lambs born and reared, and if not treated, can result in death.
What are the best current management tool(s)?	The economic impacts of flystrike is from production losses, as well as the cost of chemicals and labour used to prevent and/or treat infestations. The best way to control or minimise the impacts of flystrike is using an Integrated Pest Management (IPM) system. IPM is a straight-forward, holistic approach that is designed to manage insects so that the risk of flystrike and insecticide contamination of greasy wool is reduced. IPM involves stacking a range of biological, physical and chemical technologies together to exert the greatest pressure on the pest across all aspects of the blowfly life cycle. It includes:

	Good husbandry practices – • Make sheep less attractive to flies by crutching or by selecting animals with bare breeches to minimise faecal soiling for the wool and dag accumulation. • Undertake effective on-farm management of endoparasites which reduces incidences of scouring. • Shear regularly as short fleeces retain less moisture and become less attractive for blowfly eggs. • Tail docking can reduce faecal soiling as long as tails are not cut too short and docking wounds are treated appropriately to avoid attracting flies. Alternatively, leaving an intact tail can deter flies in the perianal region. • Graze animals on pasture species that contain condensed tannins (e.g., birdsfoot trefoil and sulla) which reduce faecal soiling or moisture content of faeces. • Avoid intensive grazing at high-risk periods and move sheep to paddocks that have higher elevations, are cooler and have higher wind speeds to reduce concentration of sheep odours attractive to blowflies. *Chemical use* - It is unlikely to be practical to abandon the use of chemicals to control flystrike, but their use can be optimised by using the least possible amount of the most appropriate chemical to give the greatest effect at the lowest cost, resulting in the minimum residue in the wool at the next shearing. Applying chemicals along the back and around the breech can reduce the volume of chemical that needs to be applied by at least 75%. *Biological pest management technologies* – Pheromone traps intended to disrupt the behaviour of flies and deplete breeding populations show mixed success.
Where to find more information	B+LNZ's *Managing flystrike and lice: A practical guide for farmers* https://beeflambnz.com/knowledge-hub/PDF/managing-flystrike-and-lice.pdf Oswald, A., 2019. Ectoparasites of sheep in New Zealand and their control, 2nd ed. New Zealand Veterinary Association, Wellington.

Part 2 - Challenges and opportunities

Climate change

Impacts on ectoparasite population/distribution

Changes in climate, particularly increasing temperatures and humidity levels, is expected to impact the prevalence and distribution of current ectoparasites. What type of impact and to what extent depends on the preferred conditions of the ectoparasite and prevailing climate conditions.

Some ectoparasites like cattle ticks (which prefer warm, humid conditions) could become more widely problematic in regions that become hotter and wetter (e.g., west coastal regions), but less problematic in regions that become drier (e.g., east coastal regions). Whereas lice populations (which require a narrow range of temperature/humidity) could decline.

Impacts on ectoparasite behaviours

The seasonal activity pattern of blowflies mean that adult flies are active from early spring through to late autumn, with activity ceasing in the colder winter months. Climate change may extend this activity period (and thus flystrike risk) well into warmer winter months.

Establishment of new ectoparasites

Changing conditions may permit new ectoparasites to gain a foothold and flourish in New Zealand. Ectoparasites can arrive via the wind or stowing away on planes or ships. New species of ticks and flies are the most likely to become established in New Zealand in the future.

Impacts to animal resilience

Climate change will also impact feed quality and quantity, thus impacting animal health nutrition. The risk of ectoparasite infestations increases when animals are undernourished. Attention to pasture management and animal health is important.

Chemical inputs

Rise in pesticide resistance

Resistance to chemical pesticides for established ectoparasites is a serious risk. Reduced efficacy of pyrethroid formulations against lice and organophosphates and benzoylphenyl urea compounds against flies is already well known. Resistance to other pest management products currently on the market here has been reported in other countries. More testing is needed to know if New Zealand has similar issues.

Pesticide misuse

Incorrect use of chemicals, due to misinterpretation of product labels and claims, can lead to ineffective parasite management, resulting in an increased risk of chemical resistance developing.

Product labels can be confusing, and terminology and definitions have changed over time. Moreover, the label claims on generic products maybe outdated and not reflect current application methods. There are currently no approved guidelines for testing the efficacy of sheep ectoparasiticides in New Zealand. Producers should seek advice from their veterinarians.

Pesticides and people/environment

Due to the potential adverse effects of insecticides on soil and water quality, biodiversity and worker health and safety, the potential risk of national and global restrictions of insecticides is increasing. Currently, non-tariff trade barriers exist on maximum residue levels, and this will become a bigger problem as tests for residues become more sensitive.

Adoption of good management practices

Changing management practises

Some management practices could impact the prevalence of ectoparasites, raise the risk of infestations and impact animal health, welfare and performance.

Examples of risky practices include:

- less frequent shearing (due to costs and poor return from the wool) which increase the prevalence of lice and flystrike,
- higher stocking densities and introduction of large housing facilities which permits easier transmission between infested and non-infested animals, especially in non-replacement calves who are more susceptible to lice and ticks, and
- improper insecticide choice and timing/method of application that heightens the likelihood of pesticide resistance developing.

Integrated Pest Management (IPM) system

A New Zealand extension programme emphasising regionally appropriate integrated pest management systems (IPM) with the ultimate aim of ectoparasite control would benefit livestock producers. Such a programme would focus on feeding management (i.e., good nutrition) to build animal health and resilience, while reducing chemical inputs and labour costs.

A example of a successful on-going IPM programme is B+LNZ’s Wormise (https://beeflambnz.com/wormwise), which provide farmers, veterinarians and rural retailers with information and services to manage internal parasites in sheep and cattle while minimising drench resistance and improving livestock welfare and productivity.

New tools on the horizon

Genotype

Early research suggests that sheep selectively bred with breech and belly bareness and short tails can effectively reduce the risk of flystrike.

Genetic variation found within Merino sheep flocks suggests there is a relationship between resistance to gastrointestinal parasites and susceptibility to lice. Indian cattle breeds are known to be more tolerant to ticks compared to New Zealand cattle breeds. Breeding programmes of the future focused on achieving animals with higher tolerance/resistance to ectoparasites might be able to exploit these differences.

Vaccines

Although many possible vaccine candidates have been identified over the decades of research, no vaccine for ectoparasites is currently available. To date, vaccine development programmes have tried unsuccessfully to use vaccines to enhance the host animal’s immune system against fly infestation and control fleece rot (which would indirectly control against flystrike). However, research is on-going.

Biopesticides

As an alternative control tool, biopesticides reduce chemical pesticide use. Most relevant research has focused on bacteria strains and fungus that produce toxins affective against different insect groups, but much more work is needed. Currently, there are no commercially available biopesticides for ectoparasites.

Sterile insect technique (SIT)

SIT involves mass rearing and releasing of the sterile males to compete against fertile males to mate with females. Where the sterile males are successful, the ectoparasite population would decline. A project is currently underway in Australia to evaluate whether this technology is effective and cost efficient.

Conclusion/clear takeaway messages

Ectoparasites can negatively affect animal health and welfare and incur financial cost to farmers due to losses in animal productivity and performance, and the cost of chemicals and labour used to prevent and/or treat infestations. Therefore, good management and control of these parasites is needed to ensure good animal performance and welfare.

There is a good understanding of the biology and distribution of a range of ectoparasites that effect sheep and cattle in New Zealand. There is also a range of tools currently available to support farmers in the management and control of these parasites. However, emerging challenges such as the arrival of new ectoparasite species, climate change and chemical resistance may mean we will need to rethink how we currently manage ectoparasites.

Effective ectoparasite control will require preparedness for climate driven changes in ectoparasite dynamics, improved ectoparasite surveillance, more strategic chemical use and wider adoption of integrated pest management systems and genetic tools.