

PROJECT FINAL REPORT



Project No.: ON-00829
Contract No.: PO4500016401
AWI Project Manager: Bridget Peachey
Contractor Name: Dr Alison Colvin
Prepared By: Dr Alison Colvin
Publication Date: October 2022

Trends in mulesing, tail docking and castration practices of Australian woolgrowers: Results of the 2021 AWI Merino Husbandry Practices Survey

Published by Australian Wool Innovation Limited, Level 3, 24 York Street, SYDNEY, NSW, 2000

This publication should only be used as a general aid and is not a substitute for specific advice. To the extent permitted by law we exclude all liability for loss or damage arising from the use of the information in this publication.

AWI invests in research, development, innovation and marketing activities along the global supply chain for Australian wool. AWI is grateful for its funding which is primarily provided by Australian woolgrowers through a wool levy and by the Australian Government which provides a matching contribution for eligible R&D activities © 2022 Australian Wool Innovation Limited. All rights reserved.

Table of Contents

Executive Summary.....	3
1. Introduction	7
2. Project Objectives	8
3. Success in Achieving Objectives.....	8
4. Methodology.....	8
5. Discussion of Results of the AWI 2021 Merino Husbandry Practices Survey	9
5.1 Demographics of survey respondents	9
5.2 Trends in mulesing practices of Australian woolgrowers	11
5.2.1 Proportion practicing mulesing.....	11
Comparing woolgrower surveys	13
National Wool Declaration versus farmer surveys	15
5.2.2 Pain management at mulesing	16
5.2.3 Ceasing mulesing.....	18
Woolgrowers who use mulesing.....	18
Woolgrowers who have ceased mulesing	19
5.3 Trends in tail docking practices of Australian woolgrowers	21
5.3.1 Methods of tail docking	21
5.3.2 Docked tail length	23
5.3.3 Pain management at tail docking.....	27
5.4 Trends in castration practices of Australian woolgrowers	31
5.4.1 Methods of castration.....	31
5.4.2 Pain management at castration.....	32
6. Impact on Wool Industry – Now & in 5 years time.....	36
7. Conclusions and Recommendations	36
7.1 Conclusions	36
7.2 Recommendations	38
8. References	39
9. Abbreviations	41

Executive Summary

Background

Australian Wool Innovation Limited (AWI) commissioned this project to undertake a deep dive into the mulesing, tail docking and castration practices of Australian woolgrowers as reported by the AWI 2021 Merino Husbandry Practices Survey (2021AWI-MHPS). This desktop review of the 2021AWI-MHPS will present an interpretation of the survey results, discuss associations between demographics and their husbandry practices, and compare the results with other relevant woolgrower surveys and the National Wool Declaration (NWD) data. Recommendations will be provided on whether more detailed analyses are required of data sets to better understand woolgrower practices.

Methods

Desktop review of the AWI 2021 Merino Husbandry Practices Survey as conducted by Kynetec and presentation of survey results including by demographic groups where appropriate. Compare the AWI 2021 Merino Husbandry Practices Survey with other relevant industry surveys.

Summary of findings

Comparing farmer surveys

The survey methodology for the AWI 2021 Merino Husbandry Practices Survey was sound. A large difference between respondents with small flocks and larger flocks for percentage mulesing caused a reduction in the overall weighted percentage of respondents mulesing lambs compared with the unweighted percentage. The most recent prior survey in 2020 (AWI 2020 Wool Industry Profile), also found a reduction in the percentage using mulesing in lambs compared with earlier surveys. It is possible that these two numbers indicate the start of a downward trend in the use of mulesing by Australian woolgrowers. However, further data is needed to determine if this trend reflects a true trend in the Australian wool industry as a whole. Future farmer surveys and the National Wool Declaration could provide a clearer picture.

National Wool Declaration v farmer surveys

The National Wool Declaration (NWD) reports the percentage of bales of wool sold through the Australian Wool Exchange (AWEX), whilst recent farmer surveys report on woolgrower practices. As a result, the percentage of mulesed bales of wool reported through the NWD and mulesing percentages from farmer surveys cannot be directly compared. Furthermore, larger woolgrowers are significantly more likely to mule their lambs and this will have a disproportionate effect on the number of mulesed wool bales sold through AWEX. However, further analysis of the NWD data using identifying information such as client ID or Australian Business Number may enable the calculation of percentage of woolgrowers who mule, based on their responses under the NWD, which could then be compared with the farmer survey results. This could provide the Australian wool industry with estimates of the percentage of farmers who use mulesing on a yearly basis and would provide an estimate for a large portion (85-95%) of the Australian woolgrower population.

AWI 2021 Merino Husbandry Practices Survey

Demographics

1. There were very few female respondents to the survey (16%).
2. Around 70% of respondents were aged over 55 years which is consistent with the national average age of sheep farmers (59).
3. A quarter of respondents were tertiary graduates. Most had completed high school and/or had TAFE, tertiary graduate or post graduate qualifications (72%).
4. Respondents aged 35-44 and 45-54 were significantly more likely to manage flocks of 2000+ sheep and those in the age group over 65 years were less likely to own 2000+ sheep.
5. Over 65s were significantly more likely to have flock sizes between 100-499 sheep.
6. Respondents in WA were more likely to have over 2000 head of sheep as were those who mule lambs.

Mulesing

1. Respondents were more likely to mule their ewe lambs (52%) than male lambs (44%), presumably because they are more likely to retain ewe lambs for several years (6-7 years) and sell male lambs at 12-18 months of age.

2. The reported percentage mulesing ewe lambs and male lambs were much lower (by 10-18%) than reported in other recent woolgrower surveys. The lower percentage of woolgrowers that mules reported in the AWI 2020 Wool Industry Profile and in the AWI 2021 Merino Husbandry Practices Survey may present a downward trend in the use of mulesing.
3. Respondents with small flock sizes (<500 sheep) were significantly less likely to mules (13-19%) and those with larger flock sizes were significantly more likely to mules (500-1999 sheep: 53-61% and >2000 sheep 59-70%).
4. The mulesing rates in the smaller flock sizes are a marked reduction from those reported in the AWI 2017 Merino Husbandry Practices Survey which reported 33% of respondents with ≤250 sheep mulesed their ewe lambs and 75% of respondents with flock sizes between 251-500 sheep mulesed ewe lambs.
5. Respondents in South Australia and Western Australia are significantly more likely to mules lambs (53-66% and 59-64%, respectively). Those in Tasmania, Queensland and NSW were significantly less likely to mules (14-15%, 9-16% and 36-47%, respectively).
6. Those that reported a finer average flock micron were less likely to mules (41-48%) as were those farmers over 65 years of age (39-45%).
7. This survey confirmed that the majority of woolgrowers use pain management for mulesing (92%) and that most only use a local anaesthetic (Tri-Solfen®) without a longer acting analgesic.
8. Only 8% use a combination of an analgesic and an anaesthetic for pain management.
9. Those who did not use pain management thought it was not necessary or had no reason/not considered using it.
10. Only 20% of those who mules say they are likely to cease mulesing in the next 5 years. This hasn't changed from the AWI 2017 Merino Husbandry Practices Survey.
11. Those who want to stop mulesing will rely more on flystrike prevention and treatment chemicals, increased crutching frequency and breeding sheep that are resistant to flystrike.
12. 50% of woolgrowers who ceased mulesing did so in the last 6 years and the main reasons why they ceased mulesing were because they had bred plain bodied sheep, animal ethics and industry pressure to cease mulesing.
13. Of those respondents who do not mules, those with smaller flock sizes (<500 sheep) were significantly more likely to have never mulesed (51%) their lambs and those with flocks >2000 sheep were significantly less likely to have never mulesed (16%).

Tail docking

1. The majority of woolgrowers dock the tails of both ewe lambs (95%) and male lambs (97%).
2. Over half used the hot knife method (58%) and a third (36%) used rings which is similar to previous surveys.
3. Location and flock size had a significant effect on which method was used for tail docking with South Australians (77-78%) and larger flock sizes (75-76%) more likely to use hot knife and NSW, TAS and small flocks (<500 sheep) more likely to use rings (47-48%, 71% and 63-68%, respectively).
4. Those who mules were significantly more likely to use hot knife method (80%) with only 13% using rings to tail dock.
5. 58% docked tails at 1 or 2 joints which is shorter than recommended best practice, as it is reported to predispose those lambs to rectal prolapse, bacterial arthritis, cancer of the perineal region and breech strike. This trend is similar to earlier surveys.
6. 60% used pain management around tail docking.
7. Only 9% used a combination of pain management products which is industry best practice.
8. Those using the hot knife method were significantly more likely to use pain management (80%) than the national average. They were also less likely to use an unsuitable pain management product for the method (3%).
9. Most Merino woolgrowers used appropriate pain management for cold knife, hot knife and shears methods of tail docking.
10. Confusion around appropriate products for the rings method was apparent with 57% using Tri-Solfen® which is not a suitable pain management product for tail docking with rings as it is only effective on open wounds.

The very small percentage who mulesed and used rings (13%) were highly likely to report using unsuitable (not effective) pain management for rings (89-93%).

Castration

1. 98% of woolgrowers castrate their male lambs and 97% of those used rings to castrate. There were no significant differences between demographics.
2. Only 30% used pain management for castration, similar to earlier survey results. Products registered for use at castration have been available for a short time relative to mulesing.
3. 8% used a combination of pain management products which is industry best practice.
4. Similar to tail docking, there was confusion over which products were suitable for pain management at castration, especially those who use rings, with 58% of those using rings using Tri-Solfen[®], which can only be used on open wounds, for pain management with rings. It is possible that Tri-Solfen[®] may have been reported by those Merino producers as being provided for castration and tail docking pain management due to its application at mulesing, which generally occurs simultaneously with castration and tail docking.
5. Those who use an analgesic were more likely to choose reasons such as 'improved animal welfare' and 'effectiveness of the product' for reasons why they used it. They were also significantly more likely to have been recommended these products by a vet.
6. The most common reason why respondents did not use pain management at castration were that they did not think it was necessary (43%) or had not considered pain management/no reason (28%).

Recommendations

Reconciling farmer surveys and the National Wool Declaration

- Further analysis of the NWD data is recommended to address the disconnect between the current NWD reports on number of bales of mulesed and non-mulesed wool sold and the proportion of woolgrowers who mules reported in farmer surveys.
- It is recommended that a steering committee be formed to address how the NWD data can be used how the NWD data can be further analysed and reported, including with respect to privacy laws.
- A retrospective analysis of the NWD data from the last 5 years to gain estimates of proportions of woolgrowers selling mulesed and non-mulesed wool would be beneficial for comparison with respective farmer surveys.
- Any results of further analysis of the NWD data should be considered in the context of 5-15% of the Australian wool clip being sold privately to processors and therefore not captured by the NWD, with that wool highly likely to be from non-mulesed sheep.

Pain management around mulesing, tail docking and castration

- Information on pain management for mulesing and tail docking on the FlyBoss website requires updating to the most current advice. The current table for pain management on FlyBoss does not have clear indication of which procedures Metacam/Meloxicam can be used for. Also, it does not promote best practice use of a combination Tri-Solfen[®] and analgesic for mulesing, it does not include information on NumOcaine[®]/Numnuts[®] and it does not indicate analgesics for mulesing and for tail docking and castration using knives or shears.
- Targeted communications are recommended around the need for pain management at tail docking and castration of all lambs and which pain management products are appropriate for the different methods of tail docking.
 - Specific communications would be beneficial for rural retailers and veterinarians selling Tri-Solfen[®] that reiterate it uses for tail docking and castration with hot knife/cold knife and shears only.
 - Specific communications for rural retailers promoting the suggestion of pain management for those purchasing rings for castration and tail docking.
 - Continued communications regarding use of a combination of local anaesthetic with an analgesic
 - One application of an analgesic at lamb marking provides pain management for both tail docking and castration, as well as mulesing (if practiced).

Tail docking length

- Further, repeated communications are recommended around tail length at tail docking. Specific communications targeting mulesing/tail docking contractors may be warranted.

1. Introduction

Sheep blowfly strike (cutaneous myiasis) is the most serious external parasitic disease affecting the Australian wool industry with economic losses estimated to be AUD\$324 million per annum in lost production, prevention and treatment (Shephard *et al.* 2022). Breech strike is the most commonly reported type of blowfly strike, its prevalence is similar across age groups (ewes: 2.3-4.1%, lambs and weaners: 2.2-4.7%) and is reported by up to 80% of woolgrowers (Colvin *et al.* 2022a). Season has a large impact on the prevalence of flystrike with higher prevalence in wetter seasons (Wardhaugh *et al.* 2007; Colvin *et al.* 2022a). Although, global warming may impact the length and severity of future flystrike seasons especially in areas experiencing warmer, drier winters (Heath 2021). Surgical modification of sheep to reduce their risk of blowfly strike has been used in Australia since the 1930s when mulesing was first trialled and found to be an effective preventative method (Phillips 2009). The practice is banned in many countries including New Zealand which was the first country to make the operation illegal from 1st October 2018 (Phillips 2009; Reddy, 2018). In Australia, 11.2 million lambs were mulesed in 2020/21 (Kynetec 2021). Sustained pressure from wool consumers in Australia and internationally to cease the practice has been the catalyst for the Australian wool industry to move away from mulesing (Wells *et al.* 2010). Increased public awareness of animal welfare has seen demand for improved welfare outcomes during husbandry practices which includes the use of pain management during painful procedures such as mulesing, tail docking and castration. Tail docking combined with mulesing was long considered the best preventative strategy for severe blowfly strike and was often carried out along with the mulesing operation (Phillips 2009; Chandler and Sparks 2020). Pain relief around mulesing has increased markedly in the last ten years (59-64% in 2011 to 87-91% in 2018). However, the use of pain relief during tail docking and castration has been quite low (42%) and the type of pain management product used for those operations were largely unsuitable (Sloane 2018; Colvin *et al.* 2022a). The most recent survey of wool producers has found this trend is sustained (Sloane 2022).

The Sheep Sustainability Framework (SSF), launched in April 2021, is a collaboration of Sheep Producers Australia and WoolProducers Australia, with funding and project management provided by Australian Wool Innovation (AWI) and Meat & Livestock Australia (MLA). The SSF was formed to demonstrate that Australia is a global leader in the sustainable production of sheep meat and wool in order to secure access to local and global markets. The AWI 2021 Merino Husbandry Practices Survey was part of a broader survey, including non-Merino producers, for the SSF to measure industry performance against the priorities of the framework which includes Theme 1: Caring for our sheep and Theme 2: Enhancing the environment and climate. A portion of the results of the 2021AWI-MHPS regarding mulesing, tail docking and castration that will be discussed in this report are relevant to the two focus areas of Theme 1 of 1. Animal care and handling and, 2. Prevent and manage disease (SSF 2022).

Farmer surveys from the last five years have found between 63-69% of woolgrowers practice mulesing (Sloane 2018; Colvin *et al.* 2021a). The AWI 2021 Merino Husbandry Practices Survey reported only 52% of woolgrowers reported the use of mulesing in their flocks (Sloane 2022). These figures are often compared to the reported proportion of mulesed and non-mulesed bales of wool as declared by vendors through the National Wool Declaration (NWD). The disconnect between the farmer surveys and the NWD is often a concern of industry although these figures cannot be directly compared. This study will delve into the reasons why and how the data from these two sources have the potential to be reconciled. This study will also interpret the results of the AWI 2021 Merino Husbandry Practices Survey regarding sheep husbandry practices of mulesing, tail docking and castration of Merino woolgrowers and compare the results with other recent farmer surveys. The associations between woolgrower demographics and their husbandry practices as well as possible impacts of market forces will be explored.

2. Project Objectives

1. Interpretation of the AWI 2021 Merino Husbandry Practices Survey results, including the impact of weighting on the results.
2. Comparison of mulesing, tail docking and castration practices from the AWI 2021 Merino Husbandry Practices Survey results and other relevant woolgrower surveys and the National Wool Declaration data.
3. Discuss associations between woolgrower demographics, their husbandry practices and other potential factors on change in mulesing practices.
4. Provide recommendations, if any, on whether further, more detailed analysis is required of data sets to better understand woolgrower practices.
5. Communicate project outcomes to woolgrowers through an article to be published in Beyond the Bale.

3. Success in Achieving Objectives

All project objectives were achieved. Results of the AWI 2021 Merino Husbandry Practices Survey are presented, interpreted and compared with other relevant industry surveys. A discussion has been presented on the effect of weighting on the survey results and how the NWD can be reconciled with the industry surveys through further analysis of the NWD dataset. An article for the December edition of Beyond the Bale has been prepared to convey the survey results and their context to woolgrowers.

4. Methodology

This is a desktop review of the AWI 2021 Merino Husbandry Practices Survey (2021AWI-MHPS) data analysis provided by Kynetec (ON-00816, Sloane 2022). All data and analyses of data relevant to the AWI 2021 Merino Husbandry Practices Survey presented in this report were collected and conducted by Kynetec.

Questions pertaining to animal husbandry practices for the 2021AWI-MHPS survey were largely based on those asked in the AWI 2017 Merino Husbandry Practices Survey (Sloane 2018) which was conducted by AWI to benchmark Australian Merino Husbandry practices.

Data from the 2021AWI-MHPS will be compared to data from other farmer surveys such as:

- 2003, 2011 and 2018 Benchmarking Australian Sheep Parasite Control Practices Surveys (EC306, WP499, ON-00540) (Colvin *et al.* 2020; Colvin *et al.* 2021a; Colvin *et al.* 2021b; Colvin *et al.* 2021c; Colvin *et al.* 2022a, 2022b)
- [AWI 2017 Merino Husbandry Practices Survey](#) (Project ON-00495) (Sloane 2018)
- [AWI 2020 Wool Industry Profile Survey](#) (Project CS-00178) (Chandler and Sparks 2020)
- MLA and AWI Wool and Sheepmeat Survey - June 2021 (Kynetec 2021)
- National Wool Declaration (NWD) data reports (AWEX 2022), retrieved from the Australian Wool Exchange webpage: <https://www.awex.com.au/market-information/mulesing-status/nwd-test-auction-data/> and from the [NWD update – 2022 Flystrike RD&E Technical Forum](#) (Grave and Hansford 2022).

Data for pain management at tail docking in section 5.2 was averaged between ewe lambs and male lambs to provide a combined mean (Table 4). Although the question on pain management around tail docking combined ewe lambs and male lambs, the data report was split into ewe lambs and male lambs by method of tail docking which had been asked for ewe lambs and male lambs separately.

Unweighted data is presented for pain management products used in combination for mulesing, tail docking and castration procedures. This was not available in the full, weighted data analysis, however, the overall percentages of products used varied little between weighted and unweighted data for this question (Table 5).

5. Discussion of Results of the AWI 2021 Merino Husbandry Practices Survey

5.1 Demographics of survey respondents

There were very few female respondents to the survey (187/1203, 16%) and a small number who preferred not to indicate their sex (3/1203 0.25%), hence, gender differences in husbandry practices will not be explored in this report. This was also the case in the AWI 2017 Merino Husbandry Practices Survey (female: 14%, male: 86%).

Around 70% of respondents were aged over 55 years (Table 1), which is consistent with the mean age of Australian farmers being 59 years of age (ABS 2022) and is similar to the AWI 2017 Merino Husbandry Practices Survey (45-54: 21%, 55-65: 38% and 65 and over: 28%).

There were significantly more older farmers in Victoria than the national average and significantly lower numbers of farmers aged 45-54 in that state.

Farmers over the age of 65 years were significantly more likely to have smaller flock sizes between 100-499 sheep (52%) and less likely to have flock sizes of 2000+ sheep (26%). They were also significantly more likely to be in the group with the lowest level of education, although only 11% of farmers of this age left school before year 10 (Table 2). Farmers in the 55-64 were significantly more likely to have Year 10-11 as their highest level of education (Table 2). Farmers aged 35-44 and 45-54 were significantly more likely to have flock sizes over 2000 sheep than the national average (12% and 23%, respectively). Farmers in the 45-54 age group were significantly less likely to have left school in year 9 or less or in year 10 - 11.

Overall, a quarter of respondents were tertiary graduates (26%, Table 2), this is higher than reported by the ABS figures for all sheep farmers (10%). There were also more post graduates in this survey (9%) compared with the general sheep farmer population (2.4%) and much fewer respondents with an education of year 11 or below (2022-MHPS: 35% and ABS: 40.6%, ABS2022).

Table 1: Age group by other demographic. Figures in blue indicate means that are significantly higher than the overall mean, figures in red indicate means that are significantly lower than the overall mean.

Demographic	n	Age group					
		18 – 24	25 – 34	35 – 44	45 – 54	55 – 64	65 and over
Total	1203	1%	4%	8%	17%	30%	40%
<i>State</i>							
NSW	422	1%	3%	7%	16%	31%	41%
VIC	269	0%	4%	7%	11%	27%	50%
QLD	63	0%	12%	4%	10%	33%	40%
SA	224	1%	4%	8%	22%	31%	33%
WA	189	1%	3%	10%	20%	33%	33%
TAS	36	0%	0%	4%	36%	26%	34%
<i>Flock size</i>							
100 - 499	115	1%	4%	4%	10%	29%	52%
500 – 1,999	523	0%	5%	7%	16%	28%	44%
2,000 +	565	1%	4%	12%	23%	34%	26%
<i>Micron</i>							
Fine (<20)	769	1%	5%	7%	16%	30%	42%
Medium (20+)	434	0%	3%	9%	19%	31%	37%
<i>Body wrinkle</i>							
Low (Score 1)	651	1%	5%	9%	16%	30%	40%
Medium (Score 2)	513	0%	3%	5%	18%	31%	42%
High (Score 3 or above)	39	3%	2%	11%	35%	25%	21%
<i>Education</i>							
Year 9 or less	64	0%	0%	0%	4%	22%	75%
Year 10 - 11	252	0%	1%	5%	10%	41%	43%
School Leaving Certificate (eg HSC)	236	1%	5%	11%	23%	25%	36%
TAFE	205	2%	2%	7%	21%	32%	36%
Tertiary Graduate	327	1%	6%	10%	18%	29%	36%
Post Graduate	111	0%	7%	7%	21%	24%	40%

Table 2: Education level by age group. Figures in blue indicate means that are significantly higher than the overall mean, figures in red indicate means that are significantly lower than the overall mean.

Age group	n	Year 9 or less	Year 10 - 11	School Leaving Certificate (eg HSC)	TAFE	Tertiary Graduate	Post Graduate
Overall	1203	6%	22%	18%	18%	26%	9%
18 – 24	7	0%	0%	23%	45%	32%	0%
25 – 34	48	0%	8%	22%	7%	39%	16%
35 – 44	103	0%	14%	27%	15%	35%	9%
45 – 54	224	1%	13%	24%	22%	28%	11%
55 – 64	371	4%	29%	15%	19%	25%	7%
65 and over	446	11%	24%	17%	16%	23%	9%

Nearly one third of respondents ran between 100-499 sheep (29%), 35% ran 500-1999 and 36% ran 2000+ sheep (Table 3). Respondents in WA were more likely to have larger flocks of over 2000 head than the national average (52%), as were those who mules ewe lambs (41%) and male lambs (49%). Only 9-10% of those who mules ewe lambs and male lambs had a flock size between 100-499.

Respondents aged 35-44 and 45-54 were significantly more likely to own flocks over 2000 sheep and farmers aged 65 and over were significantly more likely to have flocks between 100-499 and less likely to own flocks over 2000 head (Table 3).

Table 3: Respondent flock size by other demographic. Figures in blue indicate means that are significantly higher than the overall mean, figures in red indicate means that are significantly lower than the overall mean.

Demographic	n	Flock size			
		100 - 499	500-1999	2000+	
Overall	1203	29%	35%	36%	
<i>State</i>	NSW	422	28%	35%	37%
	VIC	269	30%	42%	28%
	QLD	63	46%	18%	36%
	SA	224	26%	42%	32%
	WA	189	26%	22%	52%
	TAS	36	51%	26%	23%
<i>Micron</i>	Fine (<20)	769	29%	33%	37%
	Medium (20+)	434	28%	37%	35%
<i>Body wrinkle</i>	Low (Score 1)	651	28%	35%	37%
	Medium (Score 2)	513	30%	35%	35%
	High (Score 3 or above)	39	16%	31%	53%
<i>Mules ewe lambs</i>	Yes	718	10%	41%	49%
	No	485	49%	29%	23%
<i>Mules male lambs</i>	Yes	603	9%	42%	49%
	No	600	44%	29%	27%
<i>Education</i>	Year 9 or less	64	34%	48%	18%
	Year 10 - 11	252	34%	41%	25%
	School Leaving Certificate (eg HSC)	236	19%	34%	47%
	TAFE	205	34%	35%	31%
	Tertiary Graduate	327	26%	29%	45%
	Post Graduate	111	26%	31%	43%
<i>Age</i>	18 – 24	7	34%	12%	54%
	25 – 34	48	27%	40%	32%
	35 – 44	103	13%	31%	55%
	45 – 54	224	17%	33%	49%
	55 – 64	371	27%	32%	41%
	65 and over	446	38%	38%	24%

5.2 Trends in mulesing practices of Australian woolgrowers

5.2.1 Proportion practicing mulesing

Ewe lambs

Around half of woolgrowers responding to the survey mules ewe lambs (52%, Table 4). This is the lowest estimate of mulesing of ewe lambs in recent years by between 10-18% (Table 5). Further discussion on comparing this figure is provided in *Comparing woolgrower surveys* below.

Tasmania (15%, TAS), Queensland (16%, Qld) and NSW (47%) were significantly less likely to mules. Respondents from South Australia (66%, SA) and Western Australia (64%, WA) are significantly more likely to mules their ewe lambs (Table 4). The AWI 2020 Wool Industry Profile found similar figures to the current survey in NSW (43%) and SA (66%) and slightly higher percentages in Victoria (56%, Vic) and WA (72%). The results of the 2018 Benchmarking Australian Sheep Parasite Practices Survey also found Tasmanian woolgrowers were less likely to mules (20%). However, the AWI 2017 Merino Husbandry Practices Survey reported much higher estimates of woolgrowers mulesing their ewe lambs across all states (NSW 62%, Vic 75%, Qld 40%, SA 86%, WA 77% and TAS 48%). Between the results of the AWI 2020 Wool Industry Profile and the 2021AWI-MHPS surveys, there seems to be a declining trend in the overall proportion of woolgrowers mulesing their ewe lambs.

Those with small flocks under 500 sheep were less likely to mules (19%) than the national average (52%), and those with larger flocks of 500-1999 sheep and over 2000 sheep were significantly more likely to mules (61% and 70%, respectively). The mulesing rates in the smaller flock sizes are a marked reduction from those reported in the AWI 2017 Merino Husbandry Practices Survey which reported 33% of respondents with ≤ 250 sheep mulesed their ewe lambs and 75% of respondents with flock sizes between 251-500 sheep mulesed ewe lambs.

Although finer micron flocks were less likely to be mulesed (48%) than the national average and flocks over 20 microns (59%) were more likely to mules, the difference was not as great as location or flock size (Table 3). There were increasing proportions of respondents mulesing sheep with increasing body wrinkle scores. Those with the highest reported score (3 or above) had the highest use of mulesing although it was not significant due to the low sample size.

Age of respondent had an unexpected effect with those over 65 significantly less likely to mules (45%) and those in the 45-54 age group significantly more likely (63%).

Male lambs

Respondents were less likely to mules male lambs (44%) than ewe lambs (52%), this may be because respondents intend to retain most of their ewe lambs and sell wether lambs within 12 months, relying on chemicals to prevent flystrike in wethers over that period. Every producer who mulesed male lambs also mulesed ewe lambs, although only 83% of producers who mulesed ewe lambs also mulesed male lambs (Table 4).

NSW was, again, significantly lower (36%) than the national average for respondents who mulesed male lambs as were Qld (9%) and TAS (14%). Again WA (59%) and SA (53%) were significantly more likely to use mulesing. The AWI 2020 Wool Industry Profile reported similar results to the 2021AWI-MHPS with proportions of woolgrowers mulesing male lambs in NSW (34%), Vic (48%) and SA (53%) almost the same. There was a slight increase in percent mulesing in WA in the current survey (65%) from the AWI 2020 Wool Industry Profile in WA (59%). Both the AWI 2020 Wool Industry Profile and the 2021AWI-MHPS results are lower than the 2017 AWI Merino Husbandry Practices Survey for all states (NSW 54%, Vic 72%, Qld 33%, SA 74%, WA 73% and TAS 31%).

Similar trends in the effect of flock size were seen in male lambs as for ewe lambs, where respondents with flocks of 100-499 sheep significantly less likely to use mulesing in male lambs (13%), flocks of 500-1999 (53%) and over 2000 sheep (59%) were significantly more likely to mules male lambs. Again, the AWI 2017 Merino Husbandry Practices Survey reported much higher rates of mulesing among respondents with smaller flock sizes (≤ 250 sheep: 30% and 251-500 sheep: 69%).

Woolgrowers with flocks with finer micron wool were also less likely to mules male lambs (Fine <20 : 41% and Medium >20 : 49%) and the same effect of body wrinkle was observed with lower percentages of respondents using

mulesing in flocks with wrinkle score 1 (36%) and increasing with wrinkle score 2 (52%) and wrinkle score 3 or above (67%, Table 4).

The same effect of farmer age was observed on use of mulesing in male lambs with those aged between 45-54 significantly more likely to use mulesing and those 65 years and over significantly less likely (39%). The latter being a surprising result that may be biased by the computer literacy of those of the 65 years and over age group. To be included in the MLA database, producers need to have computer literacy in order to register their email address, those with higher computer literacy may have greater access to information and discussions around mulesing which could influence their decision to mules or not to mules.

Table 4: Proportion of woolgrowers mulesing ewe lambs and male lambs by demographic or sheep characteristic and the proportion using pain management when mulesing lambs. Figures in blue indicate means that are significantly higher than the overall mean, figures in red indicate means that are significantly lower than the overall mean.

Demographic	n	Proportion of woolgrowers mulesing ewe lambs in 2021 (%)		Proportion of woolgrowers mulesing male lambs in 2021 (%)		Pain management used when mulesing lambs (%)		
		Yes	No	Yes	No	n	Yes	No
Overall	1203	52%	48%	44%	56%	722	92%	8%
<i>State</i>								
NSW	422	47%	53%	36%	64%	227	93%	7%
Vic	269	49%	51%	43%	57%	164	100%	0%
Qld	63	16%	84%	9%	91%	18	85%	15%
SA	224	66%	34%	53%	47%	166	91%	9%
WA	189	64%	36%	59%	41%	136	87%	13%
TAS	36	15%	85%	14%	86%	11	79%	21%
<i>Flock size</i>								
100-499	115	19%	81%	13%	87%	23	84%	16%
500-1,999	523	61%	39%	53%	47%	313	90%	10%
2000+	565	70%	30%	59%	41%	386	96%	4%
<i>Micron</i>								
Fine (<20)	769	48%	52%	41%	59%	424	92%	8%
Medium (20+)	434	59%	41%	49%	51%	298	93%	7%
<i>Body wrinkle</i>								
Low (score 1)	651	46%	54%	36%	64%	349	93%	7%
Medium (Score 2)	513	59%	41%	52%	48%	346	91%	9%
High (Score 3 or above)	39	70%	30%	67%	33%	27	96%	4%
<i>Mules ewe lambs</i>								
Yes	718	100%	0%	83%	17%	718	93%	7%
No	485	0%	100%	1%	99%	4	-	-
<i>Mules male lambs</i>								
Yes	603	99%	1%	100%	0%	603	92%	8%
No	600	16%	84%	0%	100%	119	-	-
<i>Education</i>								
Year 9 or less	64	51%	49%	46%	54%	38	89%	11%
Year 10-11	252	53%	47%	42%	58%	154	91%	9%
School leaving certificate	236	61%	39%	52%	48%	160	93%	7%
TAFE	205	48%	52%	41%	59%	123	92%	8%
Tertiary graduate	327	52%	48%	42%	58%	189	93%	7%
Post graduate	111	43%	57%	40%	60%	56	96%	4%
<i>Age</i>								
18-24	7	66%	34%	66%	34%	6	100%	0%
25-34	48	46%	54%	41%	59%	27	85%	15%
35-44	103	59%	41%	44%	56%	63	93%	7%
45-54	224	63%	37%	51%	49%	152	94%	6%
55-64	371	55%	45%	45%	55%	224	96%	4%
65 and over	446	45%	55%	39%	61%	248	88%	12%

Comparing woolgrower surveys

The percentage of Merino woolgrowers using mulesing in 2021AWI-MHPS (44% wether lambs and 52% ewe lambs, Table 4) is 10 to 18% lower than reported in surveys from 2017, 2018 and 2019 (Table 5). Although the AWI 2020 Wool Industry Profile survey of 2019 woolgrower practices also showed a decline in percentage mulesing from the earlier surveys, it is still ~10% higher for both ewe and wether lambs than the 2021AWI-MHPS. So, is the continued decline in the reported percentage of woolgrowers mulesing a real trend? There are some cautious reasons as to why it could be.

Table 5: Reported percentages of Merino woolgrowers using the mules operation and pain management at mulesing from farmer surveys.

Survey	Year surveyed	N	Survey method	Survey database	% used mulesing		% used pain mgt	Source
					Ewe lambs	Wether lambs		
Sheep CRC National Farmer Survey - 2011	2011	1000	Phone	-	76%**		64%	Pers. comm.
2013/14 Wool and Lamb Forecasting Survey	2013		Phone	-	73%**		75%	Pers. comm.
Sheep CRC National Farmer Survey - 2014	2014	580	-	-	83%**		61%	Pers. comm.
AWI 2017 Merino Husbandry Practices Survey	2017	1200	CATI	Kynetec database	70%	63%	83-84%	Sloane (2018)
2018 Benchmarking Australian Sheep Parasite Control Practices	2018	354	Online	AWI database	69%*		86-90%	Colvin <i>et al.</i> (2021a)
AWI 2020 Wool Industry Profile	2019	1011	Online & CATI	AWI database	63%	54%	86-87%	Chandler and Sparks (2020)
MLA and AWI Wool and Sheepmeat Survey June 2021	2017		Online	MLA database	-	-	73%*	Kynetec (2021)
"	2019		"	"	-	-	87%*	"
"	2021		"	"	-	-	84%*	"
AWI 2021 Merino Husbandry Practices Survey (2021AWI-MHPS)	2021	1203	Online & CATI	MLA database	52%	44%	92%*	Sloane (2022)

*combined ewe lambs and wether lambs

* These should be compared with caution as they estimate percentage of marked Merino lambs that were mulesed rather than percentage of farmers who mules

There are approximately 23,000 sheep farms with breeding Merino ewes in Australia (2015/16 ABS Census). Since it is not always possible to ask every woolgrower in Australia whether they mules their lambs or not, a random representative sample of the population is used to estimate what is happening in the whole population. Sampling errors occur when working with representative samples as there will always be differences between the sample population and the whole population as the whole population is larger and more complete. This means the representative sample population may be biased and these biases need to be accounted for through sampling methodology (Gideon 2012).

The 2021AWI-MHPS surveyed 1203 Merino sheep farmers, which equates to about 5% of the total Merino farmer population (1203/23,000). Using a sample size calculator, only 378 respondents were required for estimating a single proportion (e.g. % mulesing) with 5% precision and 95% confidence (Dhand and Khatkar 2014). The 2021AWI-MHPS employed two main methods to ensure that the sample population of respondents to the survey were representative of the whole woolgrower population. These were: stratified random samples (quotas), and weighting of sample data for analysis if the quota samples are disproportionate. The sample population were stratified (divided) into 18 quotas in total: 6 state quotas and 3 flock size quotas (100-499, 500-1999 and 2000+ head of sheep). These quotas were based on producer population data sourced from the Australian Bureau of Statistics (ABS). When quotas for the larger flock sizes in each state were met, the survey was closed to any further respondents with larger flock sizes and remained open to those with a smaller flock size. It is important when using a stratified random sample that if the results of the survey are disproportionate (i.e. not all quotas were filled with the required sample size), that the results are then weighted to take the relative size of each quota into account (Gideon 2012). In the case of the 2021AWI-MHPS, surveyed farms with larger sheep flocks were over-represented in the sample population, and not enough respondents with smaller flock sizes were able to be surveyed. Hence, the

survey data needed to be weighted to decrease the influence of respondents with larger flock sizes and to increase the influence of respondents with smaller flock sizes. The same methods were used for the 2017 AWI Merino Husbandry Practices Survey, which provided most of the questions on animal husbandry practices for the 2021AWI-MHPS, and the MLA and AWI wool and sheep meat surveys. The AWI 2020 Wool Industry Profile also used these methods but with levy payer groups for quotas instead of flock size (levy groups reflect the quantity of wool sold, hence, is similar to flock size estimations). The 2018 Benchmarking Australian Sheep Parasite Control Practices Survey used a slightly different method of measuring non-response bias with a short follow-up survey.

For the 2021AWI-MHPS survey, in most cases the differences between weighted and un-weighted data were small (Table 6). However, the difference between un-weighted and weighted data for the percentage using mulesing in ewe lambs was 8% (Table 6). As seen in Table 4, there was a large discrepancy between the percentage mulesing with larger flock sizes (500-2000+) which were significantly more likely to mules than the national average (61%-70% ewe lambs 53-59% male lambs) and smaller flock sizes (<500), which were significantly less likely to mules than the national average (19% ewe lambs, 13% male lambs). Hence, the weighted adjustment has reduced the national rate of woolgrowers who mules from 60% (un-weighted) to 52%. There was a substantial reduction in mulesing of lambs in small flock sizes in this survey from those reported in the 2017 AWI Merino Husbandry Practices Survey. This difference has meant that weighting the data in this survey (2021AWI-MHPS) has resulted in a larger gap between the weighted and un-weighted percentage using mulesing. The difference between smaller and larger flock sizes for percentage mulesing could be influenced by the difficulties of ceasing mulesing in operations that run large flock sizes compared with smaller flock sizes. Woolgrowers who said they were likely/very likely to cease mulesing in the next 5 years tended to have smaller flock sizes (Table 12, 100-499 sheep: 30%, 500-1,999 sheep: 22% and 2000+ sheep: 16%). Those with larger flock sizes were more unlikely/very unlikely to cease mulesing in the next 5 years (2000+ sheep: 65%, Table 12). Overall, 50% of respondents who had ceased mulesing had done so in the last 6 years (Table 14) which would correlate with a probable trend in declining mulesing rates over that period.

Although the databases used for the surveys included in Table 6 were different, there would be significant overlap between the AWI and MLA databases with 61% of respondents to the entire Project Proof Sheep Market Research Survey (1203/2003) being Merino enterprises even though the MLA database is not woolgrower focused. The 2018 Benchmarking survey used the AWI database and that survey had 67% Merino enterprises.

Table 6: Comparison of weighted and unweighted results for the Australian Wool Innovation 2017 Merino Husbandry Practices Survey and the AWI 2021 Merino Husbandry Practices Survey.

Question	AWI 2017 Merino Husbandry Practices Survey		AWI 2021 Merino Husbandry Practices Survey	
	Weighted result	Unweighted result	Weighted result	Unweighted result
Merino horned sires	34.5%	35.6%	22.2%	23.8%
Weeks ewes joined	7.9	7.6	8.9	8.0
Pregnancy scanning	46%	51%	44%	51%
Mulesing ewe lambs	-	-	52%	60%
Mulesing wether lambs	63%	66%	-	-
Pre-lambing vaccination	58%	59%	66%	67%
Pain management -mulesing:				
Anaesthetic injection at the surgery site (e.g. Numnuts)	-	-	1%	1%
Anaesthetic and antiseptic spray at the surgery site (e.g Tri-Solfen)	-	-	96%	97%
Analgesic / pain killing injection (e.g Meloxicam)	-	-	4%	4%
Analgesic / pain killing oral gel (e.g. Buccalgesic)	-	-	5%	6%

The proportions of the ewe flock sizes of respondents to the 2021AWI-MHPS and the AWI Sheep Husbandry Practices Survey were almost identical lending validity to the accuracy of flock size representation between the two surveys (Table 7).

Table 7: Percentage of respondents with ewe flock sizes in the AWI 2021 Merino Husbandry Practices Survey and the AWI 2017 Merino Husbandry Practices Survey.

Ewe flock size	Survey	
	AWI 2021 Merino Husb. Prac.	AWI 2017 Merino Husb. Prac.
<500	42%	42%
501-1000	23%	19%
1001-2000	17%	21%
2000+	20%	19%

The survey methodology for the 2021AWI-MHPS survey was sound. A large difference between respondents with small flocks and larger flocks for percentage mulesing caused a reduction in the overall weighted percentage mulesing lambs. The most recent prior survey in 2020 (AWI 2020 Wool Industry Profile), also found a reduction in the percentage using mulesing in lambs compared with earlier surveys. It is possible that these two numbers indicate the start of a downward trend in the use of mulesing by Australian woolgrowers. However, further data is needed to determine if this trend reflects a true trend that is occurring in the Australian wool industry as a whole. Future farmer surveys and the NWD could provide a clearer picture.

National Wool Declaration versus farmer surveys

An estimated 85 to 95% of Australian wool is sold through AWEX (AWEX 2014). Data on the percentage of bales of mulesed and non-mulesed wool presented for auction is collected by AWEX via the NWD. The disconnect between the number of mulesed wool bales reported in the NWD and the proportion of woolgrowers who practice mulesing reported in farmer surveys is a major concern of the wool industry. The NWD auction data is often regarded as under-estimating the proportion of Merino operations that are not mulesing (13.8% in 2021 season) versus mulesing (62.0.% in 2021 season, Table 8). The percentage of woolgrowers who mules from farmer surveys and the percentage of bales of wool from mulesed sheep from the NWD, however, cannot be directly compared and, hence, cannot be reconciled as they stand. Larger woolgrowers will have a disproportionate effect on the number of wool bales presented for auction, and, as the 2021AWI-MHPS has shown, those with larger flock sizes are significantly more likely to mules (Table 4). This results in lower proportions of non-mulesed wool bales presented for auction. Approximately 5-15% of Australian wool is sold privately, direct to processors, and this wool is most likely to be from non-mulesed sheep. Whilst it is important to report the quantity of mulesed and non-mulesed wool offered for sale, it cannot be directly compared with the proportion of woolgrowers who mules or don't mules their sheep.

Table 8: National wool declaration rates (%) for Merino wool by mulesing status and fibre diameter (micron). Wool allocated to Merino based on AWEX-ID. Figures based on percentage sum of all bales, Merino breed, Merino wool types, first hand offered, P&D certificates. Abbreviations: NM – Not Mulesed, CM – Ceased Mulesing, AA – Mulesed with anaesthetic/analgesic, M – Mulesed, ND – Not declared. Source: (Grave and Hansford 2022)

	Season									
	2012/ 2013	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019	2019/ 2020	2020/ 2021	2021/ 2022
National Declaration Rate	47%	45%	51%	57%	62%	67%	71%	75%	n/a	78%
Mulesing status										
NM	5%	5%	5%	6%	6%	8%	8%	10%	n/a	12.6%
CM	3%	2%	3%	3%	3%	2%	2%	4%	n/a	3.2%
AA	17%	17%	22%	27%	32%	37%	42%	44%	n/a	47.5%
M	22%	21%	21%	21%	21%	20%	19%	17%	n/a	14.5%
ND	53%	55%	49%	44%	38%	33%	28%	25%	n/a	22.1%
Total Bales	1,285,751	1,200,160	1,331,234	1,215,810	1,279,596	1,296,516	1,095,621	826,756	n/a	1,200,973

The percentage of Merino woolgrowers declaring their mulesing status on the NWD has grown to around 75% from 51% 7 years ago (Table 8). Around a quarter (22%) of Merino wool bales presented to auction at AWEX not having a declared mulesing status (ND) is a concern, although there has been a substantial decline in the percentage of ND wool from 2010 to 2021 alongside a steady increase in those declaring mulesed with anaesthetic or analgesic (AA) and an increase in those declaring wool as non-mulesed (NM, Table 8). Given the significant market premiums of 31-78c/kg clean fleece weights (under 20 micron) for non-mulesed Merino wool and discounts of between -4 to -10c/kg clean fleece for 'not declared' wool compared to mulesed Merino wool (AWI 2022), it is highly likely that the undeclared bales were from mulesed sheep or from mobs where younger, non-mulesed sheep were mixed with older, mulesed sheep (e.g. mixed age ewes). There may be a 6 to 7-year lag between producers ceasing to mules and being able to declare NM status when presenting wool for sale on the NWD. This is due to retention of breeding ewes in the flock, the practice of running mobs of mixed age ewes and the mean age that producers opt to sell their cast for age ewes being 6 years of age (Sloane 2018). Wethers are sold on average at 1.7 years of age, most are sold around 12 months of age, and are less likely to be mulesed than ewe lambs (Table 4). Producers cannot declare NM status on the NWD unless the entire mob is not mulesed (NWD-V9.3 2022). This option requires farms that are transitioning away from mulesing to keep their younger, non-mulesed ewes separate from their older, mulesed ewes. The ceased mulesing (CM) category on the NWD allows for a transitional period in which woolgrowers can declare, at a flock level, that no lambs born on the property in the previous 12 months have been mulesed and that no mulesed (with or without pain relief) ewes or wethers have been purchased in the previous 12 months (NWD-V9.3 2022). Confusion around the definitions of the mulesing status on the NWD and regular changes to the form and the mulesing status definitions may result in reluctance of woolgrowers to fill in that section of the form. There may also be fear among some woolgrowers that by declaring their mulesing status they may lend themselves to being targeted by animal activists as the wool sales catalogues are public documents which name the vendors and their declared mulesing status.

There is strong potential to rectify the disconnect between the NWD and surveys of woolgrowers as the NWD collects identifying data from woolgrowers (such as client ID or Australian Business Number) that could be used to estimate the proportion of woolgrowers using mulesing, which can then be compared with the results of the farmer surveys. These estimates from the NWD could be applied to 85-95% of the woolgrower population, however, private sales that do not go through AWEX would need be considered when interpreting the results.

5.2.2 Pain management at mulesing

Most respondents report using pain management at mulesing (92%, Table 4) which is consistent with that reported by Colvin *et al.* (2021a) and the AWI Wool Industry Profile but slightly higher than reported in the MLA and AWI Wool and Sheepmeat survey (Table 5). Respondents from Victoria and those with larger flock sizes, over 2000 sheep, were significantly more likely to use pain management at mulesing.

The anaesthetic and antiseptic spray Tri-Solfen® was used in 96% of cases with only small percentages using analgesic injections (4%) or oral gel (5%). Only 8.4% of respondents used a combination of pain management products (Table 9). The long acting analgesics Buccalgesic® (oral gel) and Meloxicam® (injectable) were the most commonly used in combination with Tri-Solfen® (local anaesthetic and antiseptic) which is the best practice for pain relief at mulesing (Small *et al.* 2018). The majority of respondents using Tri-Solfen® singly is consistent with that reported by Colvin *et al.* (2021a), there was a small percentage who used oral analgesic for mulesing in that report, all of which used it in combination with Tri-Solfen® (3.4%).

A very small percentage of respondents in the 2021AWI-MHPS used the pain relief product Numnuts® (1%), which is not indicated for mulesing.

Table 9: Unweighted percentages of respondents using a combination of pain management products at mulesing ewe lambs and male lambs. (Ewe lambs n = 669, male lambs n = 562).

Pain management combination	Ewe lambs		Male lambs		Mean all lambs
	n	%	n	%	%
Tri-Solfen® + Numnuts®	5	0.7%	5	0.9%	0.8%
Tri-Solfen® + Meloxicam	20	3.0%	17	3.0%	3.0%
Tri-Solfen® + Buccalgesic®	29	4.3%	27	4.8%	4.6%
Numnuts® + Meloxicam	0	0%	0	0%	0%
Numnuts® + Buccalgesic®	0	0%	0	0%	0%
Sum % using pain mgt in combination	54	8.1%	49	8.7%	8.4%
<i>N using pain mgt</i>	669		562		

*Numnuts® is not indicated for mulesing.

Respondents who used pain management at mulesing generally had multiple reasons for doing so, the main reasons being due to the effectiveness of the product to reduce pain, animal health and welfare outcomes and the product's ease of use (Table 10). Analgesic oral gel, such as Buccalgesic®, had fewer respondents selecting 'ease of use' as a reason for using that product, although it was highest rated product for improved animal health and welfare outcomes. Significantly higher percentages of respondents selected both the analgesic products due to their longer lasting pain management effects (Table 10).

Table 10: Respondent reasons for using the pain management product they used during mulesing. Respondents could select more than one reason.

Reasons for using product	Percentage of respondents selecting reason				
	All products	Tri-Solfen®*	Analgesic/injection (e.g. Metacam®)	Analgesic/oral gel (e.g. Buccalgesic®)	Numnuts®
It works / reduces pain	56%	56%	72%	74%	43%
Fast recovery / promotes healing / minimal bleeding	50%	51%	53%	37%	61%
Effective product	44%	44%	47%	44%	82%
Improved animal health and welfare	42%	42%	47%	57%	61%
Lambs quick to mother-up following treatment	41%	41%	40%	41%	43%
Easy to apply	38%	38%	43%	26%	40%
Have always used it	16%	17%	8%	6%	22%
Industry standard	16%	16%	15%	13%	43%
Availability / unaware of other products	11%	11%	0%	2%	21%
Recommended by retailer / contractor/ stock agent	11%	11%	8%	0%	0%
Lasts longer	10%	6%	46%	48%	0%
Recommended by vet	9%	8%	27%	14%	57%
Other (Please specify)	7%	7%	3%	5%	21%
<i>Number of respondents (n)</i>	672	649	29	38	5

*Tri-Solfen® contains local anaesthetics and antiseptic in a gel spray-on formulation

Only 8% of respondents who mulesed did not use pain relief, they were less likely to select multiple answers and their reasons for doing so were mainly centred around their perception that pain management was not necessary, or they had not considered it (Table 11). Specific answers from those who selected 'other reason' included 'contractor didn't have time/said it was hinderance', 'time consuming', 'not sure how it would work with flystrike product' and 'considering it for next time'. The AWI 2020 Wool Industry Profile survey found 60% of woolgrowers used flystrike products at mulesing, with those from NSW significantly more likely to use have used a product (78%). Extension communications outlining the use of spray-on pain management and how they interact with flystrike products may help boost the numbers of those reluctant to use pain management products.

Table 11: Respondent reasons for why they did not use pain management for mulesing (n = 50).

Reason	Percentage of respondents
Not necessary	35%
Other (Please specify)	27%
No reason / have not considered it	22%
Too expensive	15%
Quick procedure / not practical	13%
Nothing readily available	12%
Added stress / time	10%
Don't know what to use	9%
Vet hasn't suggested it	2%
Don't know	2%

5.2.3 Ceasing mulesing

Woolgrowers who use mulesing

Only around 20% of woolgrowers who mules say they are likely to cease mulesing in the next 5 years which hasn't changed from 2019 to 2021 (Table 12). A similar question in the MLA and AWI Wool and Sheepmeat survey – June 2021 asked for a Yes/No answer. The data from that survey shows an increase those who responded “Yes” from 2017 to 2019, and increasing by almost 2.5 times from 2017 to 2021 (2017: 17%, 2019: 25% and 2021: 42%). However, this data was not split between Merino and non-Merino sheep producers which may be the reason why the 2021 data is so much higher than the 2021AWI-MHPS data of the same year (Table 12).

Table 12: Likelihood of respondents to cease mulesing in the next 5 years as reported in the AWI 2021 Merino Husbandry Practices Survey and the AWI 2020 Wool Industry Profile survey.

Likelihood to cease mulesing in next 5 years	AWI 2020 Wool Industry Profile	AWI 2021 Merino Husbandry Practices Survey			
		Overall	Flock size		
			100-499	500-1,999	2,000+
Very unlikely	31%	32%	34%	32%	32%
Unlikely	32%	28%	18%	25%	33%
Can say either way	20%	19%	17%	21%	18%
Likely	11%	12%	22%	12%	10%
Very likely	7%	8%	8%	10%	6%
<i>Number of respondents (n)</i>	635	722	23	313	386

Woolgrowers who mules indicated that increased use of flystrike chemicals and more frequent crutching were the most likely strategies they would use if mulesing was no longer an option (Figure 1). Breeding sheep resistant to flystrike was also popular (41%). Nearly a quarter indicated that they would change enterprises or leave farming altogether with respondents from NSW significantly more likely to move to a cattle enterprise (24%). These are similar to the methods sheep producers intend to use to cease mulesing as reported in the June 2021 MLA and AWI wool and sheepmeat survey, although that survey saw greater emphasis on breeding: Breeding: 57%, more frequent shearing/crutching: 36%, more chemical: 22%.

A survey of wool producers published in 2010 found that although wool producers disliked the practice of mulesing, those who intended to continue mulesing would do so because they had a stronger dislike of the effects of breech strike which they felt would increase without mulesing (Wells *et al.* 2010). Most wool producers in the 2018 Benchmarking Australian Sheep Parasite Control Practices Survey reported using non-surgical methods of flystrike prevention such as timing of crutching (78%), timing of shearing (59%), preventative chemical treatment (75%) and genetic selection (58%) as they move away from surgical mulesing (Colvin *et al.* 2021a).

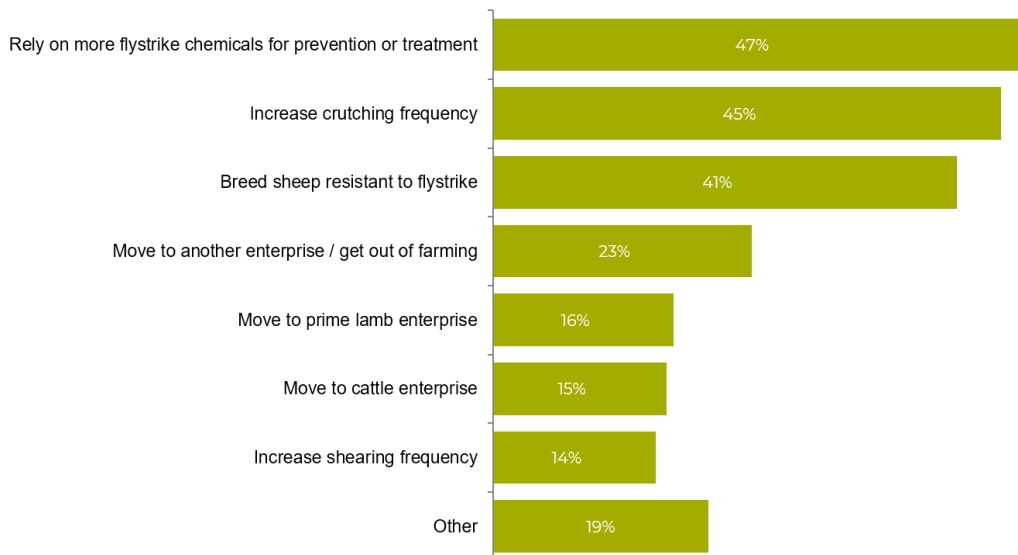


Figure 1: Percentage of respondents indicating alternative strategies they would use if mulesing was no longer an option (n = 722). Source: Sloane (2022).

Woolgrowers who have ceased mulesing

Woolgrowers who have ceased mulesing were more likely to have mulesed in the past than to have never mulesed (Table 13). Woolgrowers in Tasmania were significantly more likely to have never mulesed as were those with small flock sizes of 100-499 sheep and younger woolgrowers aged 25-34 years. Tasmanians were also significantly less likely to mules (14-15% mulesing) than the national average (44-52%, Table 4).

Table 13: Percentage of those who ceased mulesing and those who never mulesed by demographic categories. Figures in blue indicate means that are significantly higher than the overall mean, figures in red indicate means that are significantly lower than the overall mean. There are no statistical tests for all remaining columns as these were averages of ewe and male lamb data.

Demographic		n	Ceased mulesing	Never mulesed
Overall		481	60%	40%
State	NSW	195	67%	33%
	VIC	105	59%	41%
	QLD	45	69%	31%
	SA	58	56%	44%
	WA	53	54%	46%
	TAS	25	25%	75%
Total Flock Size	100 - 499	92	49%	51%
	500 – 1,999	210	62%	38%
	2,000 +	179	84%	16%
Micron	Fine (<20)	345	62%	38%
	Medium (20 +)	136	57%	43%
Body Wrinkle	Low (Score 1)	302	58%	42%
	Medium (Score 2)	167	65%	35%
	High (Score 3 or above)	12	46%	54%
Mules ewe lambs	Yes	0	-	-
	No	481	60%	40%
Mules male lambs	Yes	0	-	-
	No	481	60%	40%
Education	Year 9 or less	26	54%	46%
	Year 10 - 11	98	52%	48%
	School Leaving Certificate (eg HSC)	76	68%	32%
	TAFE	82	56%	44%
	Tertiary Graduate	138	69%	31%
	Post Graduate	55	62%	38%
Age Group	18 – 24	1	0%	100%
	25 – 34	21	27%	73%
	35 – 44	40	78%	22%
	45 – 54	72	61%	39%
	55 – 64	147	59%	41%
	65 and over	198	63%	37%

Most woolgrowers who ceased mulesing did so in the last 16 years (84%) with 50% ceasing mulesing in the last 6 years alone (Table 14). The mean year of ceasing mulesing was 2012 with Queenslanders significantly more likely to have ceased mulesing later than other states with an average cease year of 2016.

Table 14: Percentage of woolgrowers ceasing mulesing by year range (n = 327).

Year ceased mulesing	%
≤1990	3%
1991-1995	0%
1996-2000	5%
2001-2005	8%
2006-2010	17%
2011-2015	17%
2016-2022	50%

The main reason why respondents ceased mulesing was because they were breeding plain bodied sheep with less body wrinkle (Figure 2). Breeding for flystrike resistant sheep is estimated to take up to 10 years (Richards and Atkins 2010; Brien *et al.* 2021) with this data suggesting woolgrowers are seeing their breeding programs coming to fruition giving them the confidence to cease mulesing. Animal ethics and industry pressure also rated highly and would have fed into the reasons that woolgrowers were breeding more plain bodied sheep.

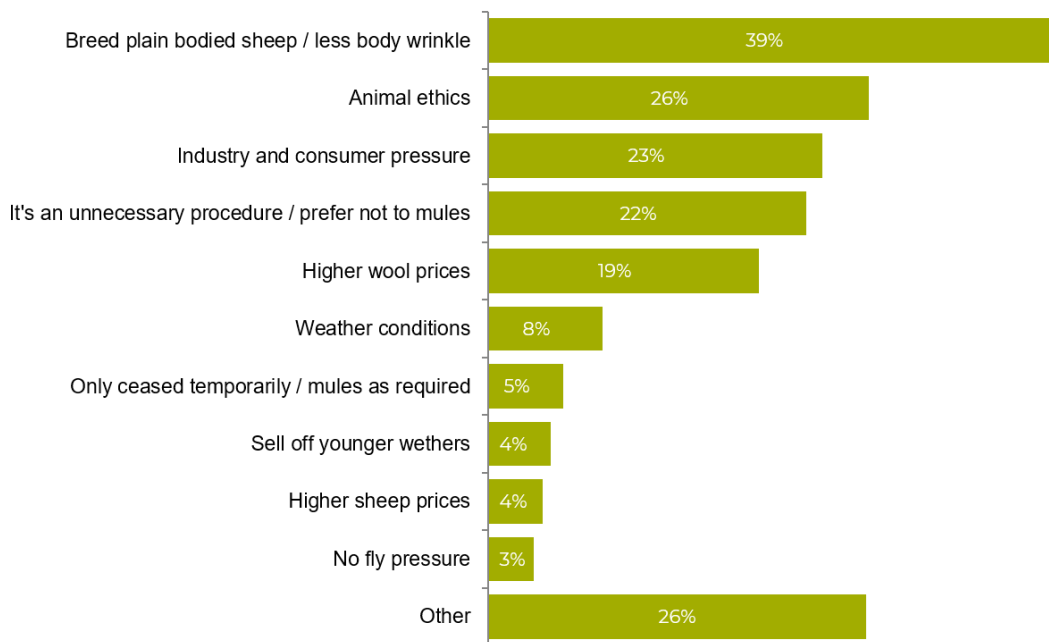


Figure 2: Reasons why woolgrowers ceased mulesing (n = 327). Source: Sloane (2022).

5.3 Trends in tail docking practices of Australian woolgrowers

Most respondents tail dock both ewe lambs (95%) and male lambs (97%) with minimal differences between demographics (Table 15). Those with finer micron sheep were significantly more likely to tail dock their ewe lambs than the national average (98%) and those with medium micron were significantly less likely (92%). Use of tail docking was slightly lower in smaller flocks of 100-499 sheep (94%) than 500-1999 sheep (95%) and 2000+ sheep (98%) but the difference was not significant.

Table 15: Percentage of woolgrowers who tail dock their ewe lambs and male lambs by demographic. Figures in blue indicate means that are significantly higher than the overall mean, figures in red indicate means that are significantly lower than the overall mean.

Demographic		Ewe lambs			Male lambs		
		n	Yes	No	n	Yes	No
	National	1203	95%	5%	1203	97%	3%
State	NSW	422	96%	4%	422	96%	4%
	VIC	269	95%	5%	269	99%	1%
	QLD	63	100%	0%	63	100%	0%
	SA	224	95%	5%	224	96%	4%
	WA	189	94%	6%	189	96%	4%
	TAS	36	99%	1%	36	99%	1%
Total Flock Size	100 - 499	115	94%	6%	115	95%	5%
	500 – 1,999	523	95%	5%	523	97%	3%
	2,000 +	565	98%	2%	565	98%	2%
Micron	Fine (<20)	769	98%	2%	769	98%	2%
	Medium (20 +)	434	92%	8%	434	96%	4%
Body Wrinkle	Low (Score 1)	651	96%	4%	651	96%	4%
	Medium (Score 2)	513	95%	5%	513	98%	2%
	High (Score 3 or above)	39	95%	5%	39	100%	0%
Mules ewe lambs	Yes	718	97%	3%	718	98%	2%
	No	485	94%	6%	485	96%	4%
Mules male lambs	Yes	603	96%	4%	603	97%	3%
	No	600	95%	5%	600	97%	3%
Education	Year 9 or less	64	97%	3%	64	98%	2%
	Year 10 - 11	252	93%	7%	252	95%	5%
	School Leaving Certificate (eg HSC)	236	94%	6%	236	96%	4%
	TAFE	205	96%	4%	205	99%	1%
	Tertiary Graduate	327	97%	3%	327	97%	3%
	Post Graduate	111	96%	4%	111	100%	0%
Age Group	18 – 24	7	100%	0%	7	100%	0%
	25 – 34	48	98%	2%	48	98%	2%
	35 – 44	103	99%	1%	103	99%	1%
	45 – 54	224	95%	5%	224	98%	2%
	55 – 64	371	95%	5%	371	98%	2%
	65 and over	446	95%	5%	446	95%	5%

5.3.1 Methods of tail docking

The most common method used was hot knife (58%), with rings (36%) the second most common (Table 16). This was similar to the AWI 2020 Wool Industry Profile survey that reported 54% of woolgrowers used hot/gas knife to tail dock and 28% used rings. But lower than reported in the AWI 2017 Merino Husbandry Practices Survey for hot knife (68%) and higher for rings (27%).

For both ewe lambs and male lambs, respondents in NSW and TAS were significantly more likely to use rings and less likely to use the hot knife method (Table 16). Those from South Australia were significantly more likely to use the hot knife method (77-78%). These trends were also observed in the AWI 2017 Merino Husbandry Practices Survey where 36% in NSW and 49% in TAS used rings and 91% of SA used hot knife to tail dock. Although the AWI 2020 Wool Industry Profile found a slightly lower percentage of South Australians using hot knife (70%) and 39% of NSW using rings.

Those with smaller flock sizes (100-499 sheep) were significantly more likely to use rings (63-68%) and those with flock sizes over 500 sheep, especially those with 2000+ sheep were more likely to use hot knife. This trend was mirrored in the AWI 2020 Wool Industry Profile where small levy payers were more likely to use rings (32% than large levy payers (13%) who were more likely to use hot knife method (77%).

Those with high wrinkle sheep were significantly more likely to use the hot knife method (92%) as were those who mulesed their ewe lambs (80%) and male lambs (83%). This is similar to the AWI 2017 Merino Husbandry Practices Survey which found 81% of people who mulesed their lambs used a hot knife for tail docking and only 13% used rings. Sheep with higher wrinkle scores would be more likely to be mulesed due their higher risk of flystrike. Rings were significantly more likely to be used by those who do not mules (55-60%).

Those in the 35-44 and 45-54 age groups were more likely to use hot knife than the national average and those 65 and over were more likely to use rings.

Table 16: Percentage of respondents using methods to tail dock ewe lambs and male lambs. Figures in blue indicate means that are significantly higher than the overall mean, figures in red indicate means that are significantly lower than the overall mean.

Demographic	Ewe lambs						Male lambs					
	n	Cold knife	Hot knife	Rings	Shears	Other	n	Cold knife	Hot knife	Rings	Shears	Other
Overall	1156	4%	58%	36%	2%	4%	1174	4%	58%	35%	2%	5%
<i>State</i>												
NSW	406	5%	48%	44%	1%	3%	410	4%	47%	45%	1%	4%
VIC	259	4%	58%	39%	0%	5%	265	5%	58%	37%	0%	5%
QLD	63	14%	23%	56%	6%	4%	63	14%	23%	57%	15%	11%
SA	214	2%	78%	19%	2%	5%	218	2%	77%	18%	1%	4%
WA	179	3%	68%	24%	4%	4%	183	3%	68%	25%	4%	4%
TAS	35	2%	22%	71%	0%	5%	35	2%	22%	71%	0%	5%
<i>Total Flock Size</i>												
100 - 499	108	3%	28%	68%	1%	7%	109	4%	29%	63%	2%	8%
500 – 1,999	496	4%	65%	30%	2%	3%	511	3%	63%	32%	2%	3%
2,000 +	552	5%	76%	17%	2%	3%	554	5%	75%	17%	2%	3%
<i>Micron</i>												
Fine (<20)	753	3%	55%	39%	1%	4%	756	4%	55%	38%	2%	5%
Medium (20 +)	403	5%	64%	30%	2%	4%	418	4%	63%	31%	2%	5%
<i>Body Wrinkle</i>												
Low (Score 1)	629	4%	57%	37%	2%	5%	632	4%	56%	37%	1%	6%
Medium (Score 2)	490	4%	59%	36%	2%	3%	503	4%	58%	35%	3%	3%
High (Score 3 or above)	37	1%	92%	7%	0%	0%	39	1%	92%	7%	0%	0%
<i>Mules ewe lambs</i>												
Yes	696	5%	80%	13%	3%	2%	704	5%	80%	13%	3%	2%
No	460	3%	34%	61%	0%	6%	470	3%	33%	60%	1%	7%
<i>Mules male lambs</i>												
Yes	583	4%	83%	10%	3%	3%	590	4%	83%	10%	3%	3%
No	573	4%	40%	55%	0%	6%	584	4%	38%	55%	1%	6%
<i>Education</i>												
Year 9 or less	62	1%	53%	38%	5%	6%	63	1%	51%	38%	5%	6%
Year 10 - 11	239	5%	59%	34%	2%	4%	243	5%	58%	35%	2%	4%
School Leaving Certificate (eg HSC)	225	3%	61%	33%	3%	3%	228	3%	60%	33%	4%	3%
TAFE	198	6%	50%	43%	1%	2%	202	7%	49%	43%	0%	2%
Tertiary Graduate	319	4%	63%	32%	1%	6%	320	3%	63%	30%	1%	7%
Post Graduate	106	2%	58%	42%	1%	7%	111	2%	57%	38%	1%	7%
<i>Age Group</i>												
18 – 24	7	0%	55%	45%	11%	0%	7	0%	55%	45%	0%	0%
25 – 34	47	2%	61%	46%	2%	8%	47	0%	57%	51%	12%	7%
35 – 44	102	2%	72%	30%	1%	3%	102	2%	72%	25%	1%	3%
45 – 54	214	3%	71%	22%	2%	5%	220	3%	71%	23%	2%	4%
55 – 64	354	4%	62%	32%	2%	2%	361	4%	61%	32%	2%	4%
65 and over	428	5%	47%	44%	1%	5%	433	6%	47%	43%	1%	6%

The main reason respondents used the hot knife method to dock tails in ewe lambs was because it was bloodless/seals the wound (63%, Table 17), this is down slightly from the AWI 2017 Merino Husbandry Practices Survey of 72% selecting the same reason. Other reasons such as the method was 'clean and neat', 'less stress' and 'quick' were also popular for hot knife tail docking. Those using cold knife were using this method because it was less stress, quick, effective, efficient and a better/preferable method that suits their program/operation. These were comparable to the AWI 2017 Merino Husbandry Practices Survey (37% better/preferable method that suits their program/operation, 22% easy and simple to use and 21% less stress). Rings were used primarily because they are easy to use (45%) with the next most common reasons being bloodless and clean/neat (Table 17) and was, again, very similar to the AWI 2017 Merino Husbandry Practices Survey (34% easy/simple to use, 28% less/no blood).

Table 17: Reason for using tail docking method in ewe lambs (reasons for male lambs very similar).

Reason	Tail docking method – ewe lambs			
	Cold knife	Hot knife	Rings	Shears
Bloodless / seals the wound	3%	63%	34%	0%
Clean / Neat	22%	36%	31%	21%
Less stress / farm to animals / recovery	30%	35%	28%	13%
Quick	31%	34%	17%	19%
Effective	33%	27%	22%	10%
Efficient	32%	26%	19%	25%
Easy to use	26%	24%	45%	23%
Better / preferable method, suits my program / operation	31%	24%	21%	23%
Less infection	15%	23%	16%	2%
Less fly strike	19%	22%	18%	17%
Reliable	18%	19%	17%	21%
Contractor preferred method	6%	18%	3%	35%
Cost effective	15%	15%	10%	12%
Other (Please specify)	11%	10%	14%	19%
Operator safety	2%	7%	13%	4%
Number of respondents	56	745	324	24

5.3.2 Docked tail length

Industry recommended best practice is to dock tails at 3 or 4 joints. About half of respondents reported docking tails at 2 joints (51-55%) and 32-37% docking at the recommended 3 joints (Table 18). Very few are docking at 1 joint or 4 joints. These results are similar to those reported in the AWI 2017 Merino Husbandry Practices Survey where 48% docked to 3 joints and 39% docked to 2 joints. The AWI 2020 Wool Industry Profile reported slightly different figures with 29% docking to 2 joints and 48% docking to 3 joints and to the tip of the vulva, combined. There were 9% of woolgrowers in that survey who did not know what length they docked their lamb tails.

Respondents in SA were significantly more likely to dock tails at 2 joints than the national average for both ewe lambs (66%) and male lambs (67%, Table 18). Those in WA were significantly less likely to dock tails at 2 joints (35-40%), although, in this state, similar percentages docked too short (45-51% at 1 or 2 joint combined) or at the desired length (43-49% at joints 3 or 4, combined).

Those with large flock sizes over 2000 sheep were significantly more likely to dock tails at 3 joints (45%).

Adverse outcomes for docking tails too short include increased predisposition to rectal prolapse, increased skin cancers of the perineal region, increased risk of bacterial arthritis and, potentially, increased risk of breech strike as the animal cannot raise their tail to defecate or flick flies away (Lloyd *et al.* 2016; Lloyd 2019). A study by Woodruff *et al.* (2020) found that 57% of farmers docked lamb tails too short (1-2 joint) and that this was influenced largely by unawareness of the recommended length and docking to a length that their shearers approve of. Other potential reasons cited in that study were the lack of knowledge of the negative health consequences associated with short

tails and greater importance placed on preventing dags and flystrike as well as the impracticality of measuring where to dock tails during the procedure.

Table 18: Length at which respondents dock tails of ewe lambs and male lambs by demographic. Figures in blue indicate means that are significantly higher than the overall mean, figures in red indicate means that are significantly lower than the overall mean.

Demographic	Ewe lambs						Male lambs					
	n	1 joint	2 joints	3 joints	4 joints	Other	n	1 joint	2 joints	3 joints	4 joints	Other
Overall	1156	7%	51%	37%	3%	3%	1174	8%	55%	32%	3%	2%
<i>State</i>												
NSW	406	6%	52%	39%	2%	1%	410	7%	59%	32%	1%	1%
VIC	259	6%	45%	40%	6%	3%	265	8%	48%	36%	6%	2%
QLD	63	2%	59%	29%	0%	11%	63	8%	64%	19%	0%	9%
SA	214	5%	66%	25%	3%	1%	218	4%	67%	25%	2%	1%
WA	179	10%	35%	46%	3%	6%	183	11%	40%	40%	3%	6%
TAS	35	17%	53%	29%	1%	0%	35	17%	55%	27%	1%	0%
<i>Flock size</i>												
100 - 499	108	11%	52%	30%	3%	4%	109	11%	53%	29%	3%	4%
500 – 1,999	496	7%	54%	34%	2%	3%	511	7%	58%	29%	2%	3%
2,000 +	552	3%	46%	45%	4%	1%	554	5%	53%	38%	3%	1%
<i>Micron</i>												
Fine (<20)	753	6%	47%	41%	4%	3%	756	7%	51%	36%	3%	3%
Medium (20 +)	403	8%	57%	31%	3%	1%	418	9%	62%	27%	2%	1%
<i>Body wrinkle</i>												
Low (Score 1)	629	6%	49%	38%	4%	3%	632	6%	54%	34%	3%	3%
Medium (Score 2)	490	7%	53%	35%	3%	2%	503	8%	57%	31%	2%	2%
High (Score 3 or above)	37	18%	40%	39%	0%	3%	39	20%	48%	30%	0%	3%
<i>Mules ewe lambs</i>												
Yes	696	5%	51%	38%	3%	3%	704	6%	56%	33%	3%	3%
No	460	9%	50%	36%	3%	2%	470	9%	54%	32%	3%	2%
<i>Mules male lambs</i>												
Yes	583	5%	50%	38%	3%	3%	590	5%	56%	33%	3%	3%
No	573	8%	51%	36%	3%	2%	584	9%	54%	32%	2%	2%
<i>Education</i>												
Year 9 or less	62	5%	64%	24%	7%	1%	63	9%	63%	21%	7%	1%
Year 10 - 11	239	10%	49%	37%	2%	2%	243	10%	52%	35%	2%	2%
School Leaving Certificate (eg HSC)	225	6%	53%	38%	1%	2%	228	10%	57%	30%	1%	2%
TAFE	198	7%	52%	35%	2%	3%	202	6%	60%	29%	2%	3%
Tertiary Graduate	319	5%	47%	40%	5%	3%	320	6%	51%	35%	5%	3%
Post Graduate	106	4%	50%	40%	4%	2%	111	4%	55%	36%	4%	1%
<i>Age</i>												
18 – 24	7	11%	20%	68%	0%	0%	7	11%	22%	66%	0%	0%
25 – 34	47	2%	42%	46%	9%	1%	47	2%	44%	46%	9%	0%
35 – 44	102	8%	43%	41%	6%	2%	102	9%	46%	38%	5%	2%
45 – 54	214	6%	50%	38%	4%	2%	220	8%	57%	30%	3%	2%
55 – 64	354	6%	48%	38%	2%	5%	361	7%	53%	33%	2%	4%
65 and over	428	7%	55%	34%	3%	1%	433	8%	59%	30%	2%	1%

In this survey most respondents cut to tails to their desired length to protect the genital area, provide protection from skin cancers or to allow tail movement to flick away flies and prevent breech strike (Table 19). This data included all tail docking lengths, hence, these main reasons were most likely related to docking at 3 joints or longer or respondents did not know which length is recommended.

Those who mulesed their lambs were significantly more likely to rely on contractors to decide the length at which to dock tails and were significantly more likely to select 'provide skin protection/prevent skin cancers' (53%, Table 18), these farmers were also more likely to dock at 3 joints (Table 18). Those with a tertiary level of education and those aged between 25-34 and 35-44 were significantly more likely to select 'specific health reasons such as prolapse, nerve damage, arthritis' as the reasons why they chose the length of tail docking (22%, 48% and 28%, respectively). Those farmers over 65 years of age were much less likely to choose that reason (9%). Farmers aged between 25-34 were also highly likely to choose 'allow movement/flick away flies/help prevent breech strike' as their reason for tail docking length (Table 19).

Table 19: Reasons why respondents chose the tail length at which to dock by demographic. Figures in blue indicate means that are significantly higher than the overall mean, figures in red indicate means that are significantly lower than the overall mean.

Demographic		n	Allow tail movement /flick away flies /help prevent breech strike	Farm tradition	Specific health reasons such as prolapse, nerve damage, arthritis	Industry standard /best practice	Keeps the area clean	Length decided by contractor	Prefer a longer tail/ aesthetic reasons	Protect the genital area	Provide sun protection/ prevent skin cancers	Satisfactory length /easy to manage	Suits our operation
Total		1156	38%	9%	15%	20%	24%	6%	4%	51%	48%	18%	11%
State	NSW	406	42%	10%	14%	21%	24%	4%	3%	49%	48%	14%	10%
	VIC	259	32%	6%	18%	19%	26%	5%	3%	47%	41%	17%	9%
	QLD	63	25%	16%	2%	10%	12%	0%	2%	59%	39%	10%	6%
	SA	214	42%	11%	17%	21%	24%	7%	4%	54%	52%	25%	14%
	WA	179	34%	5%	15%	18%	22%	9%	6%	59%	58%	18%	15%
	TAS	35	60%	15%	22%	19%	33%	0%	27%	27%	27%	19%	19%
Flock size	100 - 499	108	40%	10%	10%	10%	22%	3%	4%	46%	42%	10%	9%
	500 – 1,999	496	34%	10%	11%	16%	22%	6%	3%	49%	44%	18%	9%
	2,000 +	552	41%	6%	24%	30%	27%	7%	5%	57%	57%	23%	15%
Micron	Fine (<20)	753	40%	7%	16%	21%	23%	6%	3%	49%	48%	16%	10%
	Medium (20 +)	403	36%	12%	14%	17%	26%	5%	5%	56%	49%	21%	14%
Wrinkle	Low (Score 1)	629	39%	10%	18%	18%	20%	5%	4%	54%	49%	16%	10%
	Medium (Score 2)	490	38%	8%	13%	22%	28%	6%	3%	49%	47%	20%	13%
	High (Score 3 or above)	37	33%	9%	9%	16%	38%	5%	11%	35%	59%	27%	14%
Mules ewe lambs	Yes	696	35%	8%	15%	22%	26%	9%	4%	56%	53%	21%	11%
	No	460	41%	10%	15%	17%	22%	2%	3%	46%	42%	15%	11%
Mules male lambs	Yes	583	36%	8%	14%	22%	24%	9%	4%	57%	53%	21%	12%
	No	573	40%	10%	16%	18%	24%	3%	3%	47%	44%	15%	11%
Education	Year 9 or less	62	45%	9%	5%	4%	27%	3%	6%	48%	45%	13%	10%
	Year 10 - 11	239	35%	8%	10%	12%	27%	6%	3%	42%	40%	15%	11%
	School Leaving Certificate (eg HSC)	225	37%	10%	12%	18%	24%	5%	4%	44%	46%	23%	18%
	TAFE	198	32%	15%	13%	23%	18%	5%	4%	57%	47%	13%	13%
	Tertiary Graduate	319	39%	5%	22%	23%	27%	6%	5%	60%	55%	18%	6%
	Post Graduate	106	53%	7%	23%	34%	20%	8%	1%	49%	55%	22%	11%
Age group	18 – 24	7	22%	34%	11%	11%	21%	12%	0%	56%	89%	21%	0%
	25 – 34	47	78%	10%	43%	28%	25%	9%	7%	51%	64%	18%	13%
	35 – 44	102	40%	10%	28%	27%	27%	5%	1%	59%	48%	17%	15%
	45 – 54	214	34%	9%	20%	25%	25%	8%	6%	52%	48%	23%	15%
	55 – 64	354	36%	6%	14%	19%	22%	6%	3%	50%	53%	17%	13%
	65 and over	428	38%	10%	9%	16%	25%	4%	4%	50%	42%	15%	8%

5.3.3 Pain management at tail docking

Nearly two-thirds of woolgrower respondents reported using pain relief in ewe lambs and male lambs at tail docking (60%, Table 22) which is an increase of 20% from the AWI 2017 Merino Husbandry Practices Survey (42%), however, that survey combined tail docking with castration in one question on pain management for those procedures. The increase in use of pain management around tail docking could be due to increased familiarity with Tri-Solfen® and other pain management products becoming available for use with the procedure in the last 5 years (Table 21). It is encouraging to note that those using the hot knife method for tail docking (which was the most common method) were highly likely to use pain management (80%) and were less likely to use an unsuitable pain management product (3%). Respondents who mulesed were more likely to use pain management for cold knife, hot knife and shears than those who do not mules (Table 22). This is likely due to the procedures being carried out at the same time as both the 2017 Merino Husbandry Practices Survey and the AWI 2020 Wool Industry Profile survey found 94-96% of woolgrowers mules their lambs at lamb marking.

Tri-Solfen® was the most commonly used pain management product for tail docking (84%), followed by Buccalgesic® (10%), Meloxicam (7%) and Numnuts® (6%). There were a small number of respondents using combinations of pain management products for tail docking (9.3%, Table 20). The combination of Tri-Solfen® and a longer acting analgesic such as Buccalgesic® or Meloxicam was most common with very small numbers using NumOcaine®/Numnuts® in combination with an analgesic. There was a very small percentage using the hot knife method of tail docking reporting the use of two local anaesthetics Tri-Solfen® and Numnuts®, it is probable these respondents were confused about which product they were using or used the Numnuts® for castration and hot knife for tail docking and confused which product was applied for each procedure.

Table 20: Unweighted percentages of respondents using a combination of pain management products at tail docking by method and sex of lamb.

Product combination	Ewe lambs								Male Lambs								Mean all lambs
	Cold knife		Hot knife		Rings		All methods		Cold knife		Hot knife		Rings		All methods		All methods
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	%
Tri-Solfen® + Numnuts®	0	0%	8	1%	0	0%	8	1%	0	0%	8	1%	0	0%	8	1%	1%
Tri-Solfen® + Meloxicam	3	9%	20	3%	2	2%	25	3%	2	6%	18	3%	2	2%	22	3%	3%
Tri-Solfen® + Buccalgesic®	1	3%	27	4%	2	2%	30	4%	2	3%	18	4%	2	2%	22	3%	3%
Numnuts® + Meloxicam	0	0%	2	0.3%	0	0%	2	0.3%	0	0%	2	0.3%	0	0%	2	0.3%	0.3%
Numnuts® + Buccalgesic®	0	0%	7	1%	3	3%	10	1%	0	0%	7	1%	3	0%	10	1%	1%
Sum % using Pain Mgt in Combination	4	11%	64	10%	7	7%	75	10%	4	9%	53	10%	7	4%	64	9%	9.3%
<i>N using pain management</i>	35		612		101		748		34		613		104		751		

There is some confusion among woolgrowers as to which pain management products are suitable for different methods of tail docking. Only 25% used pain management for tail docking with rings, however, of those who reported using pain management for that method of tail docking, 57% used an unsuitable product (Table 22). That percentage rose to 89-93% for those who mulesed their lambs, however, the numbers using rings and mulesing were very low (ewe lambs: 13% and male lambs: 10%, Table 22). Those with a tertiary or post-graduate level of education were less likely to use unsuitable pain management products with rings (31% and 43%, respectively).

In the case of those using rings, the unsuitable product used was Tri-Solfen®. Tri-Solfen® is only indicated for used with mulesing and with tail docking with a knife and castration with a knife (Table 21).

For the small number who mulesed and used rings for tail docking (13%), and reported using Tri-Solfen® for pain management, two possibilities for this behaviour could be:

1. Respondents are using Tri-Solfen® on a mulesing wound and thinking it also treats tail docking as it is in the same area of the animal.
2. Respondents are using Tri-Solfen® on a mulesing wound and spraying a bit on the tail area (ring) expecting it to deliver pain management through the wool and skin.

The main reason given for those who mules and use Tri-Solfen® for pain management at tail docking was that it works to reduce pain (Table 23). Faster recovery/promotes healing/minimal bleeding, lambs quick to mother up and effective product were also commonly chosen reasons for using Tri-Solfen®, attributes that may be confused with the reasons for using Tri-Solfen® for the mules operation. Interestingly, there was a large reduction in the number of respondents choosing “availability/unaware of other products” (11%) from the AWI 2017 Merino Husbandry Practices survey where it was the most common reason at 25% (Sloane 2018). This may be due to Tri-Solfen® being reclassified as a S5 drug in 2014-2015 which means it is available from major rural retailers and is not restricted to veterinary control. Increased uptake of pain management products for painful sheep husbandry procedures is encouraging, however, more needs to be done to ensure the retailers and consumers of Tri-Solfen® are aware of the applications and limitations of the product.

There remain 37-46% woolgrowers not mulesing lambs who use Tri-Solfen® for pain management for tail docking with rings (Table 22). Tri-Solfen® has been available for pain management in sheep for 10 years (Table 21) and its use is widespread in the wool industry for the mulesing procedure. Woolgrowers are familiar with the product and the ease of purchase, as it is available from rural merchandisers rather than from a veterinary surgeon, would have contributed to its widespread use. Injectable and oral analgesics, or non-steroidal anti-inflammatories (NSAIDs), have been available for sheep for a relatively short period of time (5-6 years) and are only available from veterinary surgeons which restricts easy access to the drugs. NumOcaine® with its delivery through the Numnuts® device is the most recent pain management product and is only for use during castration and tail docking with rings. It offers pain management for a very short duration (<1hour) and is currently only available from veterinary surgeons. There was a small percentage of respondents reporting the use of Numnuts® for pain relief when using a hot knife. That product is only for use with rings and is only applied through the use of the patented device which also applies the ring to the tail. These data may indicate confusion between which product or which method was used during tail docking.

Table 21: Pain management products registered for use in sheep in Australia. Drug classes: S5 – available over the counter from major distributors directly to farmers, S4 – Purchase from veterinary surgeon only.

Pain management product	Method of application	Active ingredients	Type of medication	Duration of pain management	Indicated procedures	Drug class	Year available for use in sheep
Tri-Solfen®	Topical spray gel to wound	Lignocaine (40.6mg/ml)	Local anaesthetic	12 to 24 hours	Mulesing, tail docking by knife, castration by knife	S5	2012 - mulesing 2016 – castration and tail docking
		Bupivacaine (4.2mg/ml)	Local anaesthetic				
		Cetrimide (5.0mg/ml)	Antiseptic				
		Adrenaline (24.8mg/L)	Reduces bleeding				
Metacam®	Subcutaneous injection behind ear	Meloxicam (20mg/ml)	Analgesic (non-steroidal anti-inflammatory)	24 to 72 hours	Mulesing, castration and tail docking – all methods	S4	2016
Illium Buccalgesic®	Oral gel	Meloxicam (10mg/ml)	Analgesic (non-steroidal anti-inflammatory)	24 to 72 hours	Mulesing, castration and tail docking – all methods	S4	2017
NumOcaine®/ Numnuts®	Subcutaneous injection with Numnuts® device into tail or scrotum	Lignocaine (17.2mg/ml)	Local anaesthetic	<1 hour	Castration and tail docking with rings	S4	2019

Table 22: Mean percentage of respondents who used a pain management product during tail docking of lambs by tail docking method, and the mean percentage of those using *unsuitable* pain management products for the method used. For “All methods” only: figures in blue indicate means that are significantly higher than the overall mean, figures in red indicate means that are significantly lower than the overall mean. There are no statistical tests for all remaining columns as these were averages of ewe and male lamb data.

Demographic		Percentage using pain relief - <u>all</u> pain management products										Percentage using <i>unsuitable</i> pain management products							
		All methods		Cold knife		Hot knife		Rings		Shears		Cold knife		Hot knife*		Rings [†]		Shears	
		n	% Yes	n	% Yes	n	% Yes	n	% Yes	n	% Yes	n	%	n	%	n	%	n	%
<i>Overall</i>		1182	60%	56	54%	745	80%	331	25%	24	74%	35	0%	613	3%	103	57%	18	0
<i>State</i>	NSW	414	52%	18	51%	225	82%	155	20%	7	86%	12	0%	187	3%	39	63%	6	0
	Vic	267	63%	10	42%	176	81%	77	39%	0		6	0%	149	3%	32	45%	0	-
	Qld	63	42%	16	60%	17	83%	23	17%	8	52%	9	0%	13	0%	9	83%	5	0
	SA	22	70%	5	60%	182	82%	28	23%	3	63%	3	0%	150	1%	8	73%	2	0
	WA	183	66%	6	80%	132	77%	35	28%	6	88%	5	0%	103	7%	14	54%	5	0
	TAS	35	24%	1	0%	15	74%	15	6%	0	-	0	-	12	0%	3	71%	0	-
<i>Flock size</i>	100-499	112	32%	4	0%	31	66%	71	16%	2	71%	0	0%	20	0%	11	44%	1	0
	500-1,999	513	61%	19	54%	310	78%	165	28%	6	78%	11	0%	241	1%	46	69%	8	0
	2000+	557	80%	33	80%	405	87%	96	48%	9	80%	24	0%	352	5%	46	57%	10	0
<i>Micron</i>	Fine (<20)	761	58%	34	49%	457	79%	240	27%	15	65%	18	0%	374	4%	79	50%	11	0
	Medium (20+)	421	62%	22	60%	288	82%	91	22%	9	87%	17	0%	239	1%	24	75%	7	0
<i>Body wrinkle</i>	Low (score 1)	640	55%	32	46%	395	75%	187	24%	13	96%	17	0%	306	5%	56	48%	12	0
	Medium (Score 2)	503	64%	23	64%	317	87%	142	28%	11	57%	18	0%	277	2%	47	68%	6	0
	High (Score 3 or above)	39	77%	1	0%	34	83%	3	0%	0	-	0	-	30	3%	0	-	0	-
<i>Mules ewe lambs</i>	Yes	709	84%	34	74%	560	91%	86	50%	21	83%	28	0%	509	1%	46	89%	17	0
	No	473	32%	22	21%	185	54%	245	19%	3	41%	7	0%	104	13%	57	37%	2	0
<i>Mules male lambs</i>	Yes	595	85%	23	85%	486	90%	57	49%	21	83%	20	0%	439	1%	51	93%	17	0
	No	587	40%	33	33%	260	65%	275	22%	3	43%	15	0%	174	8%	71	46%	2	0
<i>Education</i>	Year 9 or less	63	51%	1	100%	38	83%	17	9%	4	47%	1	0%	32	0%	3	100%	2	0
	Year 10-11	245	58%	13	35%	158	77%	64	24%	7	92%	6	0%	129	1%	17	50%	6	0
	School leaving certificate	231	65%	12	78%	142	81%	67	32%	5	72%	8	0%	117	2%	21	87%	4	0
	TAFE	203	46%	11	33%	124	79%	63	11%	2	100%	5	0%	103	2%	11	100%	2	0
	Tertiary graduate	322	69%	17	76%	209	85%	85	35%	4	69%	13	0%	177	5%	34	31%	3	0
	Post graduate	111	61%	3	80%	70	77%	35	38%	2	100%	2	0%	55	7%	17	43%	2	0
<i>Age</i>	18-24	7	66%	0	-	5	100%	2	24%	1	100%	0	-	5	20%	1	100%	1	0
	25-34	48	63%	1	100%	32	81%	17	42%	2	63%	1	0%	25	3%	7	19%	2	0
	35-44	103	78%	4	83%	74	87%	24	53%	1	100%	3	0%	64	8%	12	50%	1	0
	45-54	221	66%	9	81%	155	77%	42	30%	6	67%	6	0%	68	2%	67	58%	4	0
	55-64	362	60%	16	51%	239	79%	94	21%	8	100%	10	0%	195	3%	29	61%	8	0
	65 and over	437	52%	27	45%	239	82%	151	21%	6	50%	15	0%	196	2%	41	63%	3	0

*Unsuitable product used was Numnuts® for hot knife method

†Unsuitable product used was Tri-Solfen® for ring method.

Table 23: Respondent reasons for using Tri-Solfen® for pain relief around tail docking for all methods of tail docking as well as reasons by whether respondents mules or did not mules their ewe lambs and male lambs. Respondents could select more than one answer.

Reason for using Tri-Solfen®	Total	Do you mules ewe lambs		Do you mules male lambs	
		Yes	No	Yes	No
It works / reduces pain	55%	58%	41%	58%	50%
Fast recovery / promotes healing / minimal bleeding	48%	50%	39%	50%	43%
Improved animal health and welfare	42%	44%	32%	45%	35%
Lambs quick to mother-up following treatment	40%	42%	29%	42%	33%
Effective product	40%	41%	34%	42%	35%
Easy to apply	34%	35%	26%	37%	25%
Have always used it	19%	20%	11%	21%	14%
Industry standard	19%	19%	18%	19%	17%
Recommended by retailer / contractor/ stock agent	10%	10%	9%	11%	9%
Other (Please specify)	9%	10%	5%	11%	6%
Availability / unaware of other products	11%	9%	17%	10%	12%
Recommended by vet	8%	8%	7%	8%	8%
Lasts longer	7%	6%	9%	7%	7%
Number of respondents (n)	676	576	100	488	188

Those who did not use pain management at tail docking did not use it because they thought it was unnecessary (50%), they had no reason/had not considered it (25%) or thought the procedure was quick and pain relief not practical in that situation (Figure 3).

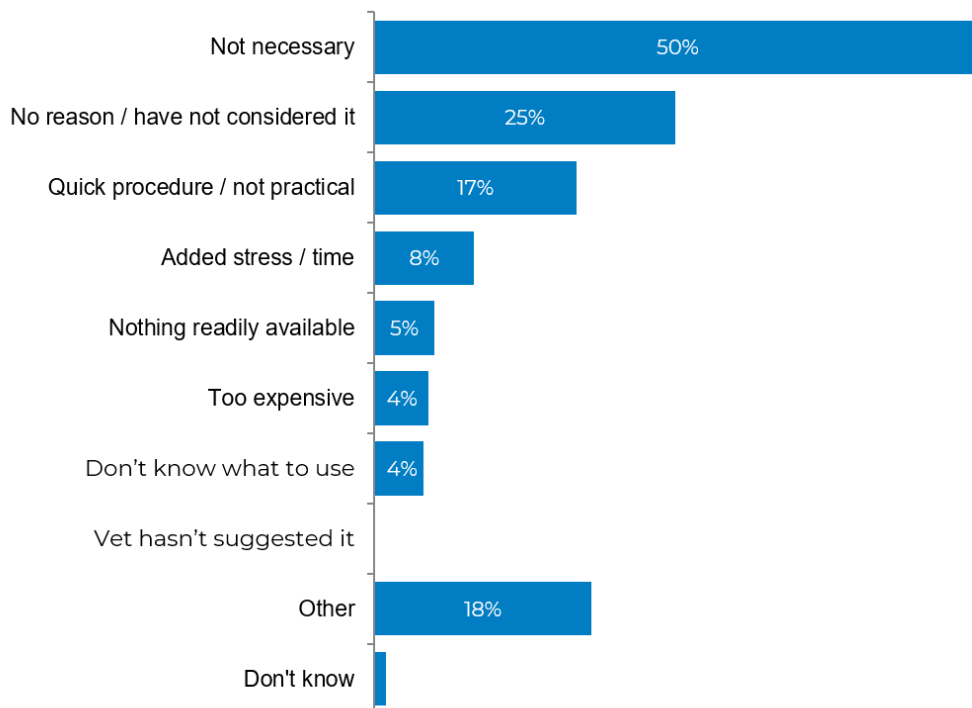


Figure 3: Reason why pain management was not given at tail docking (n = 398). Source: Sloane, 2021.

5.4 Trends in castration practices of Australian woolgrowers

Most woolgrowers castrate their male lambs (98%) and there were no significant differences between demographics (Table 24).

Table 24: Percentage of woolgrowers castrating male lambs by demographic group. Figures in blue indicate means that are significantly higher than the overall mean, figures in red indicate means that are significantly lower than the overall mean.

Demographic	Woolgrowers castrating male lambs		
	n	Yes	No
National	1203	98%	2%
<i>State</i>			
NSW	422	98%	2%
VIC	269	99%	1%
QLD	63	99%	1%
SA	224	97%	3%
WA	189	96%	4%
TAS	36	100%	0%
<i>Total Flock Size</i>			
100 - 499	115	97%	3%
500 – 1,999	523	98%	2%
2,000 +	565	98%	2%
<i>Micron</i>			
Fine (<20)	769	98%	2%
Medium (20 +)	434	97%	3%
<i>Body Wrinkle</i>			
Low (Score 1)	651	97%	3%
Medium (Score 2)	513	99%	1%
High (Score 3 or above)	39	95%	5%
<i>Mules ewe lambs</i>			
Yes	718	98%	2%
No	485	97%	3%
<i>Mules male lambs</i>			
Yes	603	98%	2%
No	600	98%	2%
<i>Education</i>			
Year 9 or less	64	100%	0%
Year 10 - 11	252	95%	5%
School Leaving Certificate (eg HSC)	236	97%	3%
TAFE	205	97%	3%
Tertiary Graduate	327	100%	0%
Post Graduate	111	98%	2%
<i>Age Group</i>			
18 – 24	7	100%	0%
25 – 34	48	98%	2%
35 – 44	103	99%	1%
45 – 54	224	98%	2%
55 – 64	371	96%	4%
65 and over	446	98%	2%

5.4.1 Methods of castration

Rings as the method of castration were almost universally used (97%, cold knife: 2%, shears/knife: 1%) with very few differences between demographics (Table 25), this is similar to results from the AWI 2017 Merino Husbandry Practices Survey (rings: 95%, cold knife: 4% and shears/knife: 1%) and the AWI 2020 Wool Industry Profile (rings: 90%, cold knife: 3% and other 3%).

Respondents from NSW were significantly less likely to use rings than the national average, however, 95% of this demographic used rings and the difference was only 2% (Table 25). Both those who have sheep with high body wrinkle (Score 3 or above) and those aged 18-24 were significantly more likely to use shears/knife method for castration.

Table 25: Percentage of farmers using castration method by demographic. Figures in blue indicate means that are significantly higher than the overall mean, figures in red indicate means that are significantly lower than the overall mean.

Demographic		Methods used of castration				
		n	Cold knife	Rings	Shears / Knife	Other
	National	1177	2%	97%	1%	1%
<i>State</i>	NSW	414	4%	95%	1%	1%
	VIC	265	1%	98%	0%	1%
	QLD	62	13%	96%	0%	9%
	SA	217	1%	99%	0%	0%
	WA	183	0%	100%	0%	0%
	TAS	36	5%	96%	0%	1%
<i>Total Flock Size</i>	100 - 499	112	2%	99%	0%	1%
	500 – 1,999	512	2%	97%	0%	1%
	2,000 +	553	2%	96%	1%	1%
<i>Micron</i>	Fine (<20)	754	3%	97%	1%	1%
	Medium (20 +)	423	2%	98%	0%	1%
<i>Body Wrinkle</i>	Low (Score 1)	633	1%	98%	0%	1%
	Medium (Score 2)	507	3%	97%	1%	1%
	High (Score 3 or above)	37	2%	95%	5%	0%
<i>Mules ewe lambs</i>	Yes	704	3%	96%	1%	1%
	No	473	2%	98%	0%	1%
<i>Mules male lambs</i>	Yes	590	3%	96%	1%	1%
	No	587	2%	98%	0%	1%
<i>Education</i>	Year 9 or less	64	1%	96%	0%	3%
	Year 10 - 11	242	0%	99%	1%	0%
	School Leaving Certificate (eg HSC)	229	2%	98%	1%	0%
	TAFE	200	3%	96%	1%	1%
	Tertiary Graduate	326	4%	96%	1%	2%
	Post Graduate	109	3%	98%	0%	0%
<i>Age Group</i>	18 – 24	7	0%	100%	11%	0%
	25 – 34	46	4%	96%	0%	0%
	35 – 44	102	0%	99%	2%	0%
	45 – 54	220	3%	96%	0%	0%
	55 – 64	360	2%	98%	0%	1%
	65 and over	438	2%	97%	1%	2%

5.4.2 Pain management at castration

Over all methods of castration, only 30% reported using pain management at castration (Table 29), similar to the AWI 2020 Wool Industry Profile (29%). Pain management products for use with castration have been available for a shorter period than for mulesing. Tri-Solfen® was registered for use with cold knife techniques in 2016 and analgesics have been registered for use with castration since 2016/2017 and the local anaesthetic product NumOcaine®/Numnuts since 2019 (Table 21).

Respondents who mulesed their lambs were significantly more likely to use pain management for castration (37%), as were those with large flock sizes over 2000 sheep (38%) and tertiary graduates (37%). As seen in Table 4, those with larger flock sizes were more likely to mules their lambs hence, with high the rate of use of pain management during mulesing, are more likely to have a pain management product on hand for castration. Those in Tasmania and those with small flock sizes between 100-499 sheep were significantly less likely to use pain management at castration (13% and 19%, respectively, Table 29). These demographic groups were also less likely to mules (Table 4).

The most common pain management product used during castration was Tri-Solfen® (59%), then NumOcaine/Numnuts® (17%), Buccalgesic® (16%) and Meloxicam (12%). This is in slight contrast to the results of the

AWI 2020 Wool Industry Profile that reported a much higher use of Tri-Solfen® during castration (87%) with lower percentages using Buccalgesic® (9%), Meloxicam (1%) and Numnuts® (1%).

Over all methods of castration, only a small number of respondents used pain management products in combination (8%, Table 26). Most used the combination of a local anaesthetic (Tri-Solfen® or NumOcaine®/Numnuts®) and an analgesic (Buccalgesic® or Meloxicam). A few reported using two local anaesthetics which may have been due to confusion between which products were used for castration which is generally carried out along with mulesing and tail docking.

Table 26: Unweighted percentages of respondents using a combination of pain management products at castration by method.

Product combination	Cold knife		Rings		Shears/knife		All methods	
	n	%	n	%	n	%	n	%
Tri-Solfen® + Numnuts®	1	6%	4	1%	0	0%	5	1%
Tri-Solfen® + Meloxicam	0	0%	5	1%	0	0%	5	1%
Tri-Solfen® + Buccalgesic®	0	0%	9	2%	1	14%	10	3%
Numnuts® + Meloxicam	0	0%	2	1%	0	0%	2	1%
Numnuts® + Buccalgesic®	0	0%	9	2%	0	0%	9	2%
Sum % using pain mgt in combination	1	6%	29	8%	1	14%	31	8%
<i>N using pain management</i>	<i>16</i>		<i>367</i>		<i>7</i>		<i>390</i>	

Similar to tail docking, there was confusion over which products were suitable for pain relief for castration with 58% of respondents who used pain management for 'rings' reporting the use of Tri-Solfen® which is an unsuitable product for ring castration (Table 29). Those who mules their ewe lambs and male lambs were significantly more likely to report using Tri-Solfen® for castration pain management. Castration and tail docking are generally carried out simultaneously with mulesing and it is probable that those respondents wrongly assumed that the Tri-Solfen® they applied for mulesing was also providing pain management for castration. It is also possible that Tri-Solfen® was applied to the scrotum during castration with the view that it would be absorbed through the wool and skin which it is not designed to do. The most common reason why respondents used Tri-Solfen® at castration was because they believe it works and reduces pain, very few use it because it was recommended by a vet or by a retailer, contractor or agent (Table 27).

Tri-Solfen® is appropriate for use with cold knife and shears castration methods and suitable pain management products for castration with rings are the injectable meloxicam products Metacam® and Buccalgesic®, and the more recently available NumOcaine® delivered with the Numnuts® device which also applies the ring for castration. Some respondents who used the cold knife method for castration reported Numnuts® as the pain management product which is unsuitable for that method (Table 29). There was also a small number of respondents who reported using pain management for castration but their specified product was a flystrike prevention chemical or they could not recall which product they had used.

Improved animal welfare outcomes and effectiveness of the product to reduce pain were the main reasons why respondents used the analgesic products (e.g. Metacam® or Buccalgesic®) and Numnuts®, they were more likely to choose these reasons than those using Tri-Solfen® (Table 27). They were also significantly more likely to have been recommended these products by a vet and, for the analgesics, were aware that the products provided pain relief for longer indicating that these respondents had educated themselves on the most appropriate pain relief product for this procedure.

The most common reason why respondents did not use pain management at castration was that they did not think it was necessary (43%), not considering pain management/no reason was the second most common reason (Table 28). Studies have shown that castration and tail docking with rings causes significant abnormal body posture and active pain behaviour displays in lambs, indicating that pain management is warranted for improved animal welfare outcomes (Mellor and Stafford 2000; Grant 2004; Small *et al.* 2021).

Table 27: Respondent reasons for using the pain management product they used during castration. Respondents could select more than one reason.

Reasons for using product	Percentage of respondents selecting reason				
	All products	Tri-Solfen®*	Analgesic/injection (e.g. Metacam®)	Analgesic/oral gel (e.g. Buccalgesic®)	Numnuts®
It works / reduces pain	53%	49%	65%	63%	61%
Fast recovery / promotes healing / minimal bleeding	30%	34%	40%	21%	26%
Improved animal health and welfare	44%	31%	72%	64%	59%
Lambs quick to mother-up following treatment	35%	29%	57%	43%	48%
Easy to apply	29%	28%	38%	27%	29%
Effective product	32%	27%	43%	31%	45%
Have always used it	10%	14%	7%	1%	4%
Industry standard	13%	14%	15%	17%	9%
Availability / unaware of other products	10%	13%	2%	7%	5%
Recommended by retailer / contractor/ stock agent	9%	12%	6%	2%	5%
Other (Please specify)	12%	10%	7%	16%	18%
Lasts longer	16%	7%	45%	33%	11%
Recommended by vet	14%	6%	29%	32%	22%
<i>Number of respondents (n)</i>	<i>394</i>	<i>240</i>	<i>46</i>	<i>60</i>	<i>70</i>

*Tri-Solfen® contains local anaesthetics and antiseptic in a gel spray-on formulation

Table 28: Reasons why respondents did not use pain management for castration (n = 783).

Reason	Percentage of respondents
Not necessary	43%
No reason / have not considered it	28%
Quick procedure / not practical	17%
Other (Please specify)	13%
Added stress / time	8%
Nothing readily available	8%
Too expensive	6%
Don't know what to use	5%
Don't know	2%
Vet hasn't suggested it	2%

Table 29: Percentage of respondents who used pain management products during castration of male lambs by castration method, and the percentage of those using *unsuitable* pain relief products for the castration method used. Figures in blue indicate means that are significantly higher than the overall mean, figures in red indicate means that are significantly lower than the overall mean.

Demographics		Percentage using pain management - all products								Percentage using <i>unsuitable</i> pain management					
		All methods		Cold knife		Rings		Shears/knife		Cold knife*		Rings ⁺		Shears/knife	
		n	Yes	n	Yes	n	Yes	n	Yes	n	%	n	%	n	%
<i>Overall</i>		1177	30%	31	45%	1134	29%	9	78%	16	6%	367	58%	7	0
<i>State</i>	NSW	414	29%	16	59%	389	27%	7	71%	11	9%	118	63%	5	0
	VIC	265	33%	4	50%	257	33%	1	100%	2	0%	91	46%	1	0
	QLD	62	19%	5	6%	58	18%	0	-	1	0%	19	65%	0	-
	SA	217	29%	2	50%	215	29%	1	100%	1	0%	67	67%	1	0
	WA	183	35%	1	100%	182	35%	0	-	1	0%	64	54%	0	-
	TAS	36	13%	3	0%	33	12%	0	-	0	-	8	67%	0	-
<i>Flock size</i>	100 - 499	112	19%	2	0%	111	19%	0	-	0	-	21	47%	0	-
	500 – 1,999	512	32%	14	61%	493	30%	2	100%	8	12%	148	68%	2	0
	2,000 +	553	38%	15	59%	530	37%	7	72%	8	0%	198	54%	5	0
<i>Micron</i>	Fine (<20)	754	32%	23	39%	721	31%	7	71%	10	0%	247	52%	5	0
	Medium (20 +)	423	27%	8	57%	413	26%	2	100%	6	15%	120	69%	2	0
<i>Body wrinkle</i>	Low (Score 1)	633	30%	11	33%	615	30%	3	65%	4	0%	199	51%	2	0
	Medium (Score 2)	507	31%	19	48%	484	29%	4	75%	11	9%	158	66%	3	0
	High (Score 3 or above)	37	28%	1	100%	35	24%	2	100%	1	0%	10	65%	2	0
<i>Mules ewe lambs</i>	Yes	704	37%	22	70%	674	35%	6	83%	15	7%	239	75%	5	0
	No	473	23%	9	7%	460	23%	3	65%	1	0%	128	30%	2	0
<i>Mules male lambs</i>	Yes	590	37%	19	69%	564	36%	5	100%	13	8%	206	73%	5	0
	No	587	25%	12	18%	570	24%	4	48%	3	0%	161	41%	2	0
<i>Education</i>	Year 9 or less	64	30%	1	100%	60	29%	0	-	1	0%	19	80%	0	-
	Year 10 - 11	242	27%	1	100%	237	26%	2	100%	1	0%	64	67%	2	0
	School Leaving Certificate (eg HSC)	229	29%	7	45%	223	29%	2	52%	3	0%	64	69%	1	0
	TAFE	200	24%	5	30%	192	24%	2	50%	2	0%	57	72%	1	0
	Tertiary Graduate	326	37%	13	42%	309	35%	3	100%	7	14%	122	44%	3	0
	Post Graduate	109	35%	4	50%	106	34%	0	-	2	0%	41	33%	0	-
<i>Age</i>	18 – 24	7	33%	0		7	33%	1	100%	0	-	3	100%	0	-
	25 – 34	46	35%	3	60%	43	34%	0	-	2	67%	13	16%	1	0
	35 – 44	102	42%	0		101	42%	2	50%	0	-	41	51%	0	-
	45 – 54	220	28%	8	79%	210	26%	1	0%	6	0%	59	53%	1	0
	55 – 64	360	31%	7	18%	351	30%	1	100%	2	0%	122	58%	0	-
	65 and over	438	29%	13	43%	418	28%	4	100%	6	0%	128	66%	1	0

*Unsuitable product used was Numnuts® for cold knife method

⁺Unsuitable product used was Tri-Solfen® for ring method.

6. Impact on Wool Industry – Now & in 5 years time

The results of this project indicate the need for further analysis of the NWD data and changes to how it is reported. The NWD represents a strong opportunity for the wool industry to gauge the mulesing practices of the Australian wool industry on a monthly and yearly basis and to measure change in mulesing practices over time. This will provide wool buyers with a clear narrative around the mulesing practices of Australian wool industry and, potentially, indicate positive changes.

The results of the AWI 2021 Merino Husbandry Practices Survey provide a snapshot of Merino husbandry practices of a portion of the Australian wool industry and the comparison between it and earlier surveys measure change in industry practices over time. The 2021AWI-MHPS also informs which areas require targeted communications to improve animal welfare outcomes that meet the Sheep Sustainability Framework.

7. Conclusions and Recommendations

7.1 Conclusions

1. Comparing farmer surveys

The survey methodology for the 2021AWI-MHPS survey was sound. A large difference between respondents with small flocks and larger flocks for percentage mulesing caused a reduction in the overall weighted percentage of respondents mulesing lambs compared with the unweighted percentage. The most recent prior survey in 2020 (AWI 2020 Wool Industry Profile), also found a reduction in the percentage using mulesing in lambs compared with earlier surveys. It is possible that these two numbers indicate the start of a downward trend in the use of mulesing by Australian woolgrowers. However, further data is needed to determine if this trend reflects a true trend in the Australian wool industry as a whole. Future farmer surveys and the National Wool Declaration could provide a clearer picture.

2. National Wool Declaration versus farmer surveys

The percentage of mulesed bales of wool reported through the NWD and mulesing percentages from farmer surveys cannot be directly compared. Larger wool growers are significantly more likely to mules their lambs and have a disproportionate effect on the number of wool bales sold through the Australian Wool Exchange. Further analysis of the NWD data using identifying data such as client ID or Australian Business Number may provide percentages of woolgrowers who mules, which can then be compared with the farmer survey results. This could provide the Australian wool industry with estimates of the percentage of farmers who use mulesing on a yearly basis and would provide an estimate for a large portion (85-95%) of the Australian woolgrower population.

3. Differences between demographics

State:

Practices around mulesing, tail docking and castration were largely influenced by flock size, state and whether respondents mulesed their lambs. Education and farmer age group also had an impact on practices.

NSW: Respondents from NSW were less likely to mules than the national average for both ewe lambs and male lambs. A high proportion used pain management for mulesing. They were more likely to use rings for tail docking and less likely to use the hot knife method. They were also less likely to use pain management at tail docking.

VIC: 100% of Victorians surveyed used pain management for mulesing.

SA: South Australians were significantly more likely to mules their lambs and a high proportion use pain management. They were more likely to use a hot knife for tail docking and more likely to cut tails too short at 2 joints. They were also more likely to use pain management at tail docking than the national average.

WA: Western Australians were significantly more likely to mules than the national average and a high proportion used pain management. They were less likely to cut the tail at 2 joints.

QLD: Queenslanders were significantly less likely to mules and a high proportion use pain management at mulesing.

TAS: Tasmanians were significantly less likely to mules and a high proportion used pain management but the proportion was lower than other states although not significantly so. Of those who don't mules, TAS were significantly more likely to have never mulesed. They were more likely to use rings for tail docking and less likely to

use hot knife. Tasmanians had higher proportions of respondents who 'prefer longer tail/for aesthetic reasons' and were less likely to use pain mgt at tail docking and castration.

Flock size:

<500 sheep: A very low proportion of this demographic mules their lambs and a slightly lower proportion used pain management but it was not significant. Those with smaller flock sizes were significantly more likely to have never mulesed. They were more likely to use rings for tail docking and less likely to use pain management at tail docking and castration

500-1999 sheep: This demographic was significantly more likely to mules than the national average and a high proportion used pain management. They were more likely to use a hot knife for tail docking and more likely to use unsuitable pain management at castration with rings

2000+ sheep: This demographic was significantly more likely to mules and more likely to use pain management. Those who don't mules were significantly more likely to have ceased mulesing than to have never mulesed. They were more likely to use hot knife for tail docking and more likely to dock at 3 joints. They were more likely to choose tail length because of 'industry standards', for 'specific health reasons', 'prevent skin cancers' and 'satisfactory length/easy to manage'. They were more likely to use pain management at tail docking and castration.

Micron:

Fine (<20µm): Those with finer micron sheep were significantly less likely to mules both ewe and male lambs than the national average. They were also significantly more likely to tail dock their female lambs.

Medium (20+ µm): Those with medium micron were significantly more likely to mules both ewe and male lambs than the national average. They were also significantly less likely to tail dock their female lambs.

Body wrinkle:

Low (Score 1): Respondents running sheep with low body wrinkle were significantly less likely to mules than the national average. They were less likely to use pain management for tail docking.

Medium (Score 2): Respondents running sheep with medium body wrinkle were significantly more likely to mules than the national average. They were more likely to use pain management for tail docking.

High (Score 3 or above): Respondents running sheep with high body wrinkle were more likely to mules than the national average but the difference was not significant due to the small sample size of this group. This demographic was significantly more likely to use the hot knife method of tail docking and significantly less likely to use rings. Those with sheep with high body wrinkle were more likely to use pain management for tail docking but it was not significant. This demographic was significantly more likely to use shears/knife for castrating male lambs.

Mules lambs: Those who mules were significantly more likely to use a hot knife for tail docking and significantly less likely to use rings for tail docking. This demographic was more likely to let tail length at docking be decided by contractor and to provide sun protection/prevent skin cancers. They were significantly more likely to use pain management at tail docking and castration and more likely to use unsuitable pain management at castration with rings

Education: Those with school leaving certificate were more likely to mules both ewe and male lambs. Post graduates were more likely to choose 'industry best practice' for tail length choice and tertiary graduate for 'specific health reasons'. Tertiary graduates were more likely to use pain management at tail docking and castration and those with a TAFE level of education were significantly less likely to use pain management at tail docking. Tertiary graduates and TAFE graduates were less likely to use unsuitable pain management at castration.

Age:

25-34: Those of this age group who don't mules were significantly more likely to have never mulesed. They were significantly less likely to use unsuitable pain management at castration.

35-44: Those of this age group were more likely to use a hot knife, more likely to choose 'specific health reasons such a prolapse etc' and 'allow tail movement' for tail length. They were significantly more likely to use pain management at tail docking.

45-54: Those aged 45-54 were significantly more likely to mules both ewe and male lambs. They were more likely to use a hot knife for tail docking, more likely to choose 'specific health reasons such a prolapse etc' and 'allow tail movement for tail length'. They were significantly more likely to use pain management at tail docking.

Over 65: This demographic group is less likely to mules both ewe lambs and male lambs. More likely to use rings for tail docking, significantly less likely to use pain management and less likely to choose specific health reasons for choosing tail length at docking.

7.2 Recommendations

National Wool Declaration

- Further analysis of NWD data is recommended to address the disconnect between the current NWD reports on number of bales of mulesed and non-mulesed wool sold and the proportion of woolgrowers who mules as reported in farmer surveys.
- It is recommended that a steering committee be formed to address how the NWD data can be used with respect to privacy laws and how the NWD data can be analysed and reported.
- A retrospective analysis of the NWD data from the last 5 years to gain estimates of proportions of farmers selling mulesed and non-mulesed wool would be beneficial for comparison with respective farmer surveys.
- Any results of further analysis of the NWD data should be considered in the context of 5-15% of the Australian wool clip being sold privately to processors, with that wool highly likely to be from non-mulesed sheep.

Pain relief for mulesing, tail docking and castration

- Information on pain management for mulesing and tail docking on the FlyBoss website requires updating to the most current advice. The current table for pain management on FlyBoss does not have clear indication of which procedures Metacam/Meloxicam can be used for. Also, it does not promote best practice use of a combination Tri-Solfen[®] and analgesic for mulesing, it does not include information on NumOcaine[®]/Numnuts[®] and it does not indicate analgesics for mulesing and for tail docking and castration using knives or shears.
- Targeted communications are recommended around the need for pain management at tail docking and castration of all lambs and which pain management products are appropriate for the different methods of tail docking.
 - Specific communications would be beneficial for rural retailers and veterinarians selling Tri-Solfen[®] that reiterate its uses for tail docking and castration with hot knife/cold knife and shears only.
 - Specific communications for rural retailers promoting the suggestion of pain management for those purchasing rings for castration and tail docking.
 - Continued communications regarding use of a combination of local anaesthetic with an analgesic.
 - One application of an analgesic at lamb marking provides pain management for both tail docking and castration, as well as mulesing (if practiced).

Tail docking length

- Further, repeated communications are recommended around tail length at tail docking. Specific communications targeting mulesing/tail docking contractors may be warranted.

8. References

- ABS, 2022. Occupation profile: Sheep farmers (ANZSCO ID 121322). National Skills Commission, Australian Bureau of Statistics, Canberra. <https://labourmarketinsights.gov.au/occupation-profile/sheep-farmers?occupationCode=121322> [Accessed: 10/10/2022]
- AWEX, 2014. The Australian Wool Market: An introduction (for prospective participants). Australian Wool Exchange, AWEX 2022. National Wool Declaration Test Data - Auction Data: Tuesday, 5 July 2022. Australian Wool Exchange.
- AWI, 2022. Use the NWD so your wool attracts the highest price. Beyond the Bale, issue 65. Australian Wool Innovation Limited, The Rocks, Sydney.
- Brien, FD, Walkom, SF, Swan, AA, Brown, DJ (2021) Substantial genetic gains in reducing breech flystrike and in improving productivity traits are achievable in Merino sheep by using index selection. *Animal Production Science* **61**, 345.
- Chandler, B, Sparks, M (2020) AWI Wool Industry Profile. Australian Wool Innovation Limited, The Rocks, Sydney, NSW.
- Colvin, AF, Reeve, I, Kahn, LP, Thompson, LJ, Horton, BJ, Walkden-Brown, SW (2022a) Australian surveys on incidence and control of blowfly strike in sheep between 2003 and 2019 reveal increased use of breeding for resistance, treatment with preventative chemicals and pain relief around mulesing. *Veterinary Parasitology: Regional Studies and Reports* **31**, 100725.
- Colvin, AF, Reeve, I, Kahn, LP, Thompson, LJ, Horton, BJ, Walkden-Brown, SW (2022b) Prevalence of sheep lice and trends in control practices across Australia – Australian sheep parasite control surveys from 2003 to 2019. *Veterinary Parasitology: Regional Studies and Reports* **27**, 100662.
- Colvin, AF, Reeve, I, Peachey, B, Walkden-Brown, SW (2021a) Benchmarking Australian sheep parasite control practices - a national online survey. *Animal Production Science* **61**, 237-245.
- Colvin, AF, Reeve, I, Thompson, LJ, Kahn, LP, Besier, RB, Walkden-Brown, SW (2021b) Benchmarking Australian sheep parasite control: changes in gastrointestinal nematode control practices reported from surveys between 2003 and 2019. *Veterinary Parasitology: Regional Studies and Reports* **26**, 100653.
- Colvin, AF, Reeve, I, Thompson, LJ, Kahn, LP, Walkden-Brown, SW (2021c) Australian surveys on parasite control in sheep between 2003 and 2019 reveal marked regional variation and increasing utilisation of online resources and on-farm biosecurity practices. *Veterinary Parasitology: Regional Studies and Reports* **25**, 100614.
- Colvin, AF, Walkden-Brown, SW, Reeve, I (2020) Benchmarking Australian Sheep Parasite Control: Project final report. University of New England, Armidale. Available at <https://www.wool.com/globalassets/wool/sheep/research-publications/welfare/surveys/2018-benchmarking-australian-sheep-parasite-control-survey.pdf> [Accessed 26/9/2022].
- Dhand, NK, Khatkar, MS (2014) 'Statulator: An online statistical calculator. Sample Size Calculator for Estimating a Single Proportion.' Available at <http://statulator.com/SampleSize/ss1P.html> [Accessed 26/09/2022].
- Gideon, L (2012) 'Handbook of Survey Methodology for the Social Sciences.' (Springer New York: New York, NY)
- Grant, C (2004) Behavioural responses of lambs to common painful husbandry procedures. *Applied Animal Behaviour Science* **87**, 255-273.
- Grave, M, Hansford, K (2022) NWD Update - 2022 Flystrike RD&E Technical Forum. Australian Wool Innovation Limited, The Rocks, Sydney.
- Heath, ACG (2021) Climate change and its potential for altering the phenology and ecology of some common and widespread arthropod parasites in New Zealand. *New Zealand Veterinary Journal* **69**, 5-19.
- Kynetec (2021) MLA and AWI wool and sheepmeat survey - June 2021. Meat and Livestock Australia Limited and Australian Wool Innovation Limited.
- Lloyd, J, 2019. Tail docking: don't cut it short. Beyond the Bale, issue 41. Australian Wool Innovation Limited, The Rocks, Sydney.
- Lloyd, J, Kessell, A, Barchia, I, Schröder, J, Rutley, D (2016) Docked tail length is a risk factor for bacterial arthritis in lambs. *Small Ruminant Research* **144**, 17-22.
- Mellor, DJ, Stafford, KJ (2000) Acute castration and/or tailing distress and its alleviation in lambs. *New Zealand Veterinary Journal* **48**, 33-43.
- NWD-V9.3, 2022. National Wool Declaration (NWD) V9.3 - Business rules for MS. Australian Wool Exchange (AWEX), Issue 1.

- Phillips, CJC (2009) A review of mulesing and other methods to control flystrike (cutaneous myiasis) in sheep. *Animal Welfare* **18**, 113-121.
- Reddy, P, 2018. Animal Welfare (Care and Procedures) Regulations 2018. 59. Prohibition on mulesing sheep. LI 2018/50. New Zealand Government, Part 2: 59.
<https://www.legislation.govt.nz/regulation/public/2018/0050/latest/whole.html#LMS22932> [Accessed 6/10/2022]
- Richards, JS, Atkins, KD (2010) Will genetics offer a permanent solution to breech strike? *Animal Production Science* **50**, 1053-1059.
- Shephard, R, Webb Ware, J, Blomfield, B, Niethé, G (2022) Priority list of endemic diseases for the red meat industry – 2022 update. Meat and Livestock Australia Limited, North Sydney, NSW, Australia.
- Sloane, R (2018) AWI 2017 Merino Husbandry Practices Survey: Project Final Report. Australian Wool Innovation Limited. Available at <https://www.wool.com/globalassets/wool/sheep/research-publications/welfare/surveys/2017-awi-Merino-husbandry-practices-survey-website-version.pdf>.
- Sloane, R (2022) AWI 2021 Merino Husbandry Practices Survey: Project Final Report. Australian Wool Innovation Limited, The Rocks, Sydney.
- Small, A, Fétiveau, M, Smith, R, Colditz, I (2021) Three Studies Evaluating the Potential for Lidocaine, Bupivacaine or Procaine to Reduce Pain-Related Behaviors following Ring Castration and/or Tail Docking in Lambs. *Animals (Basel)* **11**, 3583.
- Small, AH, Marini, D, Dyal, T, Paull, D, Lee, C (2018) A randomised field study evaluating the effectiveness of buccal meloxicam and topical local anaesthetic formulations administered singly or in combination at improving welfare of female Merino lambs undergoing surgical mulesing and hot knife tail docking. *Research in Veterinary Science* **118**, 305-311.
- SSF (2022) 'Sheep Sustainability Framework: About the framework.' Available at <https://www.sheepsustainabilityframework.com.au/the-framework/about-the-framework/> [Accessed 26/09/2022].
- Wardhaugh, KG, Morton, R, Bedo, D, Horton, BJ, Mahan, RJ (2007) Estimating the incidence of fly myiasis in Australian sheep flocks: development of a weather-driven regression model. *Medical and Veterinary Entomology* **21**, 153-167.
- Wells, AED, Sneddon, J, Lee, JA, Blache, D (2010) Understanding Australian Farmers' Intentions to Change Practices in Response to Calls from Animal Welfare Groups: The Case of Mulesing. *Agricultural science (Melbourne)* **22**, 25-26.
- Woodruff, ME, Doyle, R, Coleman, G, Hemsworth, L, Munoz, C (2020) Knowledge and attitudes are important factors in farmers' choice of lamb tail docking length. *Veterinary Record* **186**, 319-319.

9. Abbreviations

AA	Mulesed with analgesic/anaesthetic,
AWEX	Australian Wool Exchange
AWI	Australian Wool Innovation Limited
CM	Ceased mulesing, no lambs born on this property in the last 12 months have been mulesed, AND, no mulesed or (AA) ewes or wethers have been purchased in the last 12 months
MLA	Meat and Livestock Australia
ND	Not declared
NM	Not Mulesed, no sheep in this mob have been mulesed or treated with liquid nitrogen
NSW	New South Wales
NWD	National Wool Declaration
2021AWI-MHPS	AWI 2021 Merino Husbandry Practices Survey
Qld	Queensland
SA	South Australia
SSF	Sheep Sustainability Framework
TAS	Tasmania
VIC	Victoria
WA	Western Australia