final report

Project code: B.SBP.0109

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Date published: January 2014

ISBN: 9781925045857

PUBLISHED BY
Meat & Livestock Australia Limited
Locked Bag 991
NORTH SYDNEY NSW 2059

Autumn ill thrift in Tasmanian beef herds

Meat & Livestock Australia acknowledges the matching funds provided by the Australian Government to support the research and development detailed in this publication.

Abstract

Many Tasmanian beef producers have reported that animals appear to underperform during the summer/autumn period, and this is supported by data from on-farm trials at two locations in Tasmania. Underperformance is expressed primarily through cattle not putting on the expected live weight given the apparent quality and quantity of feed on offer. Autumn ill-thrift is a phenomenon recognised globally in temperate regions as affecting liveweight gains of both cattle and sheep. Whilst to some extent the causes of ill-thrift are multifactorial and can be difficult to determine, three key factors have been identified as being clearly linked with ill-thrift: 1. mycotoxins (produced by endophytes in pasture and cereal species); 2. pasture quality; and 3. parasites. The Tasmanian beef industry is dominated by perennial ryegrass pastures (80% of pastures are ryegrass) and very little use is made of fodder crops. There is high prevalence of ryegrass staggers (64%) and of photosensitation (47%) reported by Tasmanian producers – these conditions are symptoms of mycotoxins. It is likely that subclinical effects of mycotoxins (underperformance) are even more prevalent than reported. Ryegrass pastures are also known to be poor quality in autumn, which is supported by the fact that improvements in grazing/feed management do assist with managing ill-thrift. Further work to understand fully the extent of mycotoxins and the effects they are having on Tasmanian beef production is recommended.

Executive summary

This report presents the outcomes of the project 'Summer-autumn ill-thrift in Tasmanian beef herds' (B.SBP.0109) funded by Meat and Livestock Australia (MLA) and undertaken by Macquarie Franklin. The project consisted of a literature review and a beef industry producer survey to determine the severity and possible causes of ill-thrift during the autumn period. The relationship between management practices and autumn ill-thrift was also explored.

The impact of autumn ill-thrift in cattle in Tasmania is estimated to cost the industry around $3-11m annually (based on the estimates presented in this report) depending on the length of the period over which it occurs each season. If the problem is applicable to all of southern Australia then this figure could be in the order of $25-100m annually (again, based on the estimates presented in this report).

In Tasmania many producers have reported anecdotal evidence of cattle underperforming during the late autumn period. The literature review showed that ill-thrift during autumn is a real phenomenon which has been widely documented and researched both in Australia and overseas. While to some extent the causes of ill-thrift are multifactorial, the literature review highlights key factors which have been linked with ill-thrift (mycotoxins, pasture quality and internal parasites). Results of the producer survey strongly supported the literature review findings regarding the link between autumn ill-thrift and mycotoxins. It also showed that beef production in Tasmania is largely from perennial rye grass pastures and is therefore likely to be highly vulnerable to negative impacts on productivity caused by ill-thrift. Further, many producers appear unaware of the condition or its impacts. Mycotoxins are therefore likely to be a major contributor to ill-thrift in cattle over the autumn period and further research is recommended to investigate mycotoxin impacts on cattle liveweight gains.

Seasonal changes in pasture quality (e.g. low soluble carbohydrate content in autumn herbage) directly affect liveweight gain of cattle. Based on the results of two earlier trials, it is probable that the lower than expected liveweight gain over the autumn period seen in Tasmania is at least partly attributed to the poor quality of perennial ryegrass at this time of year. Educating beef producers about the variation in nutritive values of pasture during the year and the impact of best practice grazing techniques (e.g. minimising dead matter and maintaining healthy levels of post grazing residual mass) could help improve liveweight gain of cattle over autumn.

Research suggests that parasites can be a major contributor to reduced liveweight gain in these production environments. However, the results from the beef producers' survey were equivocal in this regard. In some areas (e.g. Victoria and New Zealand) drench resistance has been identified, however it is not known if this is an issue in Tasmania. Further research is recommended to investigate parasite association with ill-thrift in Tasmania, and the extent of any resistance to treatments.

There is no strong evidence (from either the literature review or the producers' survey) that ill-thrift during the summer-autumn period is due to lack of trace minerals in pasture. Poor pasture management techniques are likely to be one of the major reasons why cattle have lower than expected liveweight gains over autumn, therefore it is pivotal that any research is conducted with best-practice pasture management in place. This will enable a more accurate understanding of the contribution of the other potential causes of ill-thrift to the condition in Tasmania.

It is therefore likely that the beef industry within Tasmania, and other similar environments of southern Australia (particularly where rye grass pastures dominate the feed base), could substantially improve productivity by better understanding the causes of ill-thrift, and improving management practices to mitigate these. In addition, sheep and dairy cattle are also likely to be affected by ill-thrift, so the findings from this research have broader application. Recommendations for further work include:

- Determining which mycotoxins are present in Tasmanian ryegrass pastures and quantifying their contribution to the ill-thrift syndrome.
- Ensuring producers are aware of seasonal variation in nutritive values of perennial ryegrass, and implementing best practice pasture management to compensate for this.
- Determining whether supplementary feeding with either pellets or grain during the autumn period is a viable mitigation option. In addition to compensating for reduced pasture quality, this option may reduce cattle exposure to mycotoxins.

Other recommendations are based around other findings from the beef producer survey and are aimed at addressing potential weaknesses in common industry practices to improve productivity and profitability:

- Undertake cost benefit analysis on the practice of pregnancy testing (if this data is not already available).
- Delivery of extension programs designed to incorporate group learning principles and focus on multiple aspects of better beef production. These workshops/programs would have an economic focus where management actions are clearly translated into productivity and profit outcomes.

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1 Background

The purpose of the project was to determine if producers in Tasmania generally observe that cattle are under-performing in summer/autumn (i.e. suffering some form of 'ill thrift') and to gain an understanding of the likely causes. Ill-thrift is defined as sub optimal production relative to the apparent quality and quantity of feed on offer (Leng, 2005). A further objective of the project was to explore whether elevated levels of foetal mortality are observed in Tasmanian beef herds. Many producers anecdotally report cattle underperform during the late autumn period. Investigation by the Circular Head Beef Business Group (CHBG) and the Towards 2000 Winnaleah trial found that, while some improvement could be made through implementation of best practice pasture management, liveweight gains were still below the perceived potential. The perceived loss of performance was in the order of 0.25-0.5kg/head/day.

There were two components to the project - a literature review and a producer survey. The literature review consisted of a detailed review of studies completed in Australia and New Zealand and internationally on ill-thrift. The beef producer survey was used to confirm whether findings from the literature review hold true for Tasmanian beef producers, and also to give a better understanding of the Tasmanian beef industry (both demographics and management practices). The two components of the project will help determine the need for further research into ill-thrift and, if so, to inform the design of subsequent research.

1.1 Economic contribution of beef to the Tasmanian economy

The economic performance of the Tasmanian beef industry has been relatively stable over the decade to 2001-12 (Figure 1). The gross value of cattle and calf slaughterings has increased from $120 million to $180 million in nominal terms over this period and currently representing 16% of the state's gross value of agricultural production. Preliminary figures for 2011-12 value the industry at $178 million. The volume and composition of animals slaughtered remained relatively constant over this period.

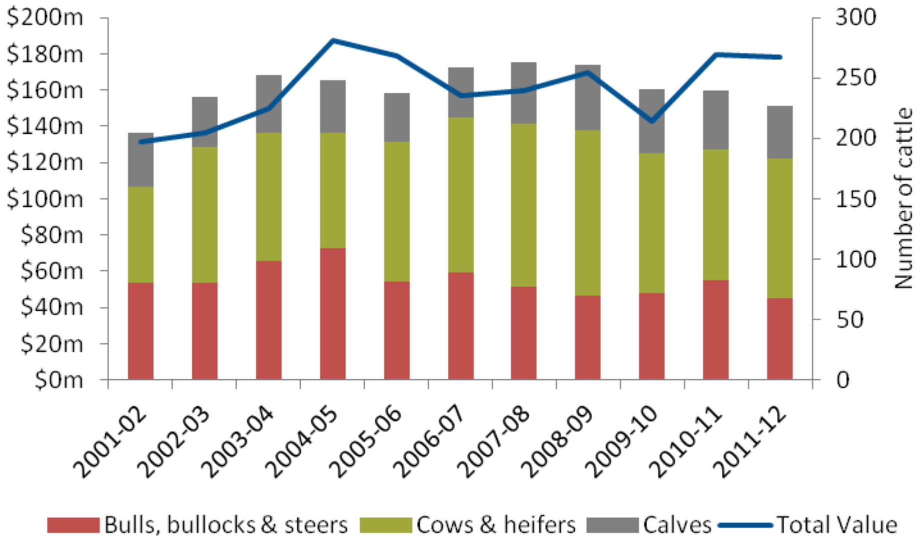

Figure 1: Size and value of Tasmanian beef industry slaughterings, 2001-02 to 2011-12

Source: ABS 7512.0 & ABS 7121.0

During 2011-12 there were 2,000 agricultural businesses with beef cattle in Tasmania. Over the same period specialised beef cattle farms employed around 1,000 full-time equivalents, with a further 500 full-time equivalents employed on mixed farming operations (Figure 1) running beef cattle.

Figure 2 and Figure 3 show the distribution of beef cattle farming businesses in Tasmania during 2010-11 with regards to turnover and number of employees. The largest group of beef cattle farms do not employ any staff and have an annual turnover less than $50,000.

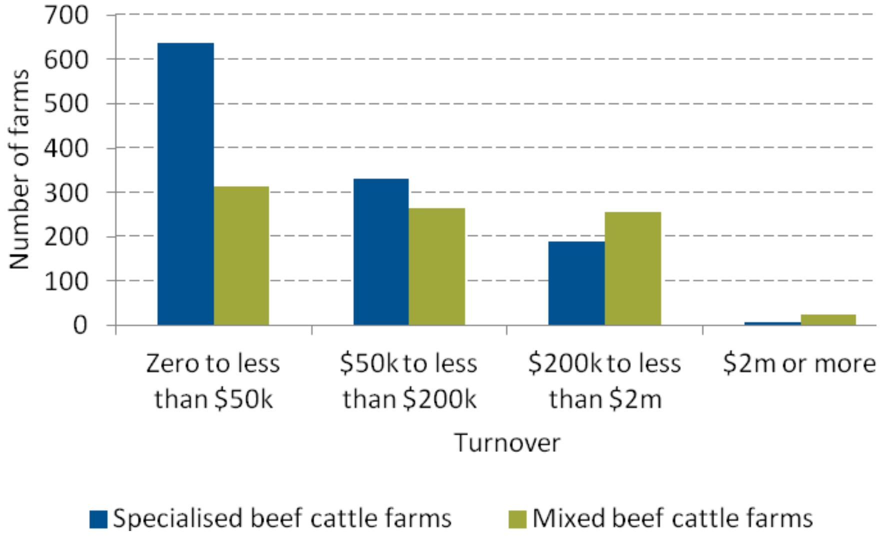

Figure 2: Number of Tasmanian beef cattle farms by turnover size

Source: ABS Count of Australian businesses

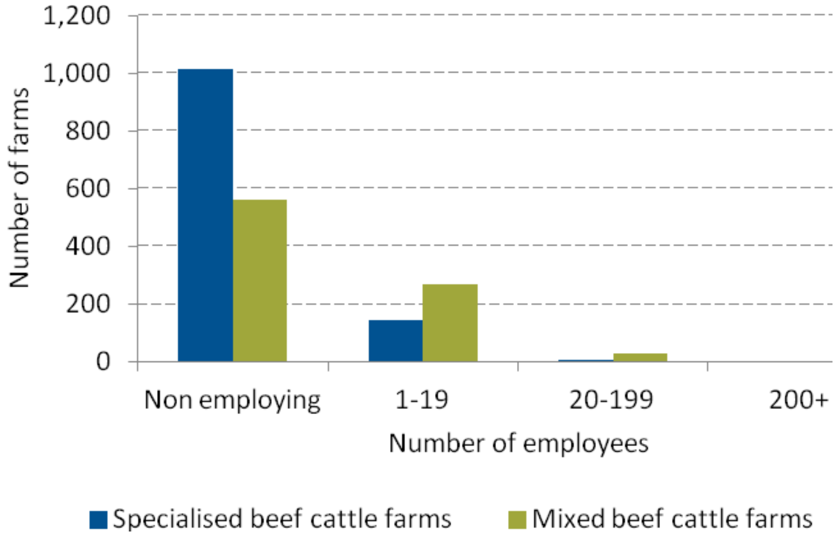

Figure 3: Number of Tasmanian beef cattle farms by employment size

Source: ABS Count of Australian businesses

2 Project objectives

The project objectives were:

1. Explore the evidence base for the sub-optimal liveweight gains being reported for beef cattle in areas of Tasmania and quantify its likely prevalence and magnitude.

2. Explore the evidence base for increased levels of foetal mortality being reported for beef cattle in areas of Tasmania and quantify its prevalence and magnitude.

3. Identify the most likely causal factors, including management practices, leading to sub-optimal liveweight gain and/or increased foetal mortality, thereby assisting producers to address the issue and guiding any future research.

4. Estimate the economic impact of sub-optimal liveweight gains and/or increased rates of foetal mortality.

3 Methodology

3.1 Literature review

The purpose of the literature review was to conduct a review of the current knowledge concerning ill-thrift in beef cattle during the autumn period. The review was world-wide in scope and was done using industry networks, reviewing scientific journals and internet search engines such as Google scholar. The results from the literature review were then used to inform the Tasmanian beef producer survey (the literature review is presented in Appendix 1).

3.2 Tasmanian beef producer survey

The survey was developed with input from a technical group consisting of local industry representatives, MLA representatives and veterinary surgeons. The survey consisted of 31 questions (Appendix 4) covering three different areas: producer demographics; standard management practices and issues related to breeding cows. The survey was produced using the internet survey provider Survey Monkey. The survey was tested by 12 producers prior to being finalised to ensure that there was no ambiguity in the questions. Hardcopy surveys were printed and mailed out to 1282 beef cattle producers with more than 100 cattle, via information contained on the Department of Primary Industries Water and Environment database. The Department undertook the mail out, to ensure privacy provisions were not breached, and it was undertaken in March 2013. The survey was promoted in Tasmanian Country newspaper, through TFGA networks and on ABC radio Country Hour and Rural Report.

3.3 Data analysis

A total of 124 survey responses were collated within Survey Monkey – 121 responses were suitable for analysis. Survey results were exported into MS Excel. Analytical tasks included producing descriptive statistics from the survey results and examining the most likely causal factors, including management practices, leading to sub-optimal liveweight gain (χ^2 tests were used to determine statistically significant differences between the frequency of observed responses in the sample).

3.4 Economic impact

The economic impact of ill-thrift has been estimated using a combination of survey results and evidence collected from Tasmanian beef benchmarking groups. An annual estimate of lost beef production due to ill-thrift was calculated by multiplying:

- a range of scenarios around the degree of underperformance (benchmarking discussions);
- the incidence of underperformance (survey); and
- the number of cattle slaughtered each year (official statistics).

Average market prices for beef were used to calculate the economic impact associated with these production losses.

4 Results and discussion

There were 121 completed surveys received (105 breeders, 85 finishers and 67 producers who both finished and bred), giving a response rate of 9.4% which is about typical (a response rate of 10% is fairly standard for these types of surveys).

4.1 Comparison of survey demographic with overall beef industry demographic

Farms responding to the Tasmanian beef industry survey were broadly representative of the regional distribution of beef farms in Tasmania (Figure 4 and Figure 5).

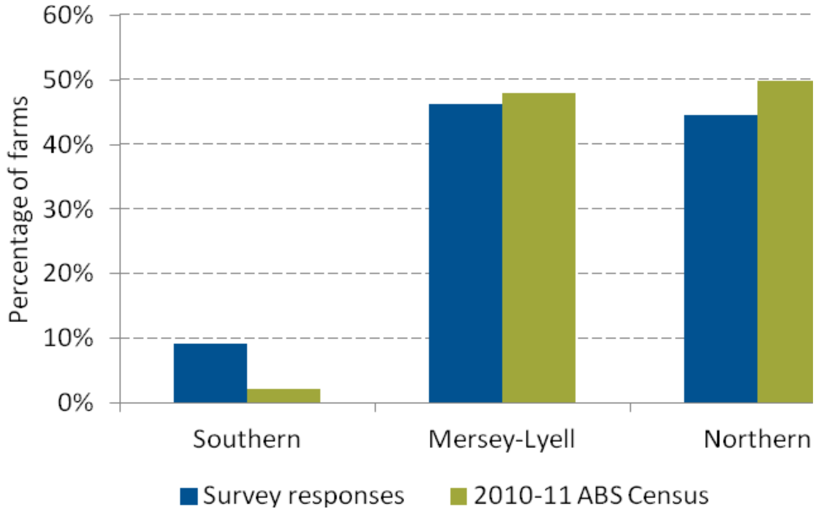

Figure 4: Survey responses by Statistical Division (number of farms)

Source: 2013 Tasmanian beef industry survey & ABS 7121.0

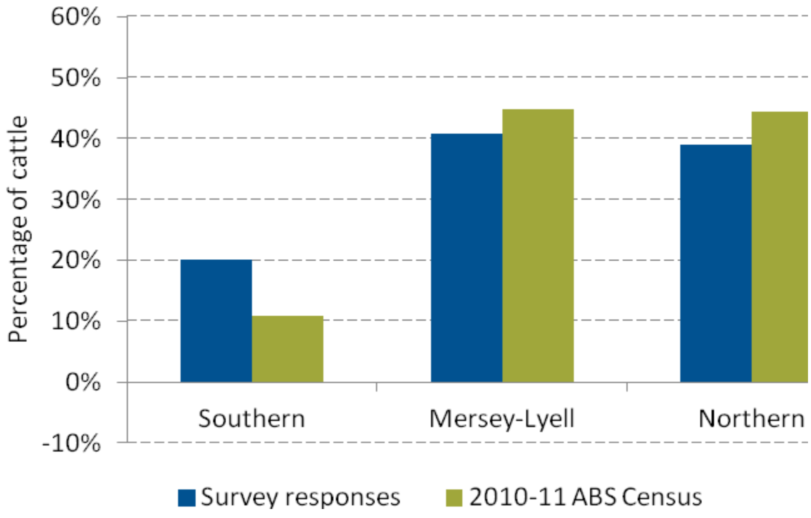

Figure 5: Survey responses by Statistical Division (number of cattle)

Source: 2013 Tasmanian beef industry survey & ABS 7121.0

At a finer regional scale a number of regions appear underrepresented by the survey - notably Central Coast, Kentish and Huon Valley (Figure 6).

Figure 6 indicates that these regions contain a relatively small share of the state beef cattle herd despite having a large number of beef farms. This reflects the large number of small scale operations in these regions. These farms are most likely cropping enterprises running a few cattle or small-scale part-time farmers that are possibly less interested in engaging with the beef industry.

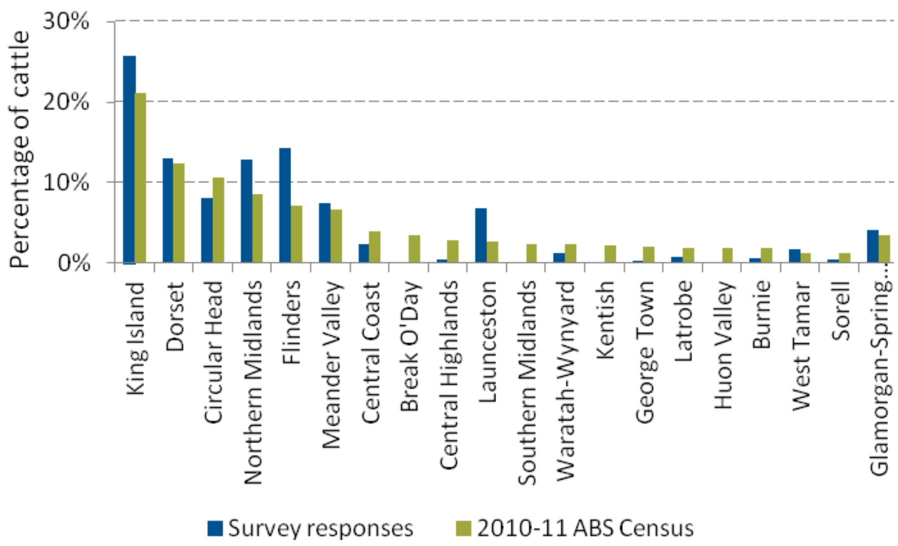

Figure 6: Survey responses by Local Government Area (number of cattle)

Source: 2013 Tasmanian beef industry survey & ABS 7121.0

4.2 Tasmanian beef industry profile

Figure 7 shows the distribution of Tasmanian beef cattle farms responding to the survey with respect to the number of cattle run. Farms responding to the survey varied widely in the number of beef cattle they ran – from a low of 37 head to a high of over 11,450 head. The median number of cattle within this distribution was 250 head with the majority of responses (50%) coming from farms running between 100 and 400 head of cattle.

The distribution of farms running more than 800 head of cattle is uniform and wide - with the largest of these farms running over 11,000 head of cattle.

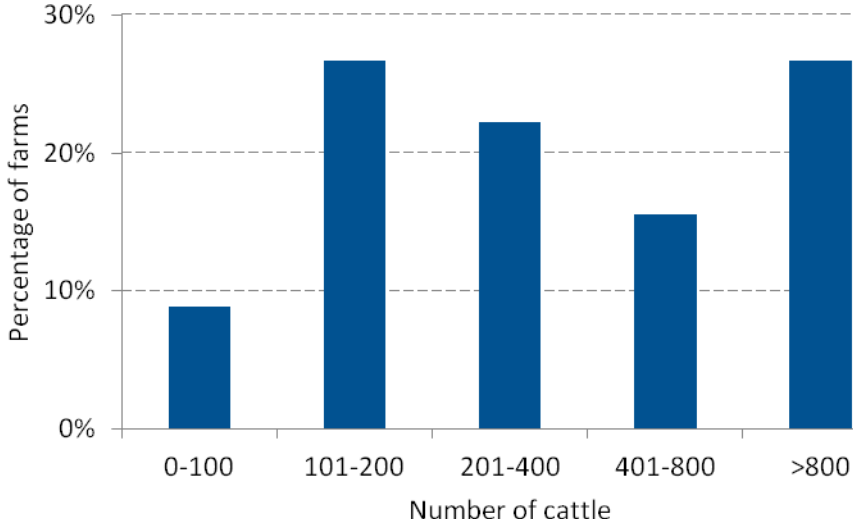

Figure 7 Distribution of survey responses (number of beef cattle)

Table 1 presents a regional breakdown of beef farms responding to the survey by region. The largest enterprises are located in northern Tasmanian followed by north-west Tasmania and the southern region.

Table 1: Size characteristics of Tasmanian beef farms responding to the survey, by region

	Average	Median	Minimum	Maximum
	Tasmania (sample size = 121)			
Productive farming area (ha)	1,028	317	28	14,230
Total number of cattle as at 1 July 2012	653	250	37	11,447
Number of breeders as at 1 July 2012	357	129	0	5,704
	northern Tasmania (sample size = 54)			
Productive farming area (ha)	1,715	654	40	14,230
Total number of cattle as at 1 July 2012	739	300	37	4,320
Number of breeders as at 1 July 2012	490	173	0	3,200
	north-west Tasmania (sample size = 56)			
Productive farming area (ha)	454	190	28	5,500
Total number of cattle as at 1 July 2012	668	250	40	11,447
Number of breeders as at 1 July 2012	285	93	0	5,704
	southern Tasmania (sample size = 11)			
Productive farming area (ha)	542	350	100	2,000
Total number of cattle as at 1 July 2012	154	120	39	361
Number of breeders as at 1 July 2012	67	60	0	135

Over half of the survey respondents are involved in both breeding and finishing cattle (Figure 8). Around one third of farms are specialised breeders with the remaining 16% concentrating on finishing cattle.

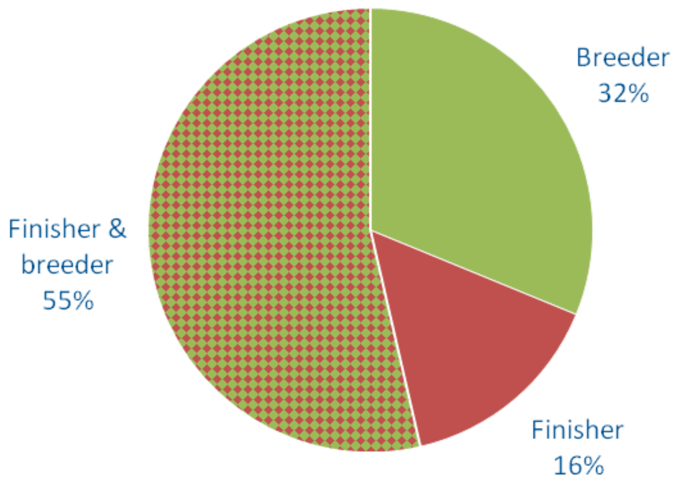

Figure 8: Breakdown of responses by type of cattle enterprise
Sample size = 121

Mixed farms, with beef cattle being one enterprise, were the largest component of the survey respondents (Figure 9).

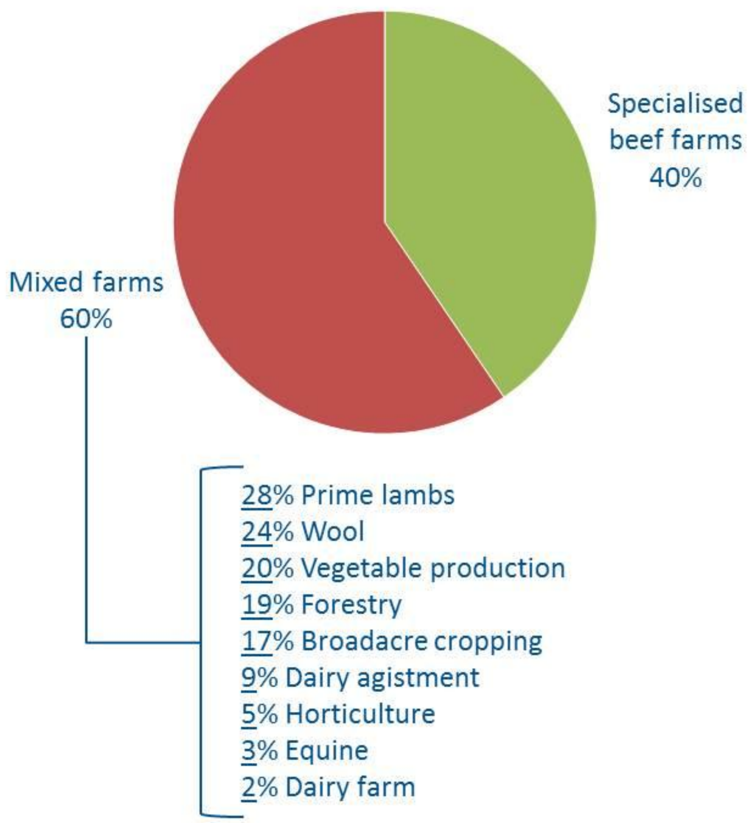

Figure 9: Breakdown of responses by type of farming enterprise
Multiple responses were permitted so shares do not sum to 100%; Sample size = 121

4.3 Ill-thrift (underperformance) in Tasmanian beef cattle

Underperformance in cattle, relative to feed on offer, was reported by 37% of farms surveyed (Figure 10), with 12% of farms unsure whether their cattle were underperforming. 50% of farms did not report any observations of underperformance.

Of those who reported underperformance, this was based on the unthrifty appearance of their cattle (58%), followed by weighing cattle (43%), condition scoring (29%) and perceived feed conversion not being as expected (24%). Autumn was the most common time of year during which underperformance was observed, closely followed by winter (Figure 11).

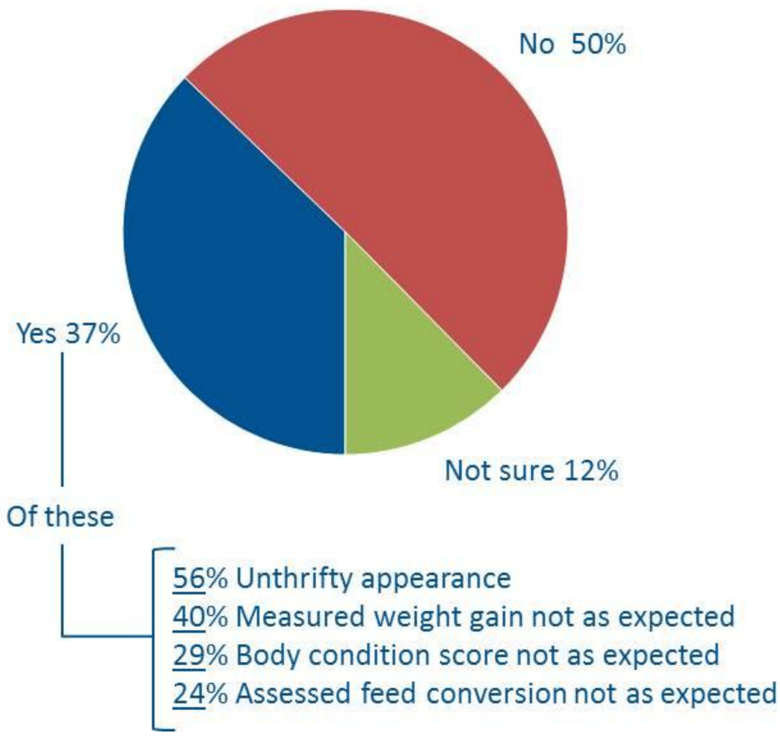

Figure 10: Observed underperformance in cattle and method of observation

Multiple responses were permitted so shares do not sum to 100%; Sample size = 121

Despite these comparatively low numbers of producers recognising ill-thrift during autumn, the literature review (Appendix 1) found that ill-thrift over the autumn period is a phenomenon that has been documented for a long time particularly in temperate regions world-wide, in both cattle and sheep. Ill thrift can be difficult to diagnose, especially where producers are not running a closely monitored system (e.g. set stocking and not weighing cattle). The survey indicated that not many Tasmanian producers are running a well-monitored system – of the 37% that had observed ill-thrift, only 40% measured weight gain, 29% assessed body condition and 24% assessed feed conversion – 58% based their observations on unthrifty appearance).

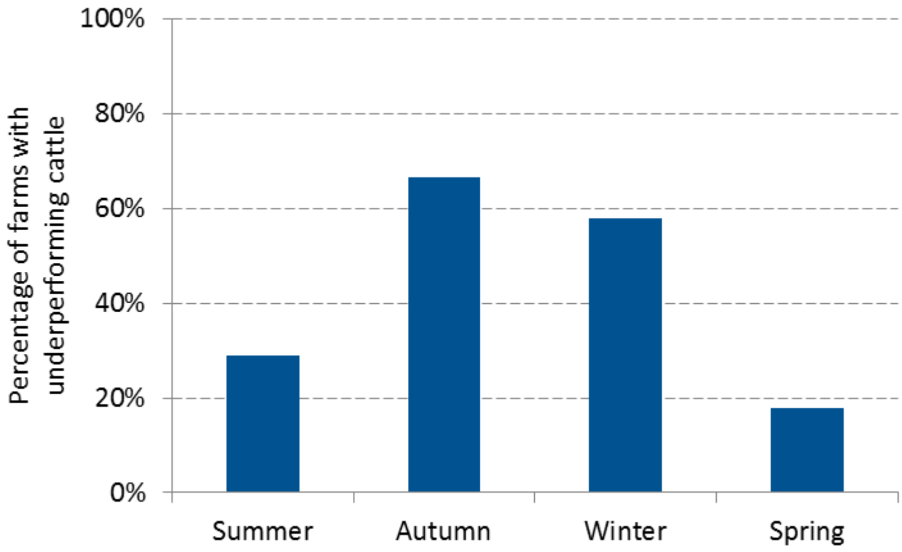

Figure 11: The time of year underperforming cattle were observed.
Multiple responses were permitted so shares do not sum to 100%; Sample size = 45

While the literature review found that ill-thrift in temperate production systems are commonly multifactorial, the most common factors were (in order of priority):

1. mycotoxins (produced by fungi in pasture and cereal species)

2. pasture quality

3. parasites

Based on the definition of ill-thrift – under-performance relative to the quality and quantity of feed on offer – the key causal factors of any ill-thrift are likely to be mycotoxins and parasites. The survey showed ryegrass pastures to be the dominant feed base for the beef industry in Tasmania (both in terms of perennial pastures and for annual ryegrass as part of a fodder cropping system) (Figure 12).

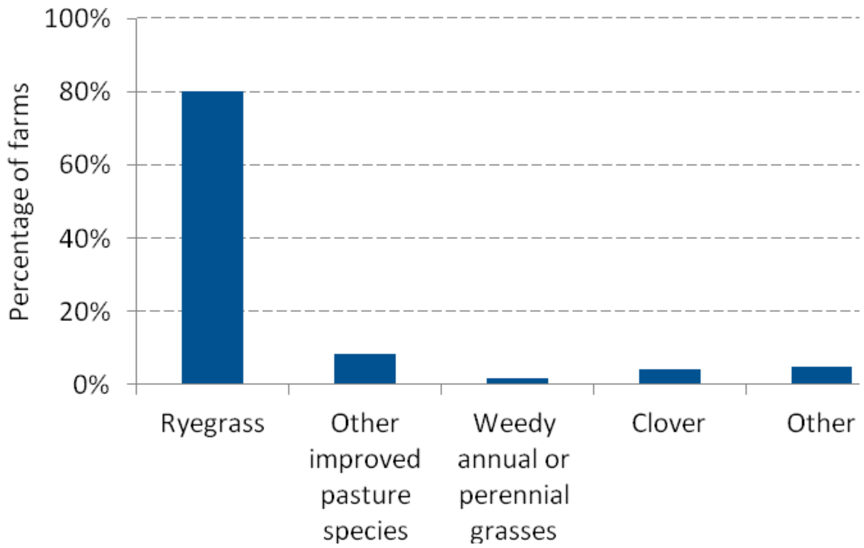

Figure 12: Ranked as the #1 component of a typical pasture composition used for finishing cattle

Multiple responses were permitted so shares do not sum to 100%; Sample size = 121

While ryegrass pastures could not be linked to underperformance based on the results from the survey (Figure 13), the dominance of ryegrass pastures in Tasmania is a risk factor for ill-thrift due to the potential for mycotoxins (Beef and Lamb New Zealand, 2006).

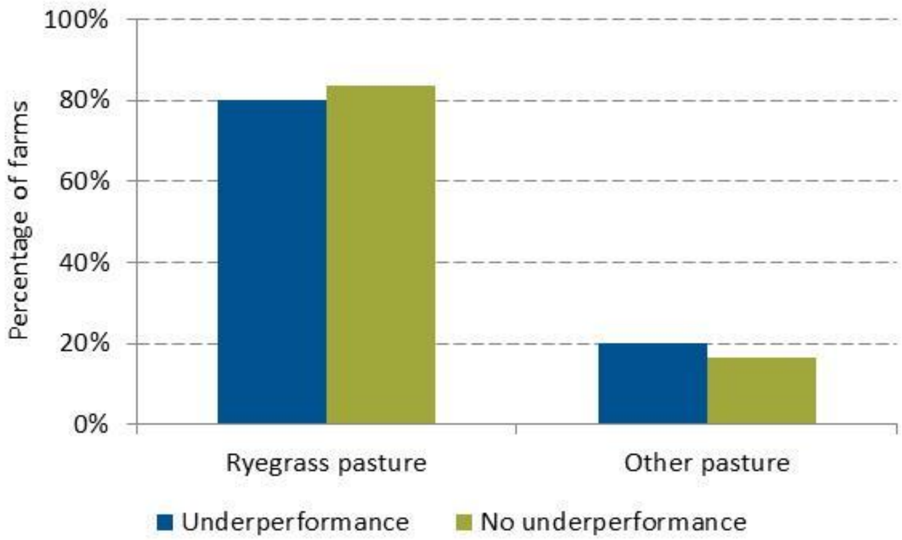

Figure 13: Typical pasture composition used to finish cattle compared with underperformance in cattle

Multiple responses were permitted so shares do not sum to 100%; Sample size = 106; No significant difference between underperformance & no underperformance at 5% or 10% level.

Over 60% of producers reported seeing or suspecting symptoms of ryegrass staggers in their livestock and nearly 50% reported seeing symptoms of photosensitisation (Figure 14 and Figure 15). Producers were more easily able to recognise symptoms of ryegrass staggers than photosensitisation (3% unsure on staggers compared with 7% on photosensitisation).

Ill-thrift is often associated with ryegrass staggers, which is a clinical condition caused by the mycotoxins released by endophytic fungi. These releases are highest in late summer/autumn (Beef and Lamb New Zealand, 2006, Leng 2005, di Menna et al, 2012). Ill-thrift can be considered as a sub-clinical response to mycotoxins (i.e. symptoms are not readily observable but mycotoxins are having an adverse impact on animal health and compromising production) (Beef and Lamb New Zealand, 2006).

Photosensitisation is one of the symptoms of facial eczema, which is again caused by mycotoxins (produced by fungi *Pithomyces chartarum*) in ryegrass. It is important to note that facial eczema is not readily detected as most cattle suffer liver damage caused by sporidesmin without showing any visual signs of facial eczema. This release of mycotoxins and condition is more prevalent in late summer/early autumn (Collins et al, 1998); Dairy Australia, 2011). Visual signs of facial eczema include photosensitisation, skin irritation and dermatitis (Dairy Australia, 2011).

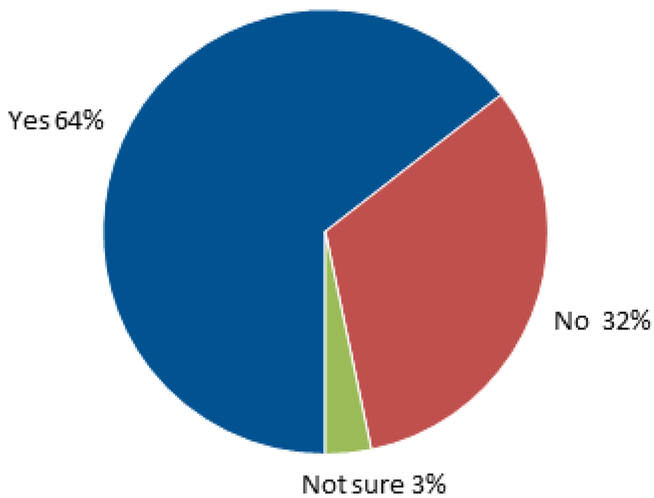

Figure 14: Overall % of respondents reporting presence of ryegrass staggers in livestock (both sheep and cattle)
Sample size = 121;

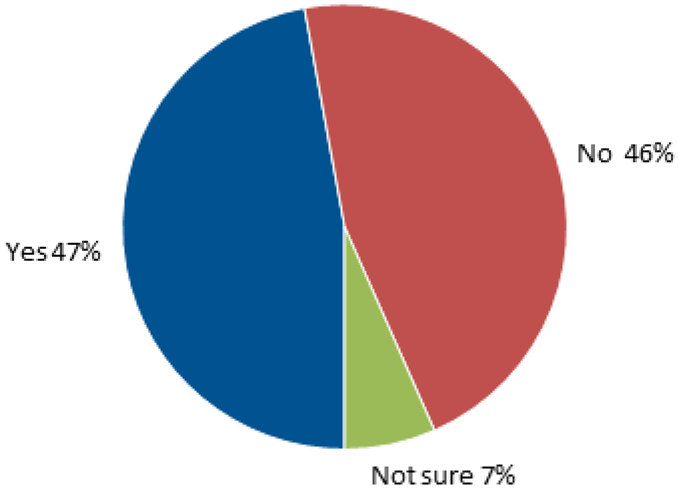

Figure 15: Overall % of respondents reporting presence of photosensitisation in livestock (both sheep and cattle)
Sample size = 121;

A significantly higher proportion of farms that reported underperformance also reported photosensitisation than those farms not reporting underperformance (Figure 16) - farms reporting photosensitisation are 22% more likely to report under performance that those that do not (marginal probability value (odds ratio) using a binary logit model). While the number of farms reporting ryegrass staggers was also higher for those that reported underperformance than those who did not, this was not statistically significant (Figure 17).

This finding supports the suggestion that mycotoxins may be causing some level of ill-thrift in Tasmanian cattle herds. The very high overall levels of both ryegrass staggers and photosensitisation reported in livestock suggests there could be a substantial number of cattle potentially suffering sub-clinical effects from mycotoxins (ie reduced liveweight gains), of which producers are unaware. These subclinical effects, if present, will likely be impacting productivity (Leng 2005).

While the survey data has been able to establish a direct link between photosensitisation and perceived underperformance, other measures of ryegrass toxicity (ryegrass staggers) were not able to be linked with perceived underperformance. The survey did not address the different varieties of ryegrass pasture used by Tasmanian beef producers, although anecdotally it is known that there is a diversity of ryegrass species and cultivars grown, which may have differential levels of endophyte and mycotoxin toxicity. This may need more detailed examination.

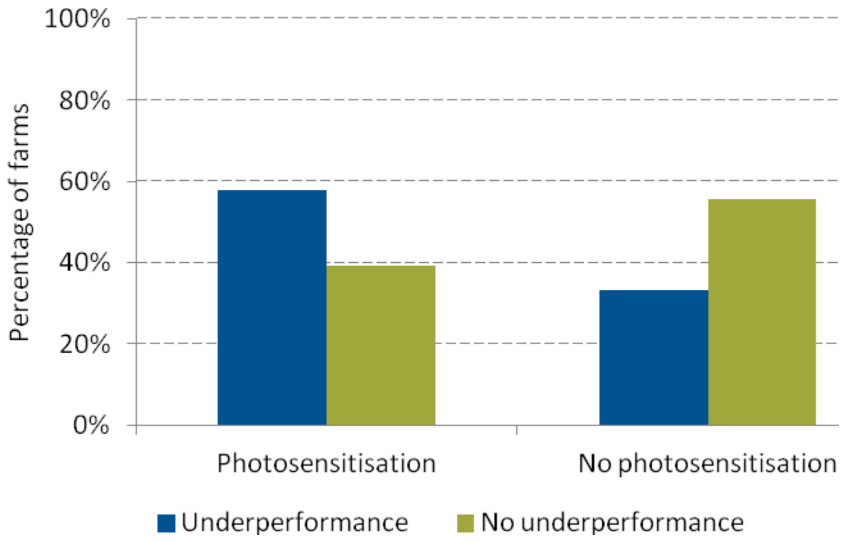

Figure 16: Suspected photosensitisation in livestock

Sample size = 99; Significant difference between underperformance & no underperformance at 5% level.

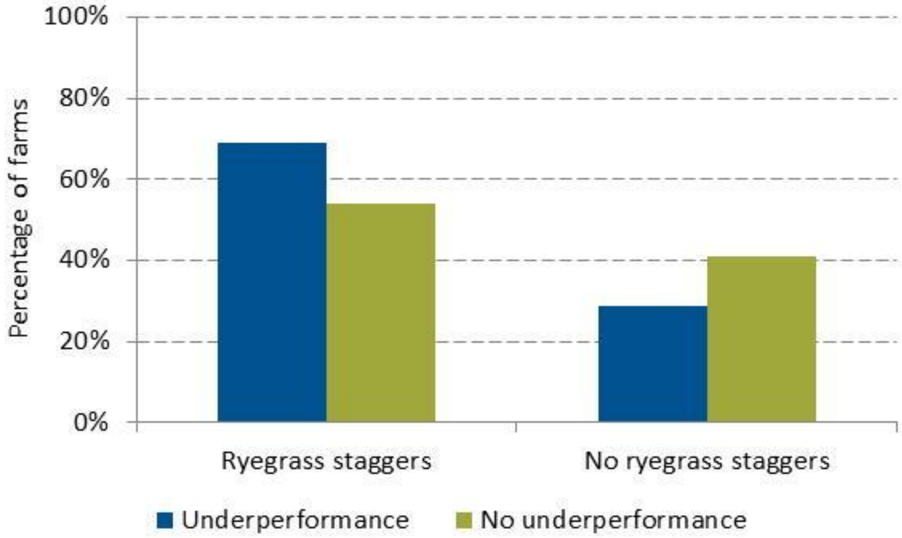

Figure 17: Ryegrass staggers in livestock

Sample size = 102; No significant difference between underperformance & no underperformance at 5% or 10% level.

4.4 Feed and stock management

In addition to the mycotoxin issue associated with ryegrass pastures, ryegrass has been found to have less nutritional value in autumn than at other times of the year (Walsh and Birrell 1986). This was demonstrated by a trial carried out by the Circular Head Beef Group which showed that liveweight gain in autumn could be increased by approximately 0.5 kg liveweight per day with very good grazing management (B. Doonan *pers comms*).

Pasture based grazing systems were usually used by almost 50% of responses followed by set stocking and time based grazing (Figure 18). Producers with underperforming cattle were more highly represented in the group using pasture based grazing compared to the groups that did not (Figure19). However, plausible reasons for this are unclear.

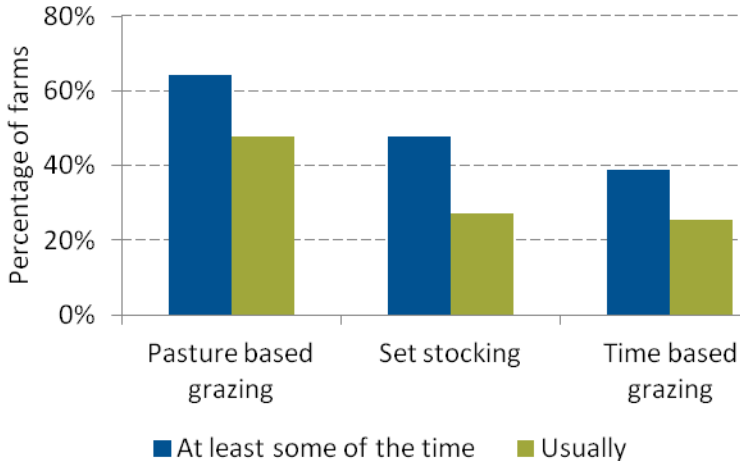

Figure 18: Grazing management system used

Multiple responses were permitted so shares do not sum to 100%; Sample size = 121;

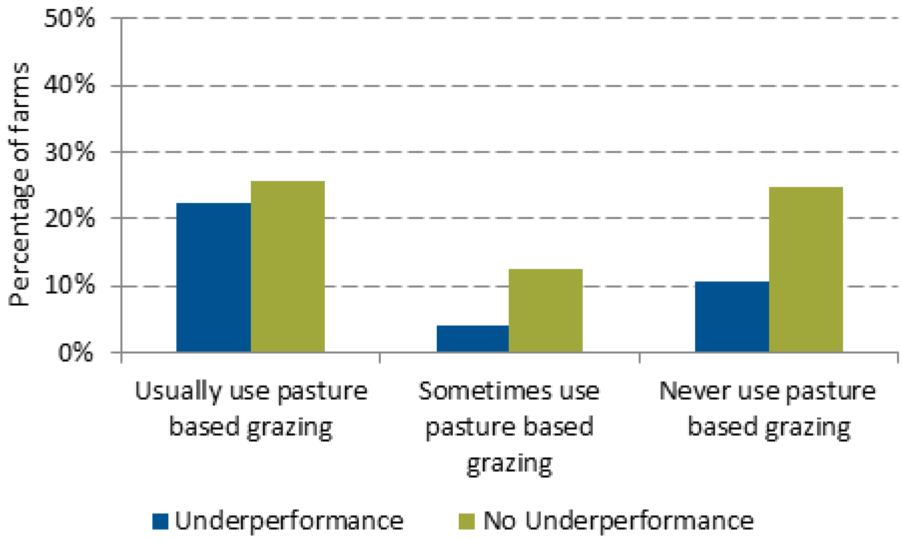

Figure19: Underperformance in cattle compared with the type of grazing management system usually used
Sample size = 106;

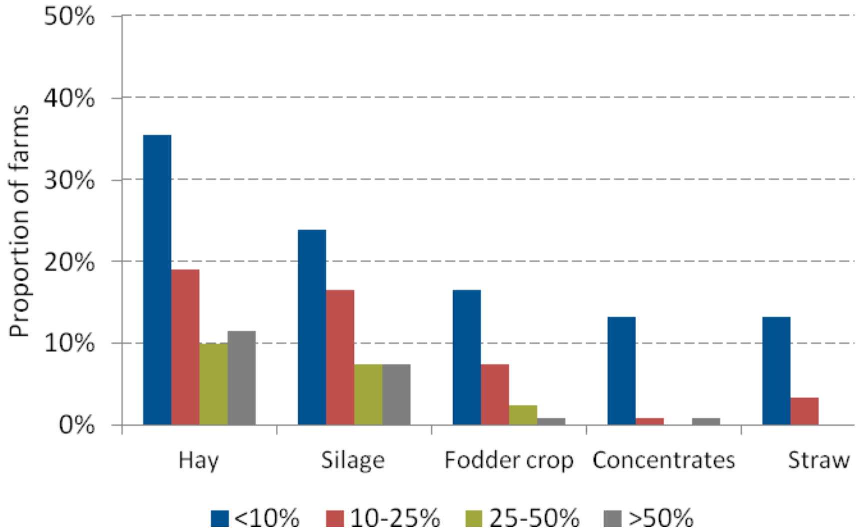

Figure 20: Typical proportion of supplements in the autumn diet
Sample size = 121

The most common supplements fed were hay and silage (usually made from ryegrass), with minimal fodder crops or concentrates being used (Figure 20). This adds to the risk of mycotoxin toxicity. In addition to potentially containing mycotoxins when they were cut, moulds that form on feed during storage can also produce mycotoxins (Whitlow and Hagler, 2010; Reed *et al* 2004). If cattle are already being affected by mycotoxins in grazed feed, feeding supplements which are also impacted by mycotoxins will effectively increase the toxin dose. In a large-scale survey, Pittet (1998) found a natural occurrence of mycotoxins in 40% of 25,000 food and feed samples collected in 30 countries around the world.

The majority of producers do not use fodder crops for finishing cattle (Figure 21). There was also no obvious relationship between producers who did or did not use fodder crops and underperformance in cattle. The majority of producers finish cattle on annual ryegrass followed by brassicas, cereals, lucerne and other fodder crops (Figure 22).

There were no differences between producers that identified underperformance in their cattle and those that did not, and the type of fodder crop that was grazed. Farms reporting underperformance grazed cattle on other forages apart from ryegrass (e.g. brassicas), and this suggests that the causes of ill-thrift are likely to be multi-factorial.

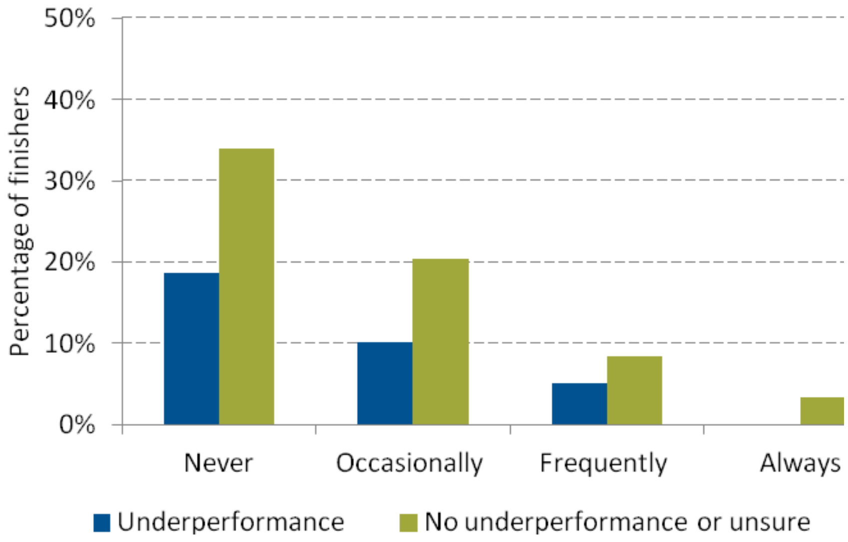

Figure 21: Use of fodder crops to finish cattle by farms with underperforming cattle and farms without underperforming cattle
Sample size = 75;

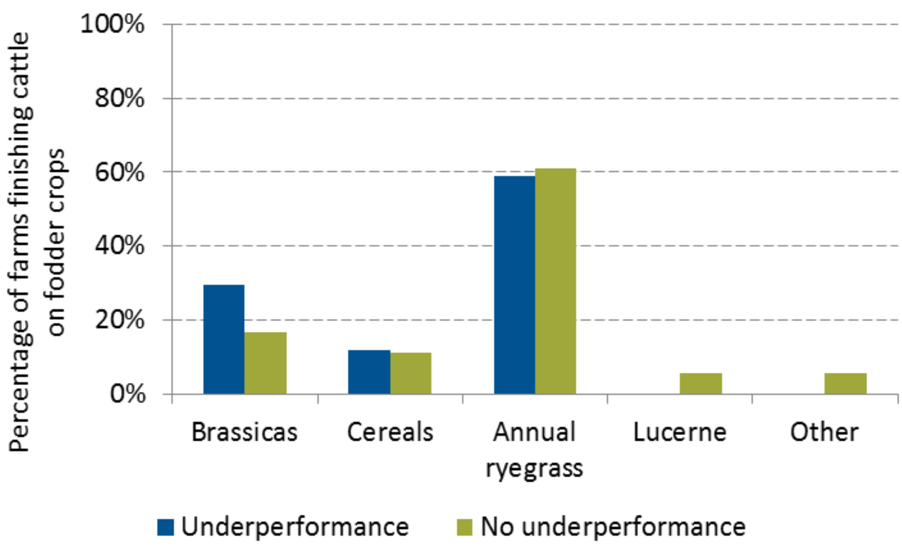

Figure 22: Contribution of fodder crops for finishing cattle by farms with underperforming cattle and farms without underperforming cattle
Sample size = 35; No significant difference between underperformance & no underperformance at 5% or 10% level.

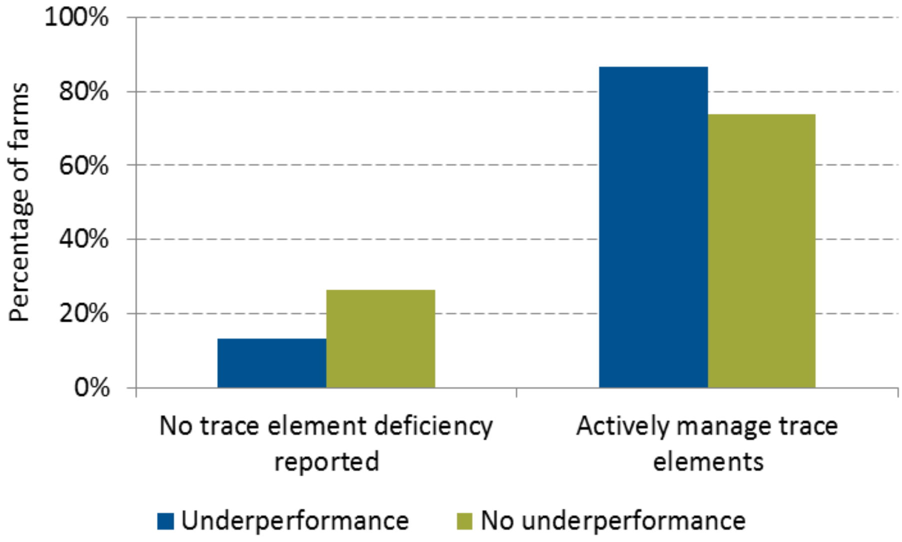

Figure 23: Management of trace element deficiency by underperformance

Sample size = 106; No significant difference between underperformance & no underperformance at 5% or 10% level.

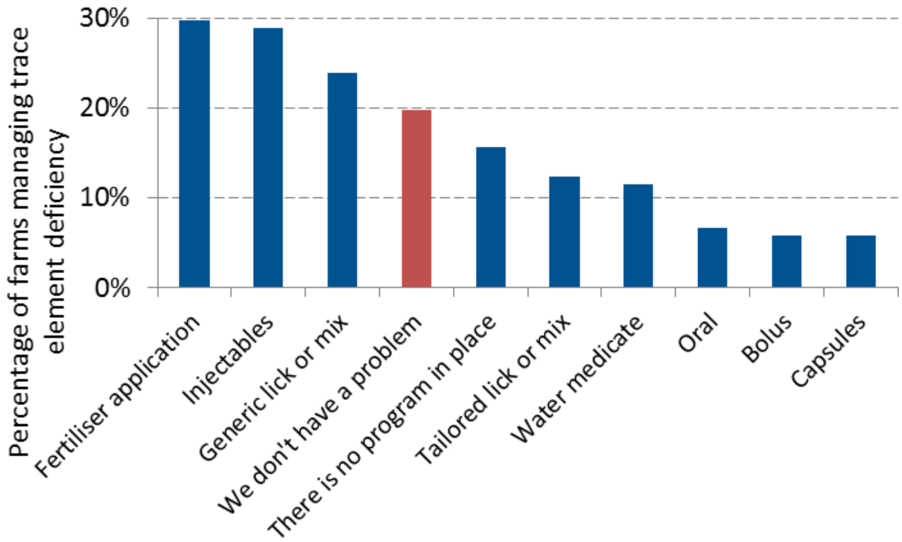

Figure 24: Management of trace element deficiency

Sample size = 84

The majority of producers are actively managing trace elements in their livestock and the numbers are similar for producers who report underperforming cattle compared to those that don't (Figure 23). The most common methods used for managing trace element deficiency are fertiliser application, injectables and generic licks (Figure 24).

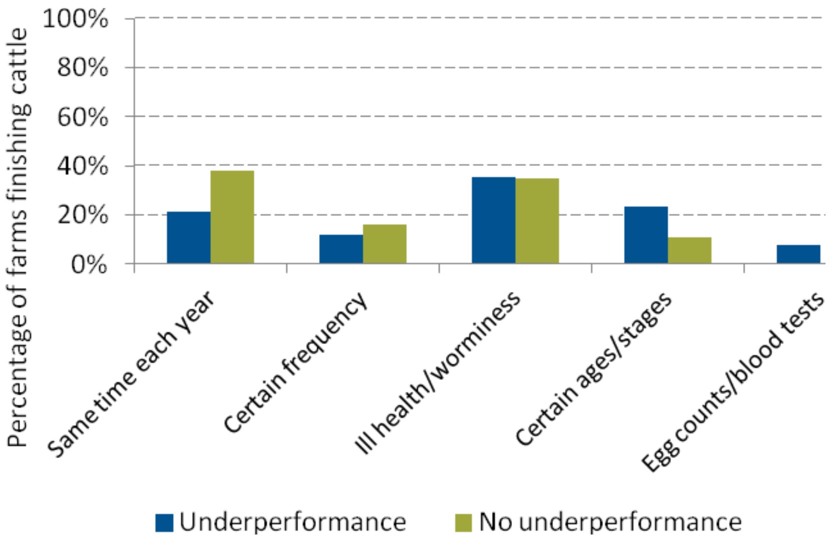

Figure 25: Methods by which farms that finish cattle manage parasite in young stock

Sample size = 75; Observed different between underperformance & no underperformance was found to be statistically significant at 5% level.

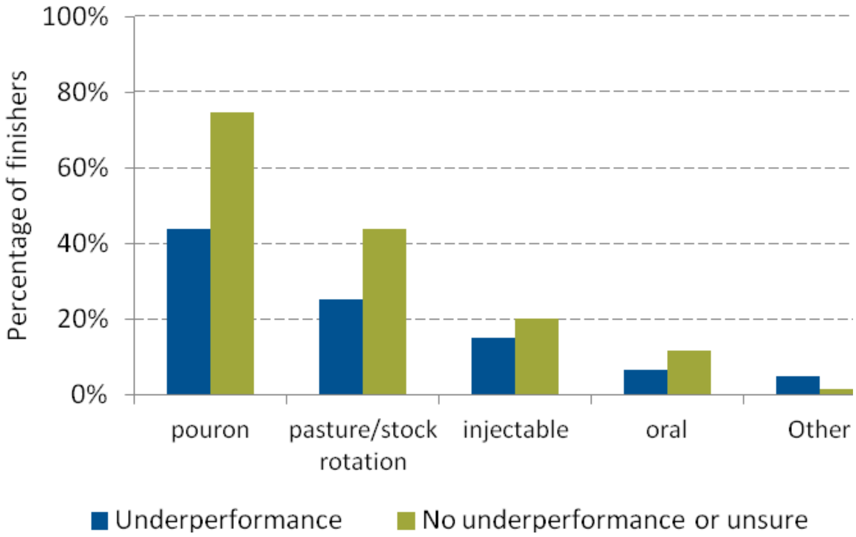

Figure 26: Worm control techniques among finishers by farms reporting underperforming cattle and farms not reporting underperforming cattle

Sample size = 75; Observed different between underperformance & no underperformance was found to be statistically significant at 5% level.

On farms finishing cattle, underperformance was significantly higher among those that drenched young stock at certain ages/stages and significantly lower among those that drenched young stock at the same time each year (Figure 25). Whilst best practice was recognised in the literature review as taking into account all of the factors such as seasonal variations, time of year, age of cattle and type of anthelmintic, it is difficult to compare results from the survey with the literature review as respondents only chose one factor in the survey. The majority of producers use pour-on drench followed by pasture stock rotation to control worms in livestock (Figure 26). Significantly more producers who did not report underperformance used pour-on and pasture/stock rotation to control parasites than those who did report under-performance.

4.5 Breeders

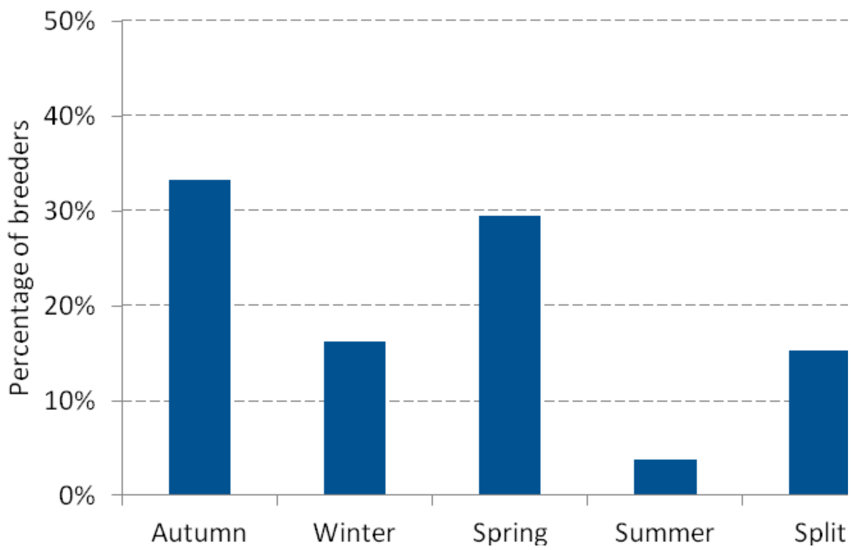

Figure 27: Time of calving
Sample size = 105

32% of producers autumn calve, followed by 29% spring calving. Only 15% of producers split calve (i.e. have two calving periods per year) (Figure 27).

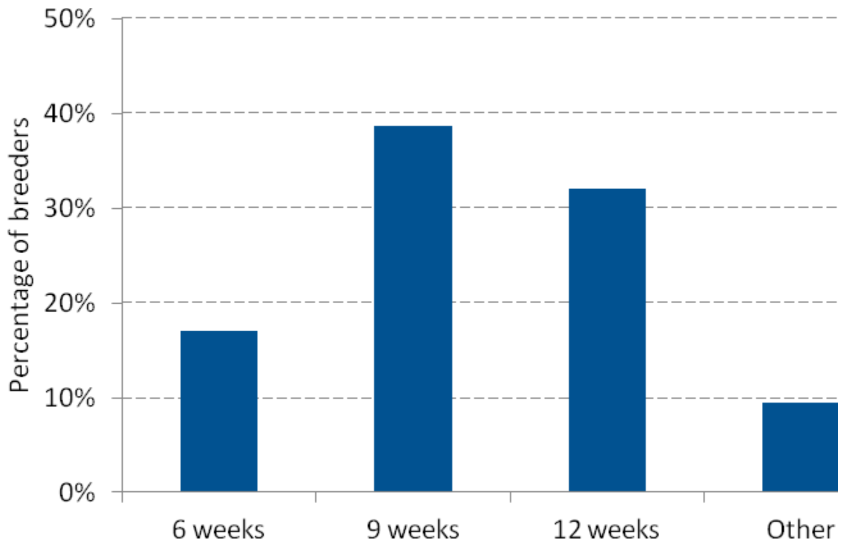

Figure 28: Length of joining
Sample size = 105

Over one third of producers join their cows with bulls for a 9 week period (Figure 28).This is considered the right amount of time (3 cycles) to enable cows to get in calf. However, one third of producers join for 12 weeks.

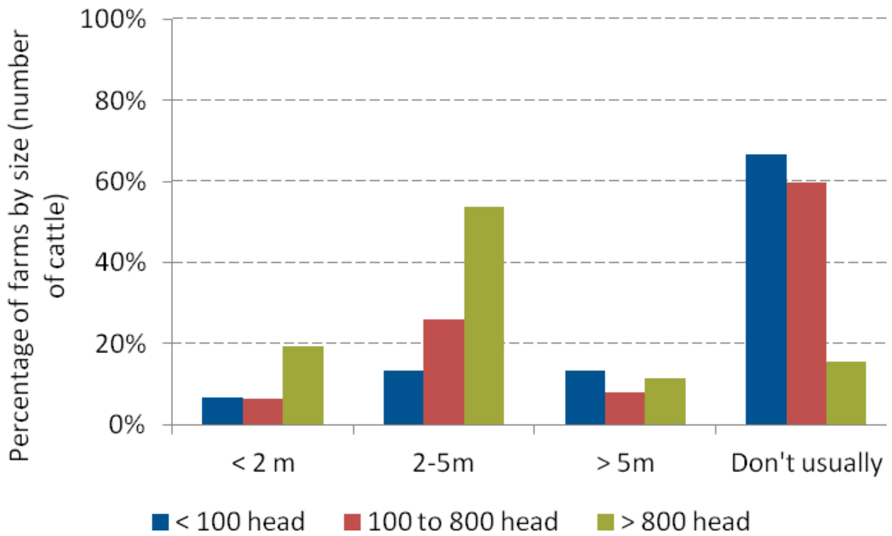

Figure 29: Pregnancy testing after joining by farm size (number of cattle)
Sample size = 105

The majority of producers running large herds (>800 head) preg test their cows 2-5 months after joining. The majority of smaller-medium sized producers do not usually preg test at all (Figure 29), and neither do 18% of large (>800 head) producers. This is a very large number of beef producers who do not use pregnancy testing on a regular basis.

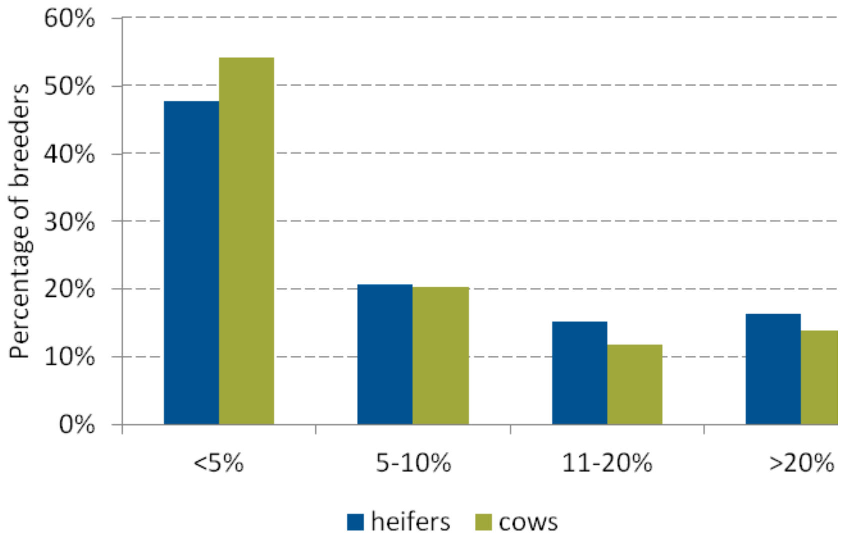

Figure 30: Empty rate at last pregnancy testing
Sample size = 105

The empty rate for the majority (approximately 50%) of those that preg tested last year is generally low (<5%) (Figure 30). However the reverse of this is that 48% of cow herds had an empty rate of higher than 5% (with 23% of these being above 10% empty). Unsurprisingly, heifers are more highly represented in the groups with higher empty rates.

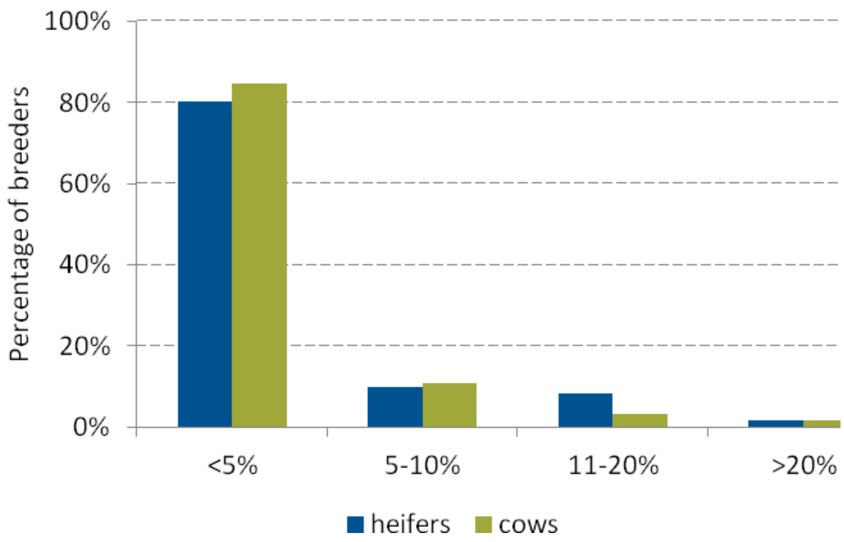

Figure 31: Percentage pregnancy tested in calf that failed to calve
Sample size = 105

The majority of breeding herds (>80%), had less than 5% of cows tested in calf which failed to calve (i.e. aborted) (Figure 31).

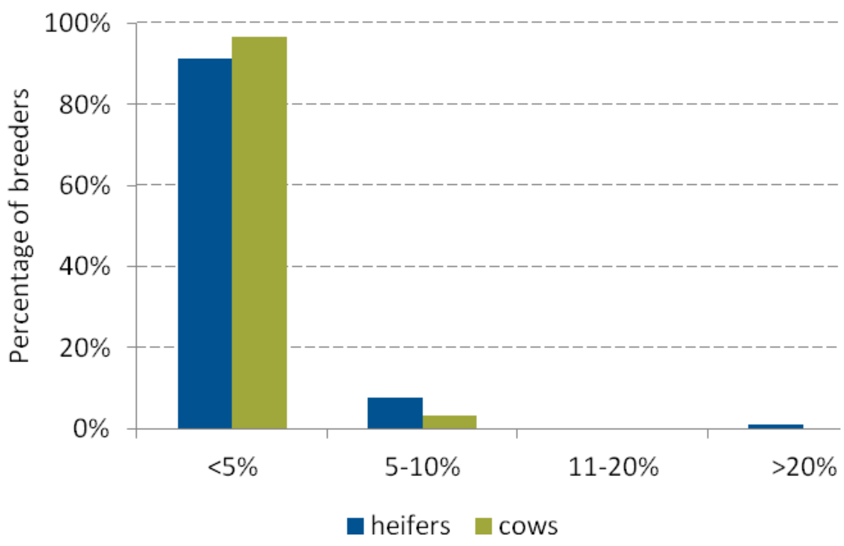

Figure 32: Percentage loss of calves between birth and marking

Sample size = 105

The majority of herds (>90%), had less than 5% of calves lost between birth and marking (Figure 32).

4.6 Economic impacts of ill-thrift

The economic impact of ill-thrift has been estimated using a combination of survey results and evidence collected from Tasmanian based beef benchmarking groups.

Information relating to the incidence of underperformance in cattle was collected during the survey. However, attempting to capture measures of underperformance on a consistent basis with the survey tool was deemed to be too difficult. This was confirmed by the survey results indicating that only 40% of producers reporting underperforming cattle actually weighed their animals. Therefore a scenario based approach was adopted, which used a range of underperformance measures collected during beef benchmarking discussion groups.

Annual estimates for lost beef production due to ill-thrift were calculated by multiplying:

- a range of scenarios around the degree of underperformance;
- the incidence of underperformance reported in the survey (37%); and
- the number of cattle slaughtered each year.

Table 2 contains a range of underperformance scenarios based upon measures collected by a Tasmanian beef benchmarking group. The length of time cattle were reported to have suffered underperformance ranges from 45 days to 90 days and the severity of underperformance ranged from 0.25 kg/day to 0.5 kg/day. Scenarios suggest the impact of underperformance on these animals ranges from around 11 kg/head to 45 kg/head at time of slaughter.

Table 2: Underperformance scenarios based on Tasmanian benchmarking group data

	Reduction in liveweight gain	
Number of days cattle affected	0.25 kg/day	0.50 kg/day
45 days	11.25 kg	22.50 kg
90 days	22.50 kg	45.00 kg

Using the incidence of ill-thrift reported in the survey (37%) and the 5-year average of number of cattle slaughtered in Tasmania and Victoria (Table 3), over 70,000 head of cattle in Tasmania, and over half a million in Victoria, are estimated to suffer from underperformance each year (Table 4). This estimated level of underperformance was then used to calculate lost production scenarios, which ranged from 832 tonne to 3,300 tonne of lost beef production each year in Tasmania (Table 5) and 5,828 tonne to 23,310 tonne of lost beef production each year in Victoria (Table 6).

Table 3: Cattle slaughter figures for Tasmania and Victoria*

	Tasmania	Victoria
Annual Tasmanian slaughter	53,000,000 kg	358,200,000 kg
Annual Tasmanian slaughter	200,000 head	1,400,000 head
Implied carcass weight	265 kg	256 kg
Target carcass weight	280 kg	280 kg

** data obtained from ABS 7218.0.55.001*

Table 4: Estimated impact of ill-thrift on number of cattle slaughtered in Tasmania and Victoria

	Tasmania	Victoria
Number of cattle impacted	74,000 head	518,000 head

Table 5: Estimated loss of production in Tasmania (kg)

	Reduction in liveweight gain	
Number of days cattle affected	0.25 kg/day	0.50 kg/day
45 days	832,500 kg	1,665,000 kg
90 days	1,665,000 kg	3,330,000 kg

Table 6: Estimated loss of production in Victoria (kg)

	Reduction in liveweight gain	
Number of days cattle affected	0.25 kg/day	0.50 kg/day
45 days	5,827,500 kg	11,655,000 kg
90 days	11,655,000 kg	23,310,000 kg

Based on a 5 year average saleyard price for both Tasmania and Victoria of approximately $3.40 /kg cwt (ABARES Australian commodities data), underperformance in beef cattle is estimated to have an annual economic impact of $3 million to $11 million in Tasmania (Table 7) and $20 million to $80 million in Victoria (Table 8). This is consistent with findings by Sackett and Francis (2006) and Sackett et al (2006) who rated the economic significance of PRGT as one of the top five most costly endemic diseases affected the meat and wool industries in Australia. To further emphasise the significance of this finding - in the absence of clinical signs of staggers scientists have noted that the one of the endophytes which causes it has remained at elevated levels (above sheep tolerance) for 2-3 months (Reed et al 2011). This is likely to be having subclinical impacts on productivity.

Table 7: Estimated annual loss ($) in Tasmania

	Reduction in liveweight gain	
Number of days cattle affected	0.25 kg/day	0.50 kg/day
45 days	$3 m	$6 m
90 days	$6 m	$11 m

Table 8: Estimated annual loss ($) in Victoria

	Reduction in liveweight gain	
Number of days cattle affected	0.25 kg/day	0.50 kg/day
45 days	$20 m	$40 m
90 days	$40 m	$80 m

5 Success in achieving objectives

5.1 Objective 1 – Evidence for suboptimal performance

1. Explored the evidence base for the sub-optimal liveweight gains being reported for beef cattle in areas of Tasmania and quantified its likely prevalence and magnitude.

Autumn ill-thrift has been widely reported in the literature as occurring in temperate pasture systems world-wide. The survey suggests that there is both potential for such a syndrome in Tasmanian beef cattle herds (due to wide use of perennial ryegrass) and the reporting of underperformance by 37% of producers surveyed. However, similar rates of underperformance were reported in winter (58%) and autumn (65%). Based on these results and the inherent limitations of the survey data, it is not possible to definitively conclude that autumn ill-thrift is occurring in the Tasmanian beef herd. However, the significant levels of reporting of symptoms of ryegrass staggers and/or photosensitisation does indicate a need for more focussed and robust studies.

5.2 Objective 2 – Evidence for foetal mortality

2. Explored the evidence base for increased levels of foetal mortality being reported for beef cattle in areas of Tasmania and quantified its prevalence and magnitude.

The survey data did not find evidence for elevated levels of foetal mortality in Tasmanian herds. However, actual data on losses was limited by the relatively high number of surveyed producers not doing pregnancy testing on a routine basis. In order to better understand this issue it will be necessary to increase the rate of pregnancy testing amongst Tasmanian beef producers.

5.3 Objective 3 – Causal factors

3. Identified the most likely causal factors, including management practices, leading to sub-optimal liveweight gain and/or increased foetal mortality, thereby assisting producers to address the issue and guiding any future research.

The key potential causal factors for autumn ill-thrift identified by the literature review were (in order of priority):

1. mycotoxins (produced by endophytes in pasture and cereal species)
2. pasture quality
3. parasites

As ryegrass is the dominant feed base for Tasmanian beef cattle, there is an inherent risk of ryegrass toxicity affecting cattle performance. However, the survey data was unable to conclusively infer the incidence and severity of any impacts on production. The relative high level of reporting of symptoms of ryegrass staggers and/or photosensitisation, and the link between reporting of photosensitisation and underperformance, does indicate a need for more focussed and robust studies, to determine whether or not mycotoxins are impacting liveweight gain. The possibility of other potential causes of underperformance including parasites or pasture quality/quantity also warrants further investigation.

5.4 Objective 4 – Economic impacts

4. Estimated the economic impact of sub-optimal liveweight gains and/or increased rates of foetal mortality.

The impact of sub-optimal liveweight gains, if calculated at the rate experienced in the management survey (37% of producers) is likely to be in the order of somewhere between $3-11m annually to Tasmanian producers. This is based on an average loss (or non-attainment) of 0.25 - 0.5kg LW/animal/day for a period of 45-90 days.

If, and it appears likely based on the amount of feedback from a MLA Feedback article on the subject and the literature review, that the problem is widespread throughout the southern region then the loss to Australian producers could be in the order of $25-100m annually.

6 Impact on meat and livestock industry – now and in five years time

This project has confirmed the likelihood of periods of underperformance in Tasmanian beef herds, and pointed to ryegrass toxicity as the most likely cause of any production losses. However, the survey data and literature review are unable to either definitively establish the actual incidence or severity of underperformance or dismiss the range of potential factors that may be associated with any such underperformance on different farms or regions. Well-designed research is required to confirm, and quantify, any lost productivity, and to establish the causes of, and solutions to, the problem. Given any problems are likely to be widespread, the potential impact of R&D in clarifying and resolve any production issues will be significant.

7 Conclusions and recommendations

Ill-thrift during autumn has been widely documented and researched both in Australia and overseas. Further, over one third of Tasmanian beef producers reported underperformance in their herds, although it was not exclusively identified as being an autumn issue. The dominance of ryegrass pastures for beef production in Tasmania, combined, with the high level of reporting of ryegrass staggers and photosensitisation in livestock, supports the hypothesis that mycotoxins are a significant issue for beef production based on ryegrass pastures. Where subclinical effects occur (i.e. there are no obvious symptoms), producers may not be aware that they have a problem. Additional to ill-thrift, as defined, the performance of ryegrass pastures (quality) in autumn is known to be poor and this is likely to exacerbate the impacts of ill-thrift at this time of year. It is important to note that the literature review indicated autumn ill-thrift is not confined to cattle, and affects sheep as well. Of the producers that responded to the survey, nearly one third also run sheep enterprises, meaning that improving knowledge and management of ill-thrift will not only have benefits for the beef industry in Tasmania but also the sheep industry.

Based on the results from the literature review and the beef producer's survey, the key areas that require further investigation to (a) better understand the causes of ill-thrift in Tasmania and (b) identify the most effective management practices to mitigate against these.

Mycotoxins
Mycotoxin research on perennial ryegrass varieties grown in Tasmania is recommended to determine which mycotoxins are present and whether they are linked to ill-thrift. The most cost-effective way to assess this may be through monitoring cattle liveweight gain when mycotoxin deactivators are used. It should be noted that this recommendation, and some others listed below, also apply to the sheep industry.

Parasites
It is quite possible that cattle producers are not strategically drenching at critical times of the year which could be contributing to ill-thrift in the autumn/summer period. They may also not be adopting recommended cultural practices to assist in parasite management and reduce the potential for drench resistance to develop. However, the extent of drench resistance and/or variations in worm burden over the year are not well documented in Tasmania.

All of these factors may potentially be having a detrimental impact on productivity throughout the year, in addition to possibly exacerbating autumn ill-thrift .Therefore the following recommendations are suggested to improve parasite management in beef herds:

1. Delivery of a program to ensure strategic drenching regimes are being implemented by cattle producers in Tasmania (e.g. taking account of seasonal variation, time of year and age of cattle). This should also include management practices for reducing exposure to parasite infection.

2. Assessment of variation in worm burden through the year (through pasture cuts or blood testing, not faecal egg counts).

3. If cattle are not responding to strategic drenching programs more research may be required to determine whether drench resistance is an issue and, if so, whether using other anthelmintic treatments is a viable option.

Feed and general herd management practices
The beef producer survey has highlighted that there is room for improvement on some key management practices used by producers. An increased rate of pregnancy testing and improved grazing management (more focussed on either time based or pasture growth stage) are practices which would help improve productivity.

1. Ensure producers are aware of seasonal variation in nutritive values of perennial ryegrass, and are implementing best practice pasture/feed management to mitigate its impacts.

2. Determine whether supplementary feeding with either pellets or grain is viable throughout the autumn period. This could contribute to reducing cattle exposure to mycotoxins, in addition to compensating for reduced pasture quality.

3. Undertake cost benefit analysis on pregnancy testing for Tasmanian beef producers (if this data is not already available).

4. Delivery of extension programs designed to incorporate group learning principles and focus on multiple aspects of better beef production. Ideally these workshops/programs would have an economic focus where management actions are clearly translated into production outcomes.

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9 Appendices

9.1 Appendix 1

Literature review of current knowledge concerning ill-thrift in beef cattle during the autumn period.

Executive summary

This literature review is part of the project 'Autumn ill-thrift in Tasmanian beef herds', B.SBP.0109, funded by Meat and Livestock Australia (MLA). In conjunction with a producer survey, the literature review is part of a scoping study to determine the likely severity, extent and possible causes of ill-thrift during the autumn period as issues for beef producers in Tasmania, and relationships between management practices and autumn ill-thrift. The results from the producer survey and this literature review will be used to inform the scale and content of Phase 2 of the project and whether further research into ill-thrift in Tasmania is justified.

In Tasmania many producers have reported anecdotal evidence suggesting that cattle underperform during the late autumn period. Ill-thrift during autumn is a real phenomenon which has been widely documented and researched both in Australia and overseas. While to some extent the causes of ill-thrift are multifactorial, this review highlights key factors which have been clearly linked with ill-thrift (e.g. mycotoxins, pasture quality and internal parasites), and the research which is required to both quantify their contribution to the condition, and to assess the impact of management strategies to offset the impact of ill-thrift.

Seasonal changes in pasture quality (e.g. low soluble carbohydrate content in autumn herbage) directly affect liveweight gain of cattle. It is probable that the lower than expected liveweight gain over the autumn period seen in Tasmania could be at least partly attributed to the poor quality of perennial ryegrass at this time of year. Educating beef producers about the variation in nutritive values of pasture during the year and the impact of best practice grazing techniques (e.g. minimising dead matter and maintaining healthy levels of post grazing residual biomass) could help improve liveweight gain of cattle over autumn.

Fungi (via mycotoxins), even at sub-clinical levels, can contribute to ill-thrift in cattle over the autumn period. Combined with anecdotal evidence of exposure to fungi in Tasmania (i.e. perennial ryegrass staggers) it is likely that, during the summer-autumn period, pastures could contain high levels of fungi, which may be exacerbating ill-thrift during this time.

Research suggests that parasites are a major contributor to reduced liveweight gain. Drenching must be strategically distributed throughout an animal's life taking into account seasonal variances to maximise effectiveness. In some areas (e.g. Victoria and New Zealand) drench resistance has been identified, however little is known about this issue in Tasmania as no broadscale studies have been undertaken. However, incidences of anthelmintic resistance have been identified in different regions of the state (e.g. Cooperia at Cressy and brown stomach worm and lungworm in NE Tasmania) (Dr Bruce Jackson[1], *pers comm*.) In addition, there is no

[1] Manager, Animal Services, Department of Primary Industry Parks, Water and Environment, Tasmania

evidence that worm burdens are higher in autumn in Tasmania than at other times of the year (Dr Bruce Jackson, *pers comm*.).
There is no strong evidence that ill-thrift during the summer-autumn period is due to lack of trace minerals in pastures. Whilst trace minerals as a contributor to ill-thrift have not been ruled out, ill-thrift has been more strongly linked with other causal factors (e.g. fungi and internal parasites) and as such these should be a higher priority for investigation.

Poor pasture management techniques appear to be one of the major reasons why cattle have lower than expected liveweight gains over autumn, therefore it is pivotal that any research is conducted with best-practice pasture management in place. This will enable a more accurate understanding of the contribution of the other potential causes of ill-thrift to the condition in Tasmania.

Introduction

This literature review is part of the project 'Autumn ill-thrift in Tasmanian beef herds', B.SBP.0109, Meat and Livestock Australia (MLA). In conjunction with a producer survey, the literature review is part of a scoping study to determine the severity of ill-thrift during the autumn period as an issue for beef producers in Tasmania, and relationships between management practices and the presence of autumn ill-thrift. The two components will be used to inform the scale and content of phase 2 of the project and whether further research is required.

Ill-thrift is defined as sub optimal production relative to the apparent quality and quantity of feed on offer (Leng, 2005). In Tasmania many producers have reported anecdotal evidence suggesting that cattle underperform during the late autumn period. Investigation by the Circular Head Beef Business Group (CHBBG) and the Towards 2000 Winnaleah trial found that while some improvement could be made through implementation of best practise pasture management, liveweight gains were still below the perceived potential. The perceived loss of performance was in the order of 0.25-0.5kg/head/day.

In order to put into context the situation in Tasmania, this literature review aims to determine the extent of ill-thrift in cattle over the autumn period by reviewing how widely it has been documented both in Australia and other parts of the world. It also aims to identify possible causes and determine how well these are understood.

It has long been documented that stock grazing summer and autumn pasture do not put on liveweight gains expected by farmers (Scott *et al*. 1976). Both dairy and beef cattle, regardless of breed, have been known to experience ill-thrift over the autumn period. Autumn ill-thrift has been recognised in other parts of the world particularly in temperate regions including Uruguay (Simeon *et al*, 2002), Ireland (French *et al*, 2001a), New Zealand (Scott *et al*, 1976), and southern states of the United States (Leng, 2005). Ill-thrift in sheep has also been widely documented in New Zealand and parts of Australia.

This literature review discusses possible causes attributed to ill-thrift in cattle including feed quality, mycotoxins (endophytes, *Fusarium spp.* and facial eczema), parasites and trace minerals in relation to ill-thrift over the autumn break with an emphasis on perennial ryegrass (which is the dominant pasture species in the areas experiencing autumn ill-thrift).

Extent of ill-thrift

Ill-thrift over the autumn period is a phenomenon that has been documented for a long time particularly in temperate regions world-wide, in both cattle and sheep. Uruguay recognises cattle having growth rates in autumn lower than expected considering the apparent quality of grasses (Simeon *et al*, 2002). Autumn ill-thrift in both sheep and cattle has been well documented in New Zealand where a significant amount of research to determine causes has been undertaken. Ill-thrift over the summer/autumn period has also been recognised in Australia although limited research has been conducted into possible causes. Parts of Europe and the United States have conducted research on livestock response to fungi which is believed to be one of the causal factors of ill-thrift.

Causes of ill-thrift

The key factors which are thought to be associated with ill-thrift and which have been investigated to varying degrees in studies around the world are feed quality, mycotoxins (endophytes, *Fusarium spp*. and facial eczema), parasites and trace minerals. Beef and Lamb New Zealand (2006) conducted a study into ill-thrift in beef cattle and sheep - this was the most comprehensive of the research reviewed for this report. By using Q-Graze (computer model predicting pasture quality and quantity) they noted that poor pasture quality was a major contributor to suppressed liveweight gain over the autumn period however, they found ill-thrift still occurred in cattle exposed to feed of adequate quantity and quality. They discovered over summer and autumn that 36% of cattle and 62% of sheep showed signs of ill-thrift. Ill-thrift was identified when bulls and lambs grew at a rate 30% slower than predicted by Q-Graze. Of the cattle showing signs of ill-thrift, 50% was undiagnosed, 30% was due to parasites and 20% was associated with fusaria toxicity. Factors believed to contribute to ill-thrift are discussed in further detail in the following sections.

Feed

Pasture quality

In Australia perennial ryegrass is limited to approximately 6 million hectares, mostly on productive soils in the high rainfall (>600mm) temperate zones of Australia (Reed *et al*, 2011). Pasture quality greatly effects cattle performance. In order to meet the nutrient requirements of grazing livestock, pasture quality, quantity and efficient utilisation need to be well managed. Nutritive value (NV) and intake mainly determine cattle liveweight gain, health and reproductive performances (Lambert and Litherland, 2004). Metabolisable energy (ME), crude protein (CP) and dry matter (DM) digestibility make up the key nutritive components of pasture and influences intake by stock. To maximise cattle performance, paddocks need to maintain 1500-2500kg of green DM/ha of pasture mass (improved and native species) and contain low levels of dead plant material. The Beef and Lamb New Zealand (2006) study into ill-thrift indicated that poor grass quality was a major determinant of cattle not achieving the predicted liveweight gain. In order to be able to fully understand the extent and causes of autumn ill-thrift as defined, it is essential to first eliminate the exacerbating (and potentially confusing factor) of poor grazing management (pasture quality and utilisation). This has been clearly demonstrated in the small amount of work done to date on ill-thrift in Tasmania.

Investigation by the Circular Head Beef Business Group (CHBBG) and the Towards 2000 Winnaleah demo trial in Tasmania found that while some improvement could be made through implementation of best practise pasture management (0.25-0.5kg/head/day), liveweight gains were still below the perceived potential in the order of 0.25-0.5kg/head/day. Based on the evidence it is likely that the main reason cattle are not putting on the predicted liveweight gain on farms throughout Tasmania is due to poor pasture quality (e.g. poor rates of DM/ha and high levels of dead plant material). However, the liveweight gain still did not appear to match pasture quality/quantity, so there are additional factors at play.

Seasonal variation in pasture

Nutrient composition of grass changes with the seasons. Walsh and Birrell (1986) studied the seasonal effect on five pasture species including perennial ryegrass in south western Victoria. They noted that animals perform better consuming spring pasture than autumn pasture due to higher soluble carbohydrate content in spring compared to autumn herbage. Reed (1978) also suggested that differences in cattle grazing in autumn in the British Isles were due to seasonal changes in the herbage composition resulting in different rates of breakdown in the reticulorumen. A study in New Zealand by Morris *et al* (1993) revealed liveweight gain in finishing steers and bulls increased with sward surface maximum height of 12-15cm in autumn and 8-10cm in spring. Malau-Aduli (2007) investigated seasonal variations in post weaning growth performance of beef cattle heifers on Tasmanian native grasses. He found that body conditions scores and average daily gains followed a sigmoid curve pattern (Figure 1). This is in stark contrast to feed-lot cattle where there is an observed linear increase. He concluded the decline in pasture quality throughout the season directly affected liveweight, body score and daily liveweight gains.

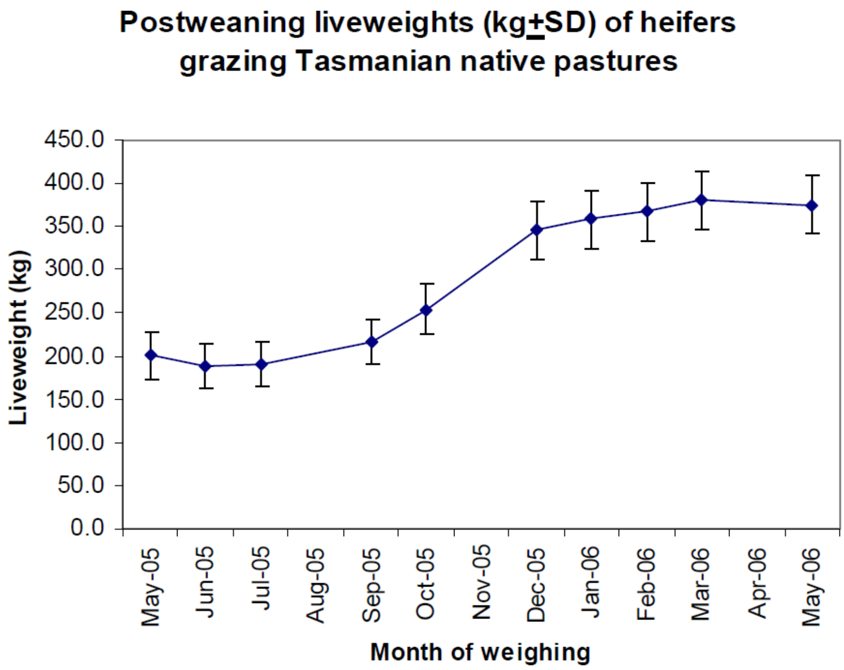

Figure 1: Postweaning liveweights of heifers grazing Tasmanian native pastures. Source: Malau-Aduli (2007)

It is important that farmers in Tasmania are aware of the seasonal changes in perennial ryegrass quality throughout the summer/autumn period and adjust management practices to counteract nutritional losses. Work in Tasmania has linked leaf stage grazing to pasture quality - grazing rotations that are too fast or too slow will compromise feed quality (D. Donaghy, *pers comm*).

Supplementary feeding in autumn

A study conducted in Ireland by French *et al*. (2001a) compared autumn grass supply (mainly perennial ryegrass) and concentrate supplement level to grass intake and animal performance. The concentrate supplement was pelleted and consisted of ground barley, unmolassed beet pulp, maize gluten, soya-bean meal, molasses and mineral/vitamin mix. Animals on low grass intake (6kg/day) did not change their grass intake when offered pellets. Therefore French *et al*. (2001a) could compare liveweight gain between the two options and found cattle carcass growth increased by 116g/kg of concentrate DM while increasing grass allowance only increased carcass growth by 38g/kg of grass DM, over the mean experimental period of 95 days. A further study by French *et al.* (2001b) also concluded that cattle grazing autumn pasture, supplemented with concentrates achieved growth rates closer to their potential, compared with changing grazing management (e.g. separating cows into leaders and followers). Malau Aduli (2007) also suggested strategic supplementation may be required, as depending on the species grown, the pasture may not meet all of the animals' nutritional requirements.

As discussed above if producers are still experiencing low liveweight gains over the autumn period with best grazing practices in place, one of the options may include supplementary feeding throughout this period. Since there is a risk that silage and hay contain high levels of fungi (i.e. endophytes, *Fusarium spp.* etc.) supplementary feeding of grain or pellets are favoured (Lambert *et al*, 2004, Whitlow and Hagler, 2004, Reed *et al,* 2004). Further research is needed to determine whether supplementary feeding cattle throughout the autumn period with either grain or pellets are practically and economically viable options.

Fungi and mycotoxins

Mycotoxins are secondary chemicals produced by a wide range of fungi that have undesirable (toxic) effects on animals (Whitlow and Hagler, 2004), for example ryegrass staggers. A review of mycotoxins by MacDonald *et al* (1999) found interactions among mycotoxins can affect productivity, health and welfare of livestock. Mycotoxins occur on both pastures and fodder crops - this review focuses on mycotoxins relating to beef cattle grazed on perennial ryegrass, as this is the most common production system in Tasmania.

There are three mechanisms through which mycotoxins produced by ryegrass endophytes act (Beef and Lamb New Zealand, 2006):

1. A reduction in nutrients available for use by the animal. Moulds may decrease nutrient concentrations in feed, some mycotoxins decrease feed intake and some irritate the digestive tract;
2. Affecting the endocrine system (e.g. zearalenone)
3. Suppressing the immune system (DON, T2 toxin).

There are a number of mycotoxins that are produced by fungi which grow on ryegrass that have been implicated in reduced liveweight gain in New Zealand (Beef and Lamb New Zealand, 2006), Australia (Reed, 2011), Europe (Marczuk *et al*, 2012) and the United States (Whitlow and Hagler, 2004). It is well-known that other animals such as sheep, llamas, deers, pigs and alpacas are susceptible to the same fungal toxins which affect cattle.

The majority of spores in ryegrass are located on dead plant material within 2.5cm of the pasture base and are concentrated in urine patches (Lancashire and Keogh, 1964). The impact of mycotoxins can be difficult to quantify as they often cause subclinical changes in animals, which are not easily measured. Beef and Lamb New

Zealand (2006) hypothesised that reduced liveweight gains in the autumn were due to large amounts of toxins being consumed at that time of the year, resulting in subclinical effects such as reduced feed intake and hence reduced liveweight gain.

Some of the fungi and mycotoxins that occur in perennial ryegrass pastures in Tasmania are discussed below.

Lolitrem B and Ergovaline

Endophyte fungi live within grasses and increase the pasture resistance to drought and insect attack and thus increase pasture vigour and persistence. Endophyte toxicosis (or perennial ryegrass toxicosis) in Tasmania and Victoria has occasionally led to large losses of livestock (Reed *et al,* 2011, di Menna *et al*, 2012). The mycotoxins lolitrem B and ergovaline are produced by the endophytic fungus *Neotyphodium lolii* which is found in perennial ryegrass (Reed *et al,* 2011). Loliterm B produces the syndrome called ryegrass staggers which affects the gastro-intestinal smooth muscle and the skeletal muscle, while ergovaline is a vaso-constrictor associated with increased sensitivity to heat in cattle. Collectively the symptoms produced by the *Neotyphodium lolii* mycotoxins are known as perennial ryegrass endophyte toxicosis (PRGT), a condition which has caused mortality of livestock in Australia, in addition to impacts on animal health and productivity (Reed *et al,* 2011).

Staggering is a clinical sign of ryegrass staggers in livestock, however less obvious signs include heat stress, reduced production rates and ill-thrift. Hovermale and Craig (2001) found there is a strong positive correlation between the lolitrem B and ergovaline levels in perennial ryegrass. They found that, when animals consumed perennial ryegrass containing *N. lolli*, animals showed clinical signs of lolitrem B (i.e. ryegrass staggers) before they demonstrated clinical signs of ergovaline (i.e. heat stress). This is because threshold levels of lolitrem B will always be exceeded before ergovaline. Bluett *et al* (2005) conducted an experiment in New Zealand comparing ryegrass infected with AR1 endophyte (containing no lolitrem B or ergovaline mycotoxins) to ryegrass containing a wild endophyte (producing lolitrem B or ergovaline mycotoxins). They found that AR1 significantly improved milk solid production and eliminated rye grass staggers. Fletcher *et al* (1999) in a New Zealand study found a 35% increase in the rate of liveweight gain by grazing hoggets/lambs on an endophyte-free pasture, in addition to a reduction in other symptoms typically associated with autumn ill-thrift syndrome in sheep. Reed *et al* (2011) found that concentrations of ergovaline and lolitrem B were not necessarily significantly higher during an outbreak of severe perennial ryegrass staggers suggesting there may be interactions with high ambient temperatures and/or interactions with other toxins or synergistic effects between lolitrem B and ergovaline.

Concentrations of the endophyte, *N. Lolli*, are highest in the crown and influorescence of the plant – within individual tillers the lower leaf sheath contains the highest concentrations of fungal mycelium (Reed *et al,* 2004). The concentration of ergovaline may vary widely over the season and is correlated with water stress in the host (Lane, 1997). The concentration of lolitrem B varies seasonally, often peaking in autumn and is higher on the older tissues of the plant (Keogh *et al,* 1996). In Australia, perennial ryegrass typically experiences a high degree of summer water stress (Reed et al, 2004), and studies have shown that production of ergovaline and lolitrem B peak in summer-autumn (Reed *at al,* 2001, Leng, 2005 and di Menna *et al,* 2012). In addition, at this time of year the mass of herbage is typically low and animals bite into the crown and lowers parts of the plant, ingesting larger amounts of the mycotoxins (Reed *et al,* 2004).

Clinical signs of ryegrass staggers are commonly observed (Dr Bruce Jackson, *pers comm.*) in Tasmania, and it is probable that pasture contaminated with *N. lolli* producing ergovaline and lolitrem B mycotoxins are having subclinical effects such as ill-thrift over the summer-autumn period. However, there are other mycotoxins which are also known to have detrimental effects on animal health and performance.

Trichothecene toxins

Fusarium is a large genus of fungi that produce trichothecene toxins linked to ill-thrift (Beef and Lamb New Zealand, 2006). *Fusarium* species tend to favour warm to temperate climates in Australia and can affect pasture and grain species (MacLachlan *et al*, 2013). *Fusarium* is common in perennial ryegrass pastures in Tasmania (Dr Bruce Jackson, *pers. comm.*). Some of the clinical signs related to trichothecene toxicity include feed refusal, ill-thrift, weight loss and decrease in milk production. These toxic compounds upset membrane transport and function, suppress immune responses and produce abnormal blood functioning (Beef and Lamb New Zealand, 2006). There are a number of different trichothecene toxins produced by *Fusarium* that have been studied in relation to ill-thrift and livestock health, including Nivalenol (NIV), deoxynivalenol (DON) and Zearalenone (ZEN).

Nivalenol (NIV) and deoxynivalenol (DON)

Nivalenol (NIV) and deoxynivalenol (DON) are trichothecenes produced by *Fusarium* species. A study conducted by New Zealand Beef and Lamb (2006) attributed 20% of ill-thrift over the summer/autumn period to *Fusarium* fungi. They tested NIV and DON levels of 100 ryegrass samples from 22 farms. They suggested the high NIV and DON levels were not causing ill-thrift directly; but rather indicate the presence of more toxic trichothecenes. High NIV and DON levels were found to reduce liveweight gains in cattle (-0.2kg/day) and lambs (-40g/day). They also hypothesised that since *Fusarium* is known to be significantly higher on urine clumps (200 fold) and assuming cows prefer these clumps (due to bulk of the feed occurring here) , they ultimately ingest higher doses of mycotoxins than tested on the pastures overall.

Marczuk *et al* (2012) reported negative effects on cattle in Poland that were exposed to low-dose zearalenone and DON mycotoxin (the mycotoxins caused acute autoimmune response and immune suppression). Reed and More (2009) found that in 13 silages in excellent/good condition surveyed, 5 contained high concentrations of DON, suggesting silage should not be fed to dilute the effects of toxins. This study suggested that endophyte infected perennial ryegrass supports *Fusarium* species and is less palatable than endophyte-free grass. Hope and Magan (2003) reported that the optimal conditions for deoxynivalenol (DON) and nivalenol (NIV) production were inside the range of optimal fungal growth.

Zearalenone

Zearalenone (ZEN) is an oestrogenic mycotoxin produced by *Fusarium* species and is found in both pasture and fodder. Reduced conception rates, reduced liveweight gain, infertility and immune suppression in livestock have been attributed to ZEN, but its lifetime effects on livestock are mostly unknown (Reed & Moore, 2009, Marczuk *et al*, 2012, and Beef and Lamb New Zealand, 2006). Reed *et al* (2004) conducted a pilot survey in south west Victoria during the autumn in 1999 and 2000, and found ZEN was widespread in perennial ryegrass pastures grazed by dairy cattle, beef cattle and sheep. ZEN was present 80% of the time on perennial ryegrass with 31% of pastures exceeding toxic levels (>1.0mg/kg in this study), however toxic levels vary in other studies. In silage samples 15 of the 24 tested contained ZEN, with three of these exceeding toxic levels. It has been suggested that ZEN, when combined with other mycotoxins, can have additive effects (Reed *et al,* 2004) and further research is required in order to determine the impact on animal performance (e.g. liveweight gain) of animals grazing affected pastures.

Sporidesmin

The mycotoxin sporidesmin is produced by a saprophytic fungus, *Pithomyces chartarum,* which lives mainly on ryegrass. *P.chartarum* favours warm climates with daytime temperatures between 20 and 24°C. As with *Fusarium* mycotoxins, *P.chartarum* populations tend to peak around late summer/autumn. A study by Collin *et al* (1998) in Australia found 67% of *P.chartarum* populations tested produced sporidesmin. Sporidesmin in the gastrointestinal tract causes damage to the mammary gland, bladder and liver (di Menna *et al*, 2009). Subclinical effects from exposure to sporidesmin include ill-thrift and reduced conception rates (Beef and Lamb New Zealand, 2006). The intake of sporidesmin is believed to increase the demand for key nutrients within the body (particularly protein). It places stress on organs, including the liver, to remove sporidesmin, ultimately taking key nutrients away from growth (Beef and Lamb New Zealand, 2006).

Sporidesmin also causes facial eczema. Facial eczema has been recorded in New Zealand, southern areas of Africa and parts of South and North America (Beef and Lamb New Zealand, 2006). Ryegrass is associated with facial eczema as it produces large amounts of dead litter which is favoured by *P.chartarum.* Facial eczema effects cattle welfare, production and health. Facial eczema often not observed - most cattle suffer liver damage caused by sporidesmin without showing any visual signs of facial eczema.

Visual signs of facial eczema include photosensitisation, skin irritation and dermatitis. A review of facial eczema by Dairy Australia (2011) reported cases of facial eczema in Victoria and unconfirmed cases in coastal NSW, South Australia and Tasmania between the periods of January to April in 2011. Figure 2 shows that pasture spore counts of *P.chartarum* conducted in Tasmania are higher in the autumn months.

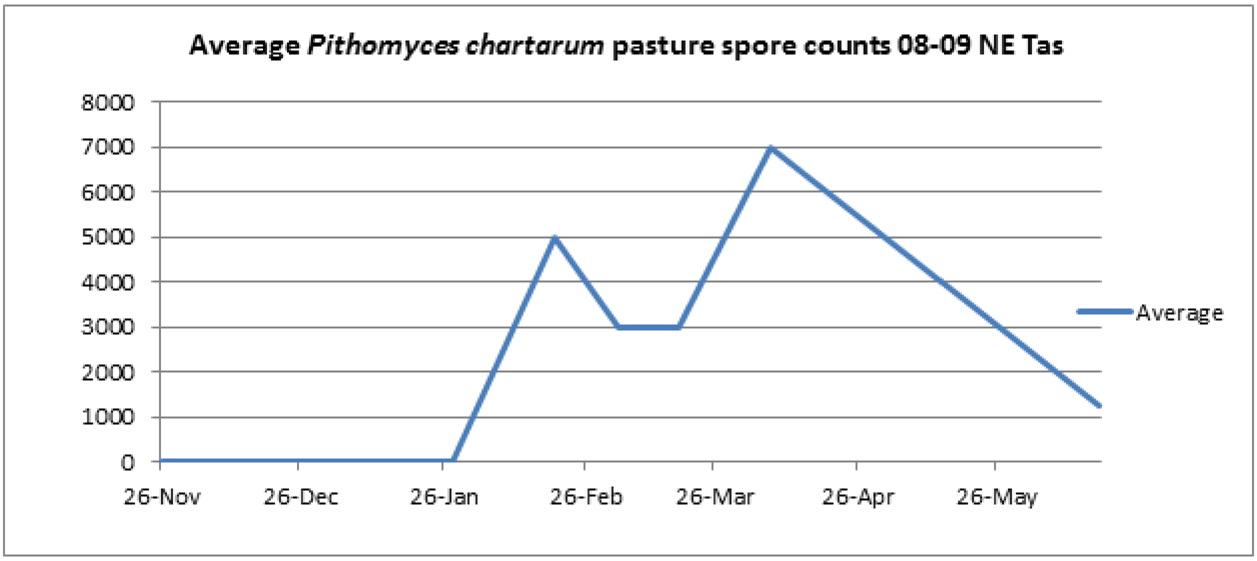

Figure 2: Pithomyces chartarum pasture spore counts from north east Tasmania in 2008 and 2009. This data was obtained from DPIPWE (Dr Bruce Jackson)

Tasmanian cattle may be exposed to sporidesmin during the summer/autumn period, contributing to ill-thrift over this period. A range of prevention strategies may be used to help reduce cattle exposure to sporidesmin, which may in turn assist in controlling ill-thrift. These include diluting ryegrass intake by supplementing feed (unlikely to contain toxins), minimising dead organic matter in ryegrass (as with managing *Fusarium* mycotoxin exposure, discussed on page 48), feeding zinc enriched feedblocks to reduce the effects while it is being ingested, and breeding for resistance (Dairy Australia, 2011).

A diet composed of mixed ingredients, each presenting a risk of contamination with toxinogenic fungi, is liable to harbour several toxins. This situation is quite common, and diets are rarely mycotoxin-free. Synergistic effects between mycotoxins in blends of toxin-contaminated diets have also been described (Bertin *at al,* 2009). Clearly, any role that mycotoxins may play in ill-thrift is very complex with many interacting factors, both environmental and management, between the toxins themselves, and also animal status (health, age, reproductive status). Hence, management techniques to control mycotoxins are neither well understood nor well documented.

Mycotoxin deactivators have been used with some success - Kiyothong *et al* (2012) found that dairy cattle exposed to fodder contaminated with mycotoxins produced significantly higher milk yields when treated with mycotoxin deactivator than untreated groups. Reed *et al* (2010) found Coopworth ewe lamb liveweight gains were higher in groups treated with mycotoxin deactivators.

Lambert *et al* (2004) discuss some of the management techniques believed to help control fungi and reduce subclinical effects such as ill thrift. They recommend chemical topping or appropriate stocking rates to boost clover production and reduce dead matter in pasture before the fungi season occurs in late spring and autumn.

Reed *et al* (2004) suggest that, where endophyte infected pastures continue to be grazed, management should aim to reduce the impact of the endophyte alkaloids on animal health by making better provision for the most vulnerable (young) stock, through pasture management/grazing strategies, alternative feeds or feed additives. Supplementary feeding and fungicides were also suggested as tools to help control exposure of stock to toxins. Other studies have indicated that applying fungicide treatments to control the fungi (e.g. *Fusarium* in grain crops), may have complex and differing effects on different mycotoxins (Bertin *at al* 2009), and may in fact exacerbate mycotoxin production. Keeping a relatively high post grazing residual mass will help prevent cattle grazing pasture below 2.5cm height in urine patches.

Collin *et al* (1998) stated that endophyte infection must be considered as a contributor to ill-thrift when feed, parasites, or trace element deficiencies are not able to be identified as causal factors.
Studies conducted in Australia, New Zealand, Europe and the United States conclude that further research on the cumulative effects, interactions and management techniques of mycotoxins are needed (Reed at al, 2004). Research conducted in Tasmania is required to determine the extent to which cattle are exposed to mycotoxins and whether they are correlated with ill-thrift. Potential research options may include monitoring cattle responses to mycotoxin deactivators over the summer-autumn period.

Parasites

It is well known that parasites are detrimental to livestock productivity, welfare and health. High pepsinogen (enzyme) levels, elevated faecal egg counts and scouring are clinical symptoms of parasites. Subclinical effects occur when large numbers of larvae are consumed which leads to an immune response resulting in low weight gains, due to redistribution of energy reserves (Beef and Lamb New Zealand, 2006). The Beef and Lamb New Zealand (2006) report into ill-thrift found that, despite regular drenching regimes, parasites were the cause of 30% of all cases of ill-thrift in cattle and 45% of cases in sheep over the summer-autumn period.

The small brown stomach worm (*Ostertagia ostertagi*) is the most harmful internal cattle parasite in Tasmania. Other significant internal parasites are the small intestinal worm (*Cooperia oncophora*) and lungworm (*Dictylocaulis viviparas*). In order to determine whether parasites are a contributing factor to ill-thrift in Tasmanian beef herds it is first necessary to understand whether the larval challenge is higher in autumn and if so why. There is at present no evidence that worm burdens in Tasmanian beef herds are higher in autumn than at other times of the year, however neither have there been any comprehensive studies of this issue (Bruce Jackson *pers. comm.*). There are some concerns that with increasing areas of irrigation in Tasmania and summer rainfall becoming more typical in some areas, that parasites, and especially *Ostertagia*, will become more prevalent (Dr Bruce Jackson *pers. comm.*).

It is important to recognise that the method of assessing worm burden is critical to obtaining meaningful results (Dr Bruce Jackson, *pers comm*.). Faecal egg counts are reasonably reliable in cattle up to 6 months of age but where they are used larval differentiations are important. Over 6 months of age, cattle can have a high worm burden but have developed their own resistance to worms. This causes a decrease in the production of eggs by the female worm, so the high worm burden won't be detected using a faecal egg count (Bruce Jackson, *pers comm*.). Other studies in Australia have also questioned the value of faecal egg counts for determining worm burdens (Rolls and Webb-Ware, 2011). A blood test which measures pepsinogen (correlated to damage to the lining of the fourth stomach), is a more accurate measure of *Ostertagia ostertagi* burden (Bruce Jackson, *pers comm*.). Pasture cuts can also be used to assess the worm burden of the pastures. However, as with ill-thrift itself, other factors can play a role in how cattle react to parasite burdens – for example animal age, immunity, pervious exposure to worms and nutrition (Bruce Jackson, *pers comm*.), so care must be taken in attributing poor animal health/production from worm burden solely to the parasites.

There are two types of disease caused by *Ostertagia*, Type 1 and Type 2. Type 1 usually occurs in calves and young cattle that have high burdens of adult worms in winter and spring, and rapid infection with large numbers of L3 larvae from heavily contaminated pastures in the autumn and winter after weaning. Beef cattle are typically affected at 15-20 months of age (Larsen and Campbell, 2007). Type 2 disease typically occurs in beef cows calving for the first and second time in the autumn and winter. The stress of calving coincides with the emergence of inhibited L4 larvae from the lining of the fourth stomach (Larsen and Campbell, 2007). Outbreaks of Type 2 disease used to be common and severe in the 1970s and have reduced mainly due to the introduction of second generation benzimidazole and macrocyclic lactoone drenches (Larsen and Campbell, 2007).

In 2011 MLA released a report entitled '*Managing production risk on high input farms*'. This summarised results from producer demonstration sites in high rainfall areas of Victoria. It highlighted that drench resistance in steers maybe widespread - 50% of properties showed evidence of resistance to Ivermectin (macrocylic lactone). Throughout south eastern Australia the small brown stomach worm (*Ostertagia*) is the most pathogenic gastrointestinal worm effecting cattle and it showed resistance to Ivermectin on 20% of properties. Little is known as to whether anthelmintic resistance is a widespread issue in Tasmania, as no broadscale studies have been undertaken. However, incidences of resistance have been identified in different regions of the state at different times (e.g. *Cooperia* at Cressy, and *Ostertagia* and *Dictylocaulis* in north east Tasmania) (Dr Bruce Jackson, *pers comm*.).

In the 2011 MLA study, liveweight gain significantly improved when good worm control practices were used compared to poor worm control practices. Strategic drench programs are pivotal to minimise impacts of worms and should take into account seasonal variations, time of year, age of cattle and type of anthelmintic to achieve good worm controls. Table 1 shows recommended timing of drenches for a spring calving beef herd (Rolls and Webb-Ware, 2011).

Table 1: Drench treatments recommended to be given each year to different classes of cattle. Source: Rolls and Webb-Ware, 2011.

Spring calving	Jan	Weaning (Feb-Apr)	Jun/Jul	Jul/Aug	Aug/Sept
Weaners Yearlings		✓	✓		(✓)
1st/2nd calvers	✓			(✓)	
Mature cows	(✓)				
Bulls	✓			(✓)	

(✓) Not a routine treatment. Indicators for treatment include scouring, sudden loss of condition and CS of 2 or less, especially if feed availability <1000kg DM/ha, high WEC.

There has never been a program such as Worm Buster delivered to Tasmanian beef producers (Dr Bruce Jackson *pers. comm.*); information is obtained by producers from their veterinarian and/or suppliers of animal health products. In Tasmania it is quite possible that cattle producers are not strategically drenching at critical times of the year which could be contributing to ill-thrift in the autumn/summer period. They may also not be adopting recommended cultural practices (e.g. grazing susceptible animals on lower risk pastures such as newly sown pastures, hay aftermath, crop stubbles fodder crops and pastures that were grazed since the previous autumn break solely by sheep or cattle >4years of age; Larsen and Campbell, 2007), to assist in parasite management and reduce the potential for drench resistance to develop.

The difference in production as measured by liveweight gain (based on a typical farm producing about 332 kg beef/ha) was up to 26 kg/head between good worm control and poor worm control for steers sold at the end of spring and up to an extra 14 kg of extra beef/head for cull heifers sold in late summer (Rolls and Webb-Ware, 2011). This highlights the potential production gains that can be made with good worm management.

Trace elements

Calcium (Ca), chlorine (Cl), phosphorus (P), magnesium (Mg), potassium (K), sodium (Na) and sulfur (S) are the major elements. Trace elements include cobalt (Co), copper (Cu), iron (Fe), iodine (I), manganese (Mn), selenium (Se), zinc (Zn) and molybdenum (Mo). All of these nutrients are critical for animal production. In Australia trace elements that are commonly deficient include copper (Cu), cobalt (Co), iodine (I), selenium (Se), and, to a lesser extent, zinc (Zn), seasonal changes in pasture and soil can affect the dietary intake of minerals (Judson and McFarlane, 1998). In Tasmania trace elements which are commonly deficient are copper, cobalt, selenium and iodine (Bruce Jackson *pers. comm.*; Mason, 1991).

Reed *et al* (2005) undertook a survey of 120 samples of perennial ryegrass in south west Victoria during autumn and winter over 2 years. On sheep/beef pastures they found deficiencies in potassium (37%), phosphorous (37%), and sulphur (25%) Phosphorous and copper were inadequate for lactating cows in 80% of pastures. There were also inadequacies in the concentration of calcium, zinc, magnesium, potassium and sulphur in some pastures (Reed *et al* 2005).

Phosphorous deficiency has been becoming more prevalent in Tasmania in the last 5-10 years, mainly on lower production country (Dr Bruce Jackson *pers. comm.*), as it has become less economical to use super phosphate on these areas. The impacts of phosphorous deficiency observed by veterinarians in Tasmania to date have mainly been on reproductive animals especially lactating cows (with first calf heifers especially vulnerable) (Dr Bruce Jackson *pers. comm.*).

Rolls and Webb-Ware (2011) found that 11 of 13 Victorian farms tested were deficient in selenium, 2 of 13 tested were deficient in copper and one farm of the 13 tested was deficient in cobalt. Similar occurrences of deficiency in these elements are observed on Tasmanian farms (Dr Bruce Jackson *pers. comm.*). There were significant increases in liveweight gain of cattle on the Victorian farms when supplemented with selenium, however supplementing in the summer/autumn period was not as effective as supplementing in the spring when selenium availability is known to be at its lowest. Similarly, in Tasmania, selenium deficiency is least likely to occur in April and most likely to occur in October/November (Mason, 1991). A producer demonstration study conducted in Tasmania on a herd of cattle where measurable differences were found in GSH-px enzyme in cattle, did not find any production response to selenium supplements (Robin Thompson, *pers.comm.*).

Mason (1991) in a detailed study on trace element deficiency in Tasmania found that cobalt deficiencies could be expected to be worse in October, and in the autumn months (March, April, May) it is rare to find cobalt deficiency. Cobalt deficiency in Tasmania is known to be more prevalent on sandy soils and grey loams (Dr Bruce Jackson *pers. comm.*). The same study found that copper deficiency is usually highest in July, with the lowest risk period in autumn (Mason, 1991). Copper is known to bind with molybdenum, which is sometimes added to fertiliser blends used on brassica fodder crops. This can result in a decline in copper levels in animals during the winter, with copper reaching very low levels in August/September (Dr Bruce Jackson *pers. comm.*).

Iodine deficiency is considered to be widespread in Tasmania (Dr Bruce Jackson *pers. comm.*), however the study of trace elements by Mason in 1991 did not assess likelihood of iodine deficiency at different times of the year. It is more commonly observed in cattle grazed on white clover or brassica crops, than other pastures (Mason, 1991).

A study by Reed *et al* (2004) on endophyte alkaloid and mineral concentrations in perennial ryegrass found that the grass tetany ratio (K/(Ca + Mg)) was satisfactory in paddocks sampled and grass tetany was unlikely to be a major concern or confusing factor on pastures where livestock staggers were commonly observed.

Trace elements may be a limiting factor for cattle growth in some areas of Tasmania however; the literature does not support the theory that it is a significant problem around the autumn/summer period. Other potential causal factors are likely to be of more relevance, although it is important to note that trace elements support immune function and if marginal deficiencies are present they may be exacerbated if animals are under immunological stress (Masters *et al*, 1999). Livestock will show signs of ill-thrift rather than unique clinical symptoms to single deficiencies (Beef and Lamb New Zealand, 2006). Hence there may be interactions between trace elements and mycotoxins/endophytes which challenge the immune system during autumn.

Discussion

The literature review supports the findings by the Circular Head Beef Business Group (CHBBG) and the Towards 2000 Winnaleah trial that ill-thrift during autumn is a phenomenon which has been widely documented and researched both in Australia and overseas. Whilst most of the research has been conducted on mainland Australia or overseas, it is of relevance to beef production in Tasmania, and can be used to inform research which may be required to address the issue. While to a large extent the causes of ill-thrift are multifactorial, this review highlights key factors which have been clearly linked with ill-thrift (e.g. mycotoxins, pasture quality and parasites) and identifies the research which is required to quantify their contribution to the condition, and to assess the impact of management strategies to address ill-thrift in Tasmanian beef herds.

Seasonal changes in pasture quality (e.g. low soluble carbohydrate content in autumn herbage) directly affect liveweight gain of cattle. It is quite possible that the lower than expected liveweight gain over the autumn period observed in Tasmania could be attributed to the poor quality of perennial ryegrass at this time of year. Beef producers need to be aware that even though autumn pasture may look as lush as spring pasture it has lower nutritive value. Educating beef producers about the variation in nutritive values of pasture during the year and the impact of best practice grazing techniques (e.g. minimising dead matter and maintaining healthy post grazing residual mass) could help improve liveweight gain of cattle over autumn.

Certainly this was the case in the trial carried out by the Circular Head Beef Business Group which showed that liveweight gain could be increased by approximately 0.5 kg liveweight per day with very good grazing management (B. Doonan *pers. comm.*). However, there was still a perceived gap in performance from that expected given the pasture quality and grazing management – this performance gap is defined as ill-thrift.

Fungi (via mycotoxins), even at sub-clinical levels, can contribute to ill-thrift in cattle over the autumn period. The dominance of perennial ryegrass pastures in Tasmanian beef production systems, combined with anecdotal evidence from Tasmanian beef producers of exposure to mycotoxins (i.e. ryegrass staggers and photosensitisation) during the summer-autumn period suggests that high levels of fungi may be at least exacerbating ill-thrift at this time. Further research is needed to investigate mycotoxin association with ill-thrift in Tasmania. Monitoring cattle responses against mycotoxin deactivators is likely to be an effective way of achieving this.

Parasites are of particular concern to cattle producers in Tasmania as the research reviewed suggests they are a major contributor to reduced liveweight gain. Drenching must be strategically distributed throughout the animals' life, taking into account seasonal variances to maximise effectiveness. It has also been highlighted that despite regular drenching parasite infection was a major contributor to ill-thrift in the summer-autumn period in cattle in New Zealand. Cattle in Victoria showed signs of resistance to anthelmintic treatments, however little is known as to whether this is an issue in Tasmania. There are knowledge gaps as to the level of parasite association with ill-thrift in Tasmania, and the extent of resistance to drench treatments. Indeed, even basic information about typical approaches used by Tasmanian producers in managing parasite burdens, in a manner which will minimise the risk of drench resistance developing is not known.

Based on previous research both in Tasmania and southern Australia, there is no compelling evidence that ill-thrift during the summer-autumn period is due to lack of trace elements in pastures. In addition, trace element deficiencies are highly farm specific in Tasmania and so research in this area is unlikely to result in widespread industry benefit. Whilst trace elements as a contributor to ill-thrift have not been ruled out, ill-thrift has been more strongly linked with other casual factors (e.g. fungi), which should be a higher priority for investigation. It is however, acknowledged that there may be value in conducting research which clearly eliminates or incriminates all of the potential causal factors of ill-thrift.

As discussed above, poor pasture management techniques is a major contributor to lower than expected liveweight gains of cattle over autumn, therefore it is pivotal that any future research is conducted with best-practice pasture management in place. This will enable a more accurate understanding of the contribution of the real potential causes of ill-thrift to the condition in Tasmania.

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9.2 Appendix 2

Copy of the Tasmanian beef producers' survey

Tasmanian Beef Industry Survey

MACQUARIE FRANKLIN   mla MEAT & LIVESTOCK AUSTRALIA

Fill out this survey for your chance to **win a case of Tasmanian wine!**

This survey is part of a project being run by Macquarie Franklin to identify some of the key issues facing beef production in Tasmania. It is being funded by Meat and Livestock Australia and supported by DPIPWE. The results obtained will be used to help determine future research priorities for the industry.

The information collected during this survey will be kept confidential. However, it may be beneficial for the project team to be able to contact you if they need to follow up on any of the information you provide.

If you have any comments or questions or would like to discuss the project please contact
Basil Doonan on 0400 455 158 or bdoonan@macfrank.com.au

Please post completed surveys to

Macquarie Franklin
112 Wright St
East Devonport TAS 7310

Alternatively, the survey can also be completed online at **www.surveymonkey.com/s/beef_industry_survey**

1. Your name *(Optional)*____________________

2. Your phone number *(Optional)*____________________

3. Your email address *(Optional)*____________________

4. Your postcode____________________

5. What kind of cattle enterprise do you run? *(Select as many options as apply)*
   - ◯ Breeder
   - ◯ Finisher
   - ◯ Finisher & breeder
   - ◯ Backgrounder

6. Apart from cattle, what other enterprises do you farm? *(Select as many options as apply)*
   - ◯ Dairy farm
   - ◯ Dairy agistment
   - ◯ Prime lambs
   - ◯ Wool
   - ◯ Broadacre cropping
   - ◯ Vegetable production
   - ◯ Horticulture
   - ◯ Forestry
   - ◯ Other *(please specify)* ____________________

1

Tasmanian Beef Industry Survey

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7. What is the productive/farming area of your operation (ha)?

____

8. On 1 July 2012, what was the total number of cattle you ran?

____

9. On 1 July 2012, how many breeders did you run?

____

10. What type of grazing management system do you usually use?

	Never	Sometimes	Usually
Set stocking	○	○	○
Pasture based grazing (leaf stage)	○	○	○
Time based grazing (days)	○	○	○
Other *(please specify)*			

11. What is the typical pasture composition that you use for finishing your cattle? *(Please rank the following pasture types in order of importance to your finishing operation, with 1 being the most important and 5 the least).*

_____Ryegrass

_____Other improved pasture species (e.g. phalaris, cocksfoot, brome)

_____Weedy annual or perennial grasses (e.g. barley grass, fog grass)

_____Clover

_____Other *(please specify)*______________________________

12. Typically, what proportion of the diet in autumn is supplements?

	<10%	10-25%	25-50%	>50%
Silage	○	○	○	○
Hay	○	○	○	○
Straw	○	○	○	○
Concentrates (cereal or pellets)	○	○	○	○
Fodder crop	○	○	○	○

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Tasmanian Beef Industry Survey

13. How do you measure trace element status? *(Select as many options as apply)*
    - ◯ Don't measure trace element status
    - ◯ Feed testing
    - ◯ Liver testing
    - ◯ Blood tests
    - ◯ Soil testing
    - ◯ Pasture testing
    - ◯ Other *(please specify)* ____________________

14. How are you managing for trace element deficiency? *(Select as many options as apply)*
    - ◯ We don't have a problem
    - ◯ There is no program in place
    - ◯ Generic lick or mix
    - ◯ Tailored lick or mix
    - ◯ Injectables
    - ◯ Bolus
    - ◯ Capsules
    - ◯ Water medicate
    - ◯ Oral
    - ◯ Micronutrients are managed through fertiliser application
    - ◯ Other *(please specify)* ____________________

15. Have you ever had, or suspected you may have had, ryegrass staggers in any of your livestock (sheep, cattle or horses)?
    - ◯ Yes
    - ◯ No
    - ◯ Not sure

16. Have you ever had, or suspected you may have had, photosensitisation (a clinical condition in which the skin is abnormally sensitive to sunlight) in any of your livestock (sheep, cattle or horses)?
    - ◯ Yes
    - ◯ No
    - ◯ Not sure

17. Have you observed underperformance in your cattle relative to feed on offer?
    - ◯ Yes
    - ◯ No
    - ◯ Not sure

Tasmanian Beef Industry Survey

18. If you have observed underperformance in your cattle, what time of year did it occur? *(Select as many options as apply)*

◯ Summer ◯ Autumn ◯ Winter ◯ Spring

19. If you have observed underperformance in your cattle, what did you actually see that made you think they were underperforming? *(Select as many options as apply)*

◯ Weight gain not as expected (measured by weighing)
◯ Weight gain not as expected (measured by body condition scoring)
◯ Unthrifty appearance
◯ Feed conversion not as expected (feed on offer assessed)
◯ Other *(please specify)* ______________________________

20. At what age do you generally sell your cattle?

	<12 months	12-24 months	>24 months
Heifers	◯	◯	◯
Steers	◯	◯	◯

21. Do you use fodder crops for finishing stock in autumn?

◯ Always
◯ Frequently
◯ Occasionally
◯ Never

22. What is the contribution of each of the following fodder crops to finishing your cattle? *(Please rank from most important to least important, with 1 being the most important and 6 the least).*

_____Don't grow fodder crops
_____Brassicas
_____Cereals
_____Annual rye grass
_____Lucerne
_____Other *(please specify)*______________________________

23. How do you know it's time to drench your young stock (excluding cows)?

◯ I drench at the same time each year (e.g. spring/autumn)
◯ I drench each mob at a certain frequency (e.g. 2 months, 10 weeks)
◯ If a mob is showing signs of ill health/worminess it is drenched
◯ Mobs are drenched at certain ages/stages of finishing
◯ I drench based on egg counts or blood tests
◯ Other *(please specify)* ______________________________

Tasmanian Beef Industry Survey

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24. What methods do you use for worm control? *(Select as many options as apply)*
    - ◯ Pasture/stock rotation
    - ◯ Oral
    - ◯ Pouron
    - ◯ Injectable
    - ◯ Other *(please specify)* ____________________

25. What time of year do you typically calve? *(Select as many options as apply)*
    - ◯ Summer
    - ◯ Autumn
    - ◯ Other *(please specify)* ____________________

26. How long do you join cows for (i.e. leave with bulls)?
    - ◯ 2 cycles (6 weeks)
    - ◯ 3 cycles (9 weeks)
    - ◯ 4 cycles (12 weeks)
    - ◯ Other *(please specify)* ____________________

27. How many months after joining do you preg test cows?
    - ◯ < 2 months
    - ◯ 2-5 months
    - ◯ > 5 months
    - ◯ Don't usually preg test

28. Typically, what proportion of the diet in autumn is supplements?

	<5%	5-10%	11-20%	>20%
Heifers	◯	◯	◯	◯
Cows	◯	◯	◯	◯

29. At your last calving, what percent of cows that were preg tested in calf failed to calve?

	<5%	5-10%	11-20%	>20%
Heifers	◯	◯	◯	◯
Cows	◯	◯	◯	◯

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30. At your last calving what was the percent loss of calves between birth and marking?

	<5%	5-10%	11-20%	>20%
Heifers	○	○	○	○
Cows	○	○	○	○

31. Do you have any comments or suggestions on support/R&D that you would like to see provided to improve the beef industry in Tasmania?

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