BENCHMARKING AUSTRALIAN SHEEP PARASITE CONTROL

LONGITUDINAL SURVEY REPORT

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Australian Wool Innovation and Meat and Livestock Australia

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EXECUTIVE SUMMARY

Background. In 2004, The IPM-sheep (Integrated Parasite Management – sheep) project funded by Australian Wool Innovation Ltd (AWI) conducted a large national survey to benchmark parasite control practices in sheep in Australia. This survey was largest of its kind in Australia with 2292 respondents to a questionnaire of 30 questions. In 2011 AWI and Meat and Livestock Australia (MLA) commissioned a follow up survey "Benchmarking Australian sheep parasite control" of which this report forms part. The objectives of the follow up survey were to

- Measure change in sheep parasite control practices and attitudes between 2003 and 2011, the years surveyed in the 2004 and 2012 surveys respectively.
- Provide a new benchmark against which to measure change in parasite control practices and attitudes into the future

The benchmarking Australian sheep parasite control survey of 2012 had two components:

- A longitudinal analysis of practice change amongst sheep producers who participated in both surveys
- A cross sectional analysis of all of the responses to the 2012 survey.

This report is on the longitudinal component of the survey.

Methods. In February 2012, a 15 page questionnaire was mailed to 757 producers whose 2012 address could be matched with a 2004 address, asking about their worm, blow fly and lice control practices. A response rate of 36.5 per cent was obtained with one reminder, with a further 15.1 per cent responding to a one page follow-up questionnaire which sought information on a small number of questions central to the project. In total 310 useable survey responses were obtained.

Organisation of this report. This report presents the results from the survey in a series of tables, starting with changes in basic farm characteristics and general animal husbandry practices, and proceeding to a detailed examination of changes in worm, blow fly and lice control.

The main results are provided in the body of this report, together with basic explanatory information to assist in the reading of the tables. Appendix A1 provides further details on statistical aspects of the tables, together with a detailed account of the methods and the investigation of non-response bias.

Appendix A2 contains copies of the questionnaires.

Summary of findings

Survey size and responses

1. The longitudinal survey involved a total of 757 mail outs to addresses from the earlier survey in 2004. The response rate to the full survey was 36.5% and to the full and short follow up survey combined, 51.6%. There were 310 useable survey responses.

Farmer and enterprise details

Not surprisingly the physical details of the properties surveyed were very similar between the two surveys. However there were significant changes in the stock carried between 2003 and 2001 viz:

2. Reduction in the percentage of properties with cattle (56% to 41%). Most pronounced in the NE and S regions.
3. Reduction in both cattle and sheep DSEs carried over the survey year. No change in cropping %.
4. Increase in ewe proportion of flock from 55.3 to 62.2% and a decrease in the wether proportion from 17.4 to 11.1%.

Worm Control

There were a number of significant changes relating to the control of worm infections between the two surveys viz:

5. Increase in number of anthelmintic classes per anthelmintic treatment from 1.33 to 1.53 indicating a wider use of combination treatments. This was greatest in the SE and NE and was similar for young stock and ewes.
6. Reduction in proportion of anthelmintic treatments administered orally from 94.6% to 89.3% with the reduction being greatest for ewe treatments (94% to 83.8%).
7. No difference in proportion of overall treatments using an intra ruminal capsule (3.28% and 3.56% in 2003 and 2001 respectively), with a non-significant increase in capsule use in ewes from 2.49% from to 5.18% P = 0.14). Capsules are most widely used in the S and SE.
8. Major increase in the proportion of anthelmintic treatments administered by injection from 2.12 to 7.17% with little regional variation.
9. Little change in the anthelmintic classes used, with use of older classes of anthelmintic persisting. There was no reduction in the use of BZ, Levamisole or Closantel. ML use was also similar overall but with Abamectin largely replacing Ivermectin. Penetration of the new generation AAD anthelmintic Monepantel in 2011 was low (1.9% of treatments).
10. Reduction in percentage of respondents conducting WEC monitoring from 47% to 27%.
11. Reduction in number of WEC tests performed across all regions. In 2011 only 1% of respondents did more than 4 WEC tests/year and only 10% did more than 1. Those numbers have not changed since 2004, but the number of respondents doing a single WEC test reduced from 17% in 2003 to 9% in 2011.
12. Reduction in proportion of respondents drenching new sheep on arrival from 87.4% to 48.7%.
13. No change in the proportion of respondents who had performed a formal drench resistance test in the previous 6 years (29%).
14. Reduction in the importance of WEC as a factor influencing drenching decisions in ewes and weaners. The importance of seasonal weather conditions as a factor influencing drenching decisions decreased for ewes but increased for weaners, between the two surveys and there was also a slight but significant increase in importance of the presence of dags in weaners.
15. Reduced use of smart grazing from 28 to 12%, but some of this change may be due to differences in terminology used in the two surveys.
16. Increase in the proportion of respondents leaving sheep undrenched as a refugia from 5% in 2003 to 11% in 2011). Highest use of this practice is in the SW.
17. There was no change in proportion of respondents using rams selected for resistance to worms (16%).

Blowfly Control

With regard to blowfly control there were few major findings, largely due to the comparatively few questions given over to fly control in the 2004 survey. The main findings were:

18. Significant increase in the reported incidence of body strike in ewes (1.2% to 4.2%). and weaners (1.4 to 4.8%) between 2003 and 2011.
19. No change in breech strike incidence in ewes (3.1% in 2004, 2.9% in 2011) while in weaners the increase approaches significance (P=0.06, 1.9 to 3.3%)

Lice Control

With regard to lice and lice control the major significant changes related to the classes of insecticide used in lice control. The main findings were:

20. The mean number of years out of the last 6 in which lice were been detected more than tripled from 0.7 in 2003 to 2.5 in 2011. This was common across all regions.
21. Reduction in the use of off shears back liner for lice control (76% to 56%).
22. Significant changes in the proportion of different insecticide classes used in various treatment types.
    a. Off shears or short wool backliners. The use of IDIs decreased from 95.1% to 26.1%. neonicotinoids increased from 0 to 31.8%, OPs from 0 to 13.6%, and spinosyn from 0 to19.3%).
    b. Long wool jetting. Reduction in IDIs from 35.6% to 0%. Reduction in OPs from 42.2% to 4%. Increases in ML from 8.9% to 52% and Spinosyn from 13.3% to 32%.
    c. Long wool pour on. Reduction in SPs from 64.3% to 20.7% and IDIs from 28.6% to 3.4%. Increase in Spinosyn from 0% to 62.1%.
23. Increase in suspected lice resistance from 14% to 28% of respondents. There was also a change in chemicals against which resistance was suspected. For IDI this increased from 44.0 to 68.3% while for SP it reduced from 48% to 2.4%.

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Survey logistics and data entry was managed by Cathy Coleman, set up of data structures by Michael Coleman, data entry by Ruth McGregor and Abby Partridge, data cleaning by Bright Asante.

1 INTRODUCTION

In 2011 Australian Wool Innovation Ltd (AWI) and Meat and Livestock Australia (MLA) commissioned a project "Bench marking Australian sheep parasite control" of which this report forms part. The project is a follow up on a 2004 benchmark survey on parasite control in sheep funded by AWI under the IPM-sheep (Integrated Parasite Management – sheep) project. That survey was largest of its kind in Australia with 2292 respondents to a questionnaire of 30 questions.

The objectives of the follow up "Bench marking Australian sheep parasite control" survey were to:

1. measure change in sheep parasite control practices and attitudes between 2003 and 2011, the years surveyed in the two surveys, and
2. provide a new benchmark against which to measure change in parasite control practices and attitudes into the future.

The 2012 survey had two components:

3. a longitudinal analysis of practice change amongst sheep producers who participated in both surveys, and
4. a cross sectional analysis of all of the responses to the 2012 survey.

This report is on the longitudinal component of the survey.

2 METHODS

2.1 Survey

The results presented in this report are drawn from a subset of wool producers in a random sample drawn from a list of shareholder addresses supplied by Australian Wool Innovation Ltd (AWI), together with additional shareholder addresses that were identical or very similar to the addresses of producers who returned a survey in 2004. The list supplied by AWI covered the same postcode areas as in the 2004 Benchmark Survey. These postcode areas were identified in 2004 by regional IPM-sheep project managers as being within the 'sphere of influence' of the programs they intended to run at that time. The content of the questionnaire was based on the 2004 questionnaire, with a number of improvements to layout of questions, the omission of some questions no longer required, and the addition of some questions in new areas of interest.

This questionnaire was mailed out to 757 addresses during February 2012, with a reminder and second copy of the questionnaire mailed out to non-responders six weeks later. A short one-page questionnaire containing a small number of key questions was mailed to remaining non-responders six weeks after the reminder. The survey data to be analysed for this report was taken as all questionnaires received by 13 July 2012. The final response rates are shown in Table 2.1. Further details of the final response rates are provided in Table 1.1 of Appendix 1.

Table 2.1 Survey response rates for the main questionnaire and the short one-page questionnaire.

Region	Response rate – full questionnaire (%)	Response rate – full questionnaire together with short questionnaire (%)
QLD	36.1	47.8
New England	44.8	66.1
NSW(remainder)	33.1	46.0
VIC	33.7	46.2
SA	42.6	62.3
WA	35.7	53.5
TOTAL	36.5	51.6

2.2 Analysis

A number of quality control procedures were carried out with the survey data and these are fully described in section A1.4 of Appendix 1 to this report. A range of analysis techniques were used according to the information that was required from the data and a full description of these techniques is given in Appendix 1.

As described in sections A1.5 and A1.6 in Appendix 1 to the cross-sectional survey report, a comparative analysis of the data from those who filled in the full survey and those who did not respond to the full survey, but responded to the short survey, suggested that there is some minor non-response bias present in the responses to the full survey. This includes under-representation of producers with cattle, and over-representation of those who had, between 2004 and 2012, decreased their use of mulesing (for a full listing of differences between those responding to the full and short surveys, see Tables A1.2 to A1.9 in section A1.5 of Appendix 1 to the cross-sectional survey report). It was concluded from the analysis that the level of non-response bias was not sufficient to warrant adjusting all the findings from the full survey. However, where questions were common to the full survey and the short survey, data from both were used. Tables based on data from both surveys include those relating to:

5. total cattle and sheep numbers,
6. lice treatments in the last three years,
7. use of mulesing or Anti-Flystrike Clips,
8. monitoring of worm egg counts, and
9. testing for drench resistance.

An additional data quality issue specific to the longitudinal survey relates to the possibility that the producers in the longitudinal survey may have different characteristics to the overall population of producers in the study area, due to new entrants to the industry that are not represented in the longitudinal survey sample. The characteristics of producers in the cross-sectional survey group (comprising a random sample of producers in 2012) and the longitudinal survey group were compared across the same set of questions used to examine non-response bias. As described in section A1.5 of Appendix 1 to this report, no significant differences were found between the two groups, from which it was concluded that the changes shown by producers between 2004 and 2012 can be taken as representative of changes more generally among producers in the study area.

Due to the smaller sample available to the longitudinal survey, the regions used in reporting findings in the cross-sectional survey report were condensed into just four regions. These regions and their relationship to the cross-sectional survey regions are shown in Table 3.1.

3 RESULTS

3.1 Location of Respondents

The regions from which responses were received are shown in Figure 3.1, below. The figure also shows the regions into which respondents have been grouped for the reporting of results in the ensuing sections and further details are provided in Table 3.1. The number of responses from each postcode area within these regions is shown in Figure 3.2, below.

Figure 3.1 Regions in which respondents were located.

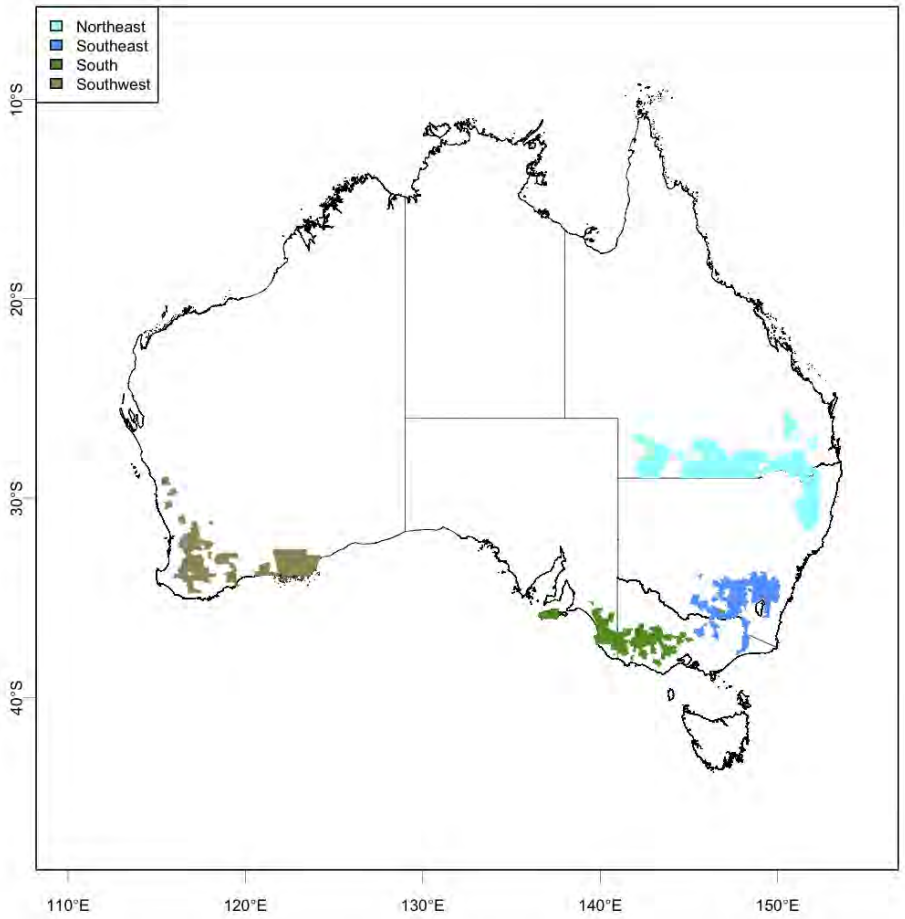


Table 3.1 Correspondence between cross-sectional survey regions and longitudinal survey regions

Longitudinal survey region	Abbreviation	Cross-sectional survey region
Northeast	NE	South western Queensland, Granite Belt and Darling Downs
Northeast	NE	New England region of New South Wales
Southeast	SE	Central and southern tablelands of New South Wales
Southeast	SE	Southern New South Wales and northern Victoria
Southeast	SE	Gippsland region of Victoria
South	S	Western Victoria and south eastern South Australia
South	S	Southern region of South Australia
South	S	Kangaroo Island
Southwest	SW	South western region of Western Australia

3.1.1 Regional frequency of responses

The geographical distribution of responses is shown in Figure 3.2, below. Table 3.2 shows the total number of usable responses to the full and short surveys from each of the regions in Figure 3.1 on the previous page.

Figure 3.2 Frequency of responses in each postcode area from which responses were received.

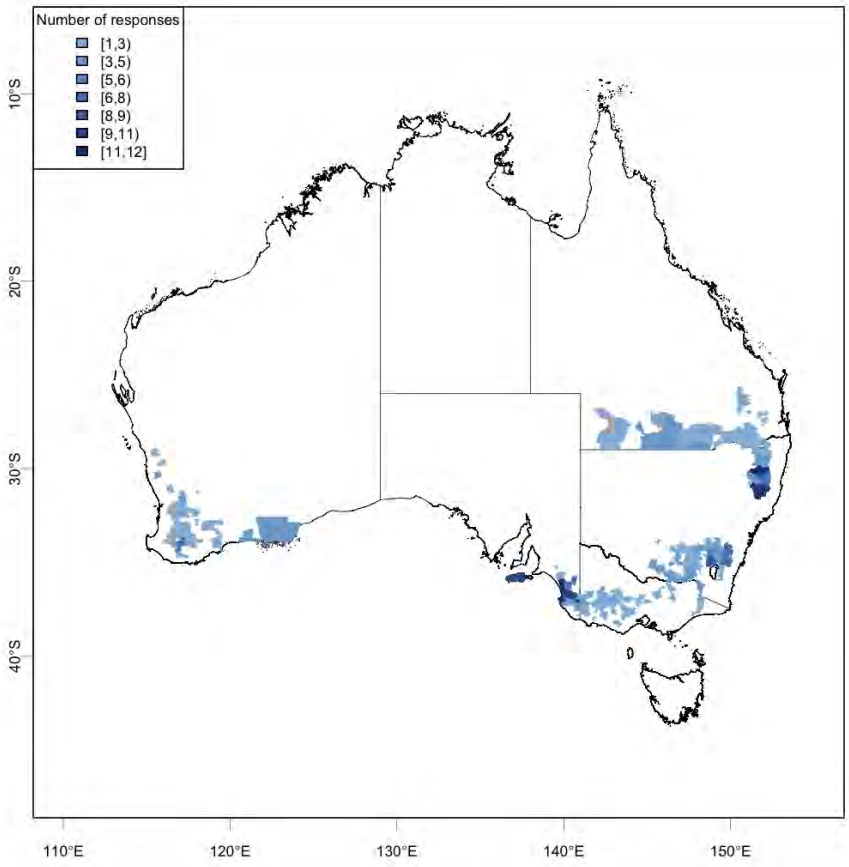


Table 3.2 Usable responses to the full and short surveys by region.

Region	Usable responses to full survey	Usable responses to short survey	Total
NE	55	21	76
SE	58	22	80
S	70	30	100
SW	36	18	54
All regions	219	91	310

3.2 Explanation of Figures and Tables

The tables presented in the ensuing sections show the results for each of the regions in Figure 3.1, above, as well as the results for all regions combined. The tables are for questions that were exactly the same, or very similar, in the 2004 and 2012 surveys. Some questions in 2004 and 2012 asked for information at the time of the survey, whereas other questions asked for information relating to the previous year (i.e. 2003 and 2011). For this reason some figures show 2003 and 2011, and others show 2004 and 2012, depending on the question. For the findings from all questions in the 2012 survey, see the cross-sectional survey report.

To the extent that the 2012 values can be considered to be dependent on the 2004 values, the convention in most graph types of placing the independent variable on the horizontal axis and the dependent variable on the vertical axis has been reversed. This places the more recent (2012) information on the horizontal axis where it is easier to read.

The tables are of three types, depending on the type of data each question generated. For each type, the findings are presented as a standard series of graphs and tables.

3.2.1 Continuous data

For continuous data, such as proportion of income from sheep and wool, or sheep DSEs in a typical year, linked boxplots are used to summarise the distribution of values, one for 2004 and one for 2012. The dashed lines on the boxplot extend to the maximum and minimum values, while the blue box spans the range of values from the 75% quartile to the 25% quartile. A 75% quartile, for example is a cutoff value, such that 75% of values are less than the cutoff . The median value is shown by a small circle within the blue box. The estimated mean and 95% confidence limits on the estimate are represented by a vertical line within the blue box, with short horizontal bars at the upper and lower ends to mark the upper and lower confidence limits. A line connects the 2004 and 2012 means to indicate the trend between the two survey years. The values of the mean and confidence limits are provided next to the vertical line with short horizontal bars. In cases where the confidence interval is very narrow, the values are shifted upwards and downwards on the graph so that the numbers do not overprint each other. The tables to the right of the box plots give the 2004 and 2012 mean values and a paired t-test indicates whether the difference between 2004 and 2012 is significant or not.

3.2.2 Ordinal data

A number of questions provided ordinal data, such as rating the importance of factors used in deciding whether to drench ewes. For these questions, the top left panel is a change table that shows the proportions of respondents who gave various combinations of ratings in 2004 and 2012. For example, using the importance of FEC results in deciding whether to drench ewes (section 3.6.6.1), 8 per cent of respondents rated this as “Very important” in 2004, but changed to rating it as “Important” in 2012. However, only 4 per cent changed their rating from “Important” in 2004 to “Very important” in 2012. The figures along the diagonal from the lower left to the top right are the proportions of respondents who did not change their rating. The figures below and to the right of this diagonal are proportions of respondents who decreased their rating in some way, while the figures above and to the left of the diagonal are those who increased their rating. The overall shift of opinion between 2004 and 2012 is a reflection of the proportions of respondents decreasing or increasing their ratings. The blue dot on each axis of the level plot denotes the mean rating in 2004 and 2012. These are provided as a general guide only, as means of ordinal data can in some circumstances be misleading. The top right panel shows the distribution of opinion about the importance of the factor in 2004 and 2012, with the statistics for a marginal homogeneity or McNemar’s test which indicates whether or not there has been a significant net change in opinion. The lower left panel shows the regional distributions as stacked histograms, while the lower right panel shows the statistics for marginal homogeneity or McNemar’s tests within each region. For other questions where there is only a small number of ordinal categories, regional change tables are used instead of regional distributions. These are interpreted in the same way as for the national table. For more information on the statistics presented in association with summary tables for ordinal data, see Appendix A1.6.2.

Several questions provided data that could be treated as either ordinal or continuous data, such as the number of years in the past five years that lice had been detected and/or treated. For these, both paired t-tests, and marginal homogeneity tests are shown.

3.2.3 Nominal data

For nominal data, such as whether the respondent had any cattle or not, the findings are presented in the same way as for ordinal data, as described above.

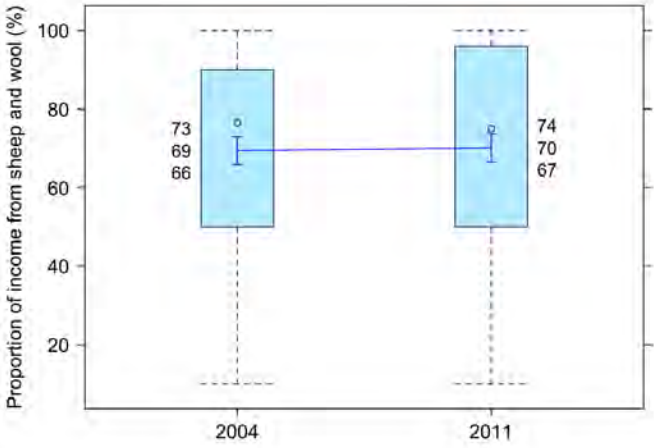
Respondents who failed to complete particular questions are omitted from the tables that report on those questions. For this reason, the sample size reported in the table column headed "n" will vary from table to table and will generally be less than the 219 responses for the full survey and 91 responses for the short survey. In some cases, where a question was asked in both the full and short surveys, the percentages reported in tables are based on both surveys.

3.3 Farm Characteristics

3.3.1 Proportion of income derived from sheep and wool

Respondents were asked to estimate the proportion of their income that was derived from wool sales, sheep sales, beef cattle and cropping.

National box plots	National mean values

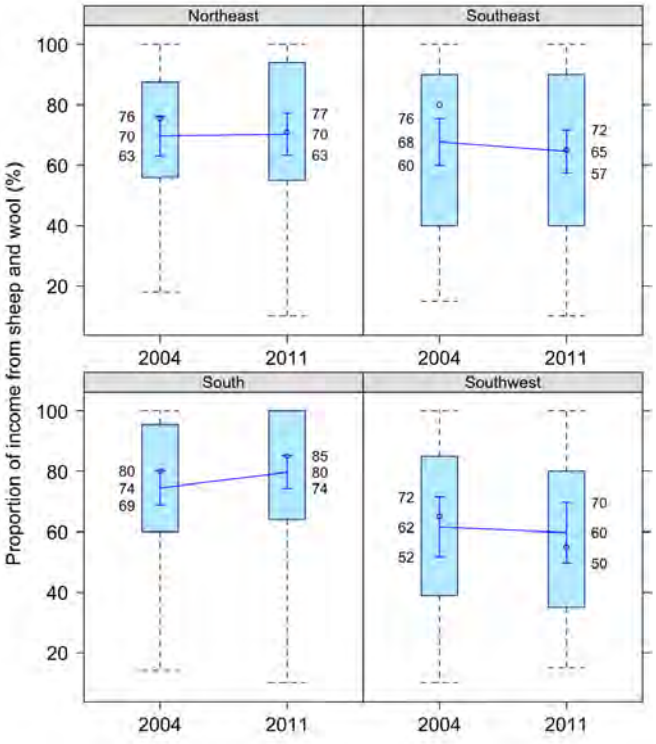


% income from sheep and wool

	2003	2011
Mean values	69.4	70.1

Paired t-test: t=0.50, df=207, p =0.6158, n=206

Regional box plots	Paired t-tests

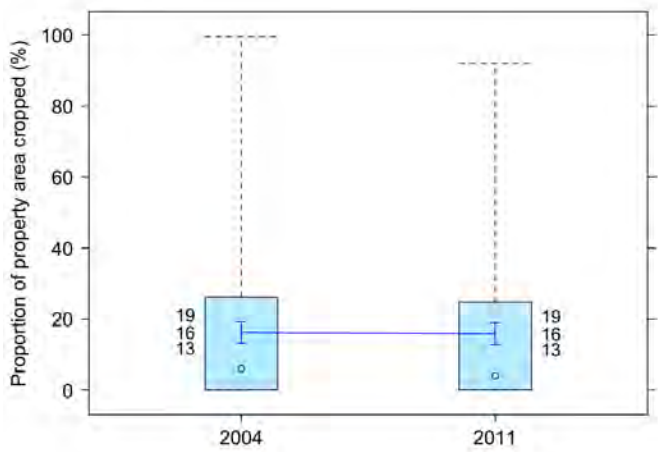


	t	*df*	*p value*	*n*
NE	*0.20*	*51*	*0.8439*	*52*
SE	*-0.95*	*52*	*0.3480*	*53*
S	*2.86*	*66*	*0.0057*	*67*
SW	*-0.57*	*33*	*0.5757*	*34*

3.3.2 *Proportion of property cropped*

Respondents were asked to estimate the proportion of their property area that was cropped.

National box plots	National mean values

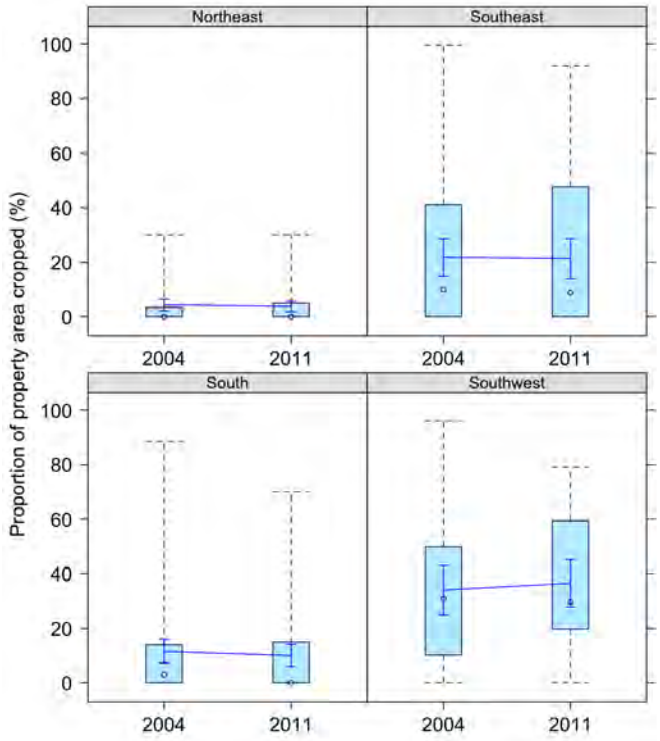


% income from sheep and wool

	2003	2011
Mean values	16.2	15.8

Paired t-test:t =–0.30, df=208, p=0.7613, n=209

Regional box plots	Paired t-tests

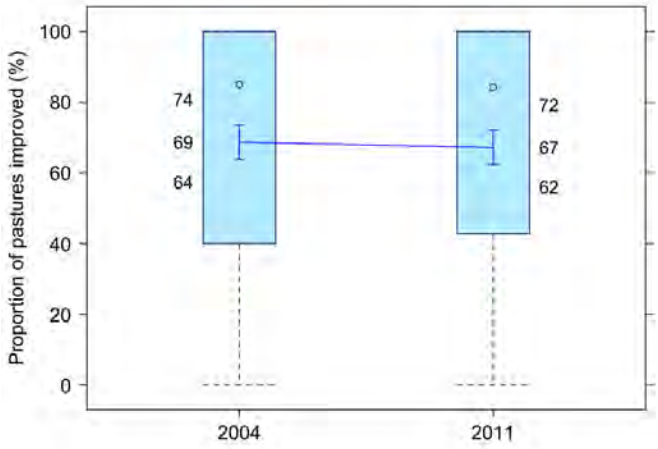


	2004 mean	*2011 mean*	*p value*	*n*
NE	*4.4*	*3.8*	*0.5403*	*52*
SE	*21.8*	*21.3*	*0.8587*	*54*
S	*11.7*	*10.1*	*0.4679*	*68*
SW	*34*	*36.5*	*0.4746*	*35*

3.3.3 *Proportion of pastures improved*

Respondents were asked to estimate the proportion of their pasture area that had been improved.

National box plots	National mean values

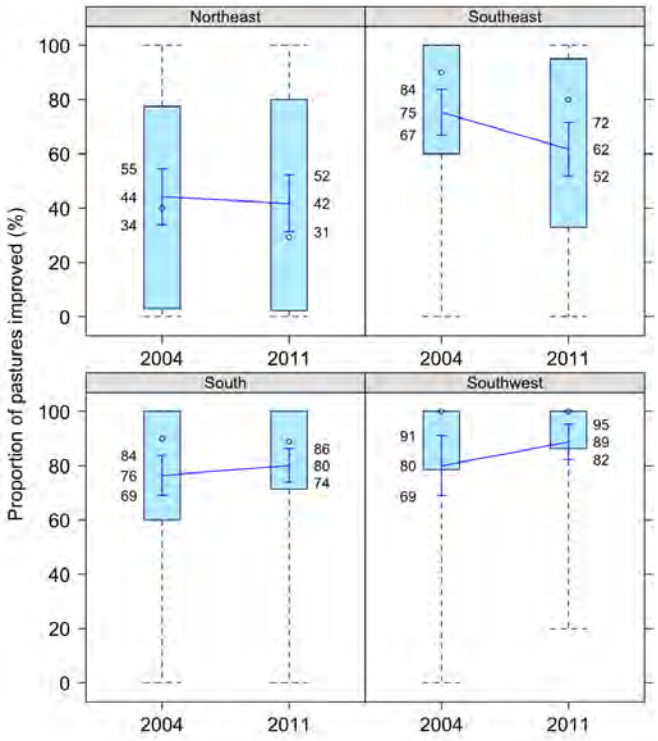


% of pastures improved

	2003	2011
Mean values	68.7	67.2

Paired t-test:t =–0.65, df=208, p=0.5180, n=209

Regional box plots	Paired t-tests

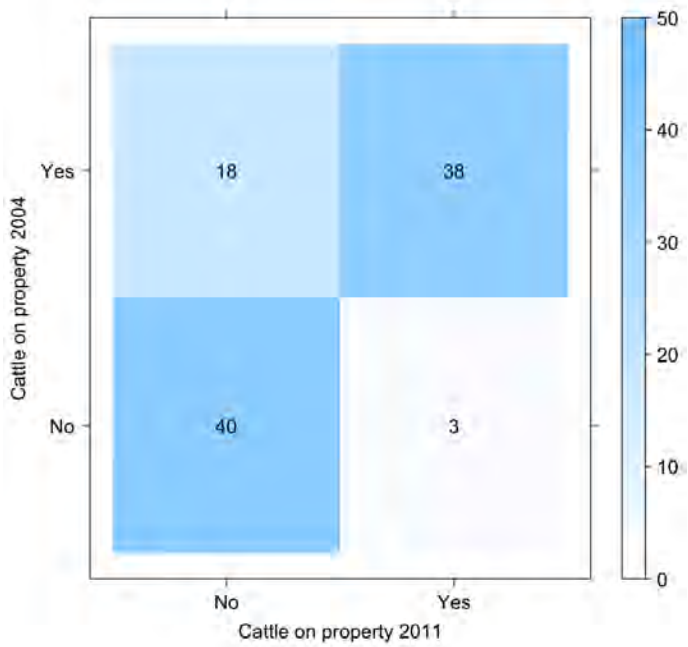


	2003 mean	*2011 mean*	*p value*	*n*
NE	44	42	0.6483	52
SE	75	62	0.0029	54
S	76	80	0.2925	68
SW	80	89	0.0964	35

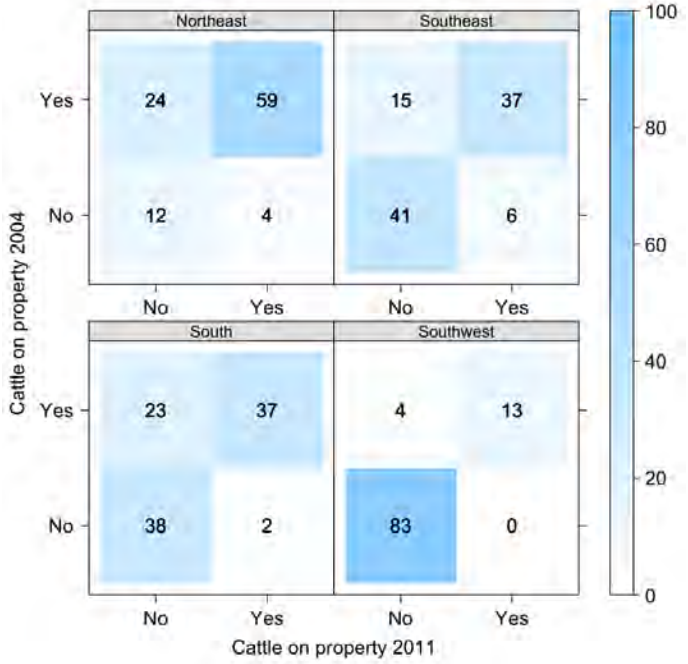
3.3.4 *Proportion of respondents with cattle*

Respondents were asked to indicate the number of cattle they ran in a typical year. The results below are for the aggregate of the responses to the full and short surveys

National change table	McNemar's test
% of respondents	$\chi^2=32.33$ *df=1, p<0.0005, n=304*



Regional change tables	Exact McNemar's tests

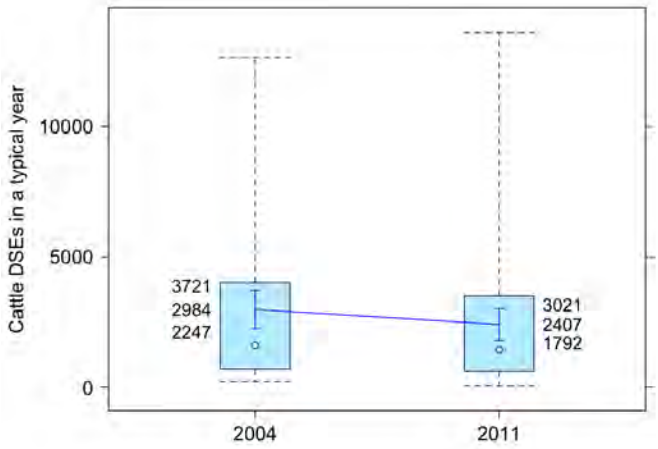


	p value	*n*
NE	*0.0014*	*74*
SE	*0.1435*	*78*
S	*<0.0005*	*98*
SW	*0.5000*	*54*

3.3.5 *Cattle DSEs in a typical year – mean of respondents with cattle in 2004 and 2012*

Respondents provided their typical cattle numbers in various classes, from which the DSE for the total cattle herd was calculated using the conversion factors given in section A1.7 of Appendix 1.

National box plots



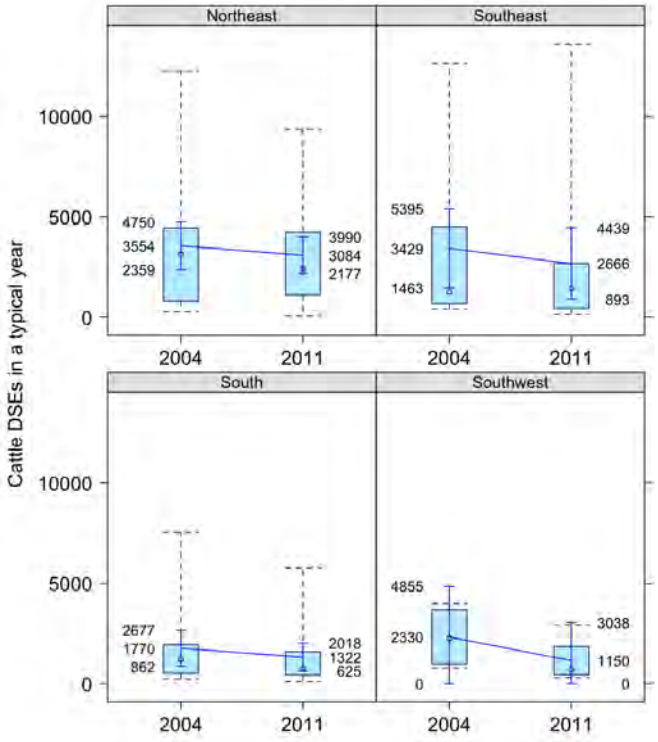
National mean values

DSE of total cattle herd in a typical year

	2004	2012
Mean values	2984	2407

Paired t-test:t =–3.09, df=72, p=0.0028, n=209

Regional box plots



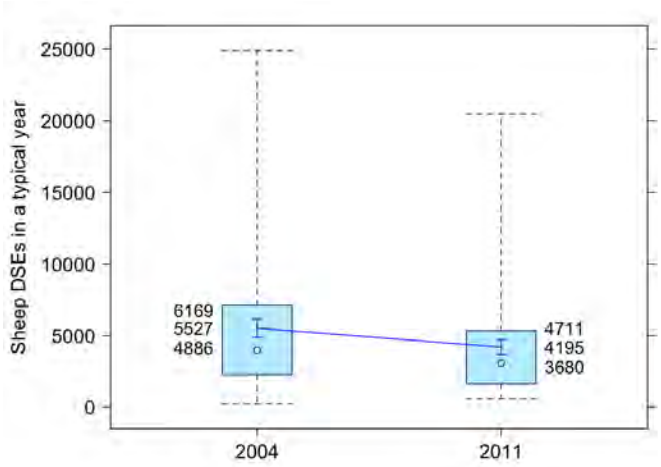
Paired t-tests

	t	*df*	*p value*	*n*
NE	-1.57	30	0.1258	31
SE	-1.74	17	0.0999	18
S	-1.56	18	0.1351	19
SW	-1.79	3	0.1717	4

3.3.6 *Sheep DSEs in a typical year*

Respondents provided their typical sheep numbers in various classes, from which the DSE for the total flock was calculated using the conversion factors given in section A1.7 of Appendix 1.

National box plots



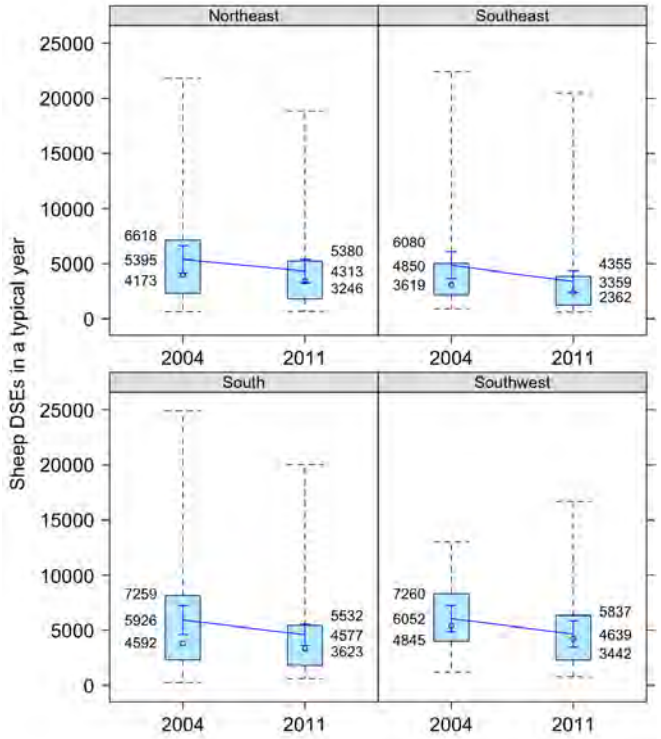
National mean values

DSE of total sheep flock in a typical year

	2004	2012
Mean values	5527	4195

Paired t-test:t =–7.17, df=200, p=<0.00005, n=201

Regional box plots



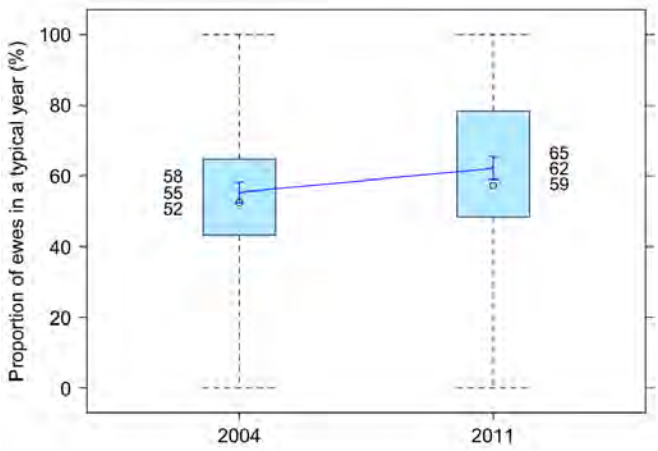
Paired t-tests

	t	*df*	*p value*	*n*
NE	-3.25	48	0.0021	49
SE	-4.65	53	<0.00005	54
S	-3.52	65	0.0008	66
SW	-3.14	31	0.0037	32

3.3.7 *Flock composition – proportion of ewes in a typical year*

Respondents provided their typical sheep numbers in various sheep classes, from which the proportion of ewes in a typical year could be calculated.

National box plots



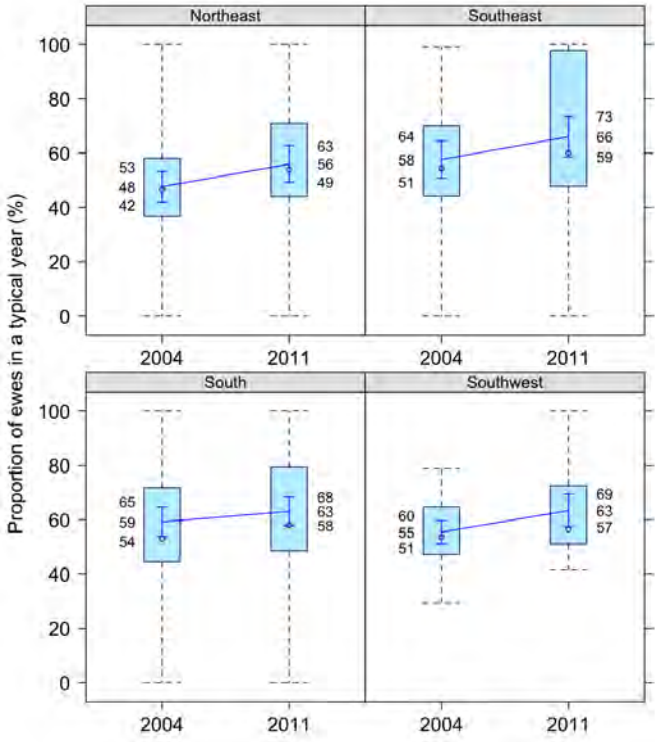
National mean values

Proportion of ewes in a typical year (%)

	2004	2012
Mean values	55.3	62.2

Paired t-test: t=3.75, df=200, p =0.0002, n=201

Regional box plots



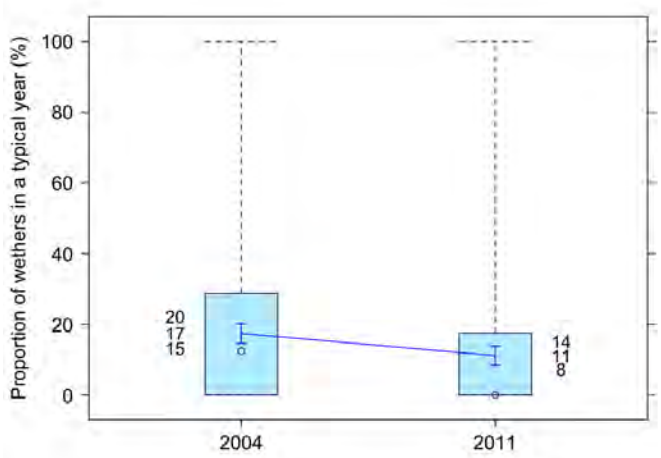
Paired t-tests

	t	*df*	*p value*	*n*
NE	2.58	48	0.0131	49
SE	1.86	53	0.0689	54
S	1.33	65	0.1893	66
SW	2.26	31	0.0310	32

3.3.8 *Flock composition – proportion of wethers in a typical year*

Respondents provided their typical sheep numbers in various sheep classes, from which the proportion of wethers in a typical year could be calculated.

National box plots



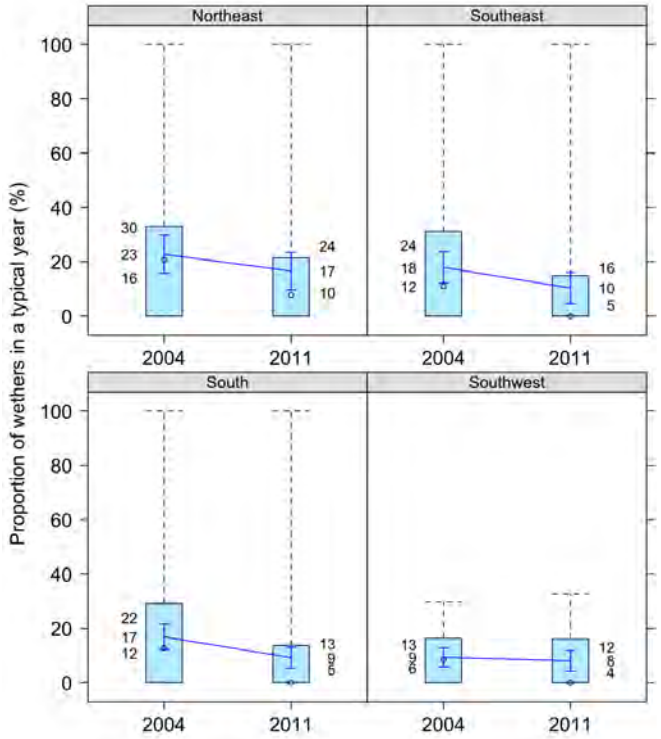
National mean values

Proportion of wethers in a typical year (%)

	2004	2012
Mean values	17.4	11.1

Paired t-test: t=-4.53, df=200, p <0.00005, n=201

Regional box plots



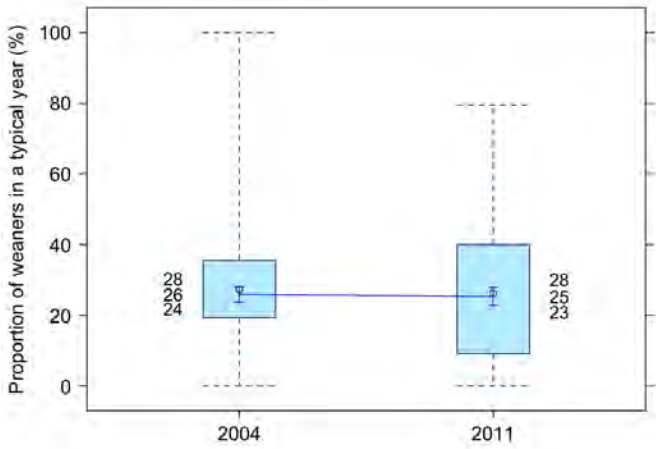
Paired t-tests

	t	*df*	*p value*	*n*
NE	-2.20	48	0.0330	49
SE	-2.08	53	0.0426	54
S	-3.83	65	0.0003	66
SW	-0.98	31	0.3332	32

3.3.9 *Flock composition – proportion of weaners in a typical year*

Respondents provided their typical sheep numbers in various sheep classes, from which the proportion of weaners in a typical year could be calculated.

National box plots



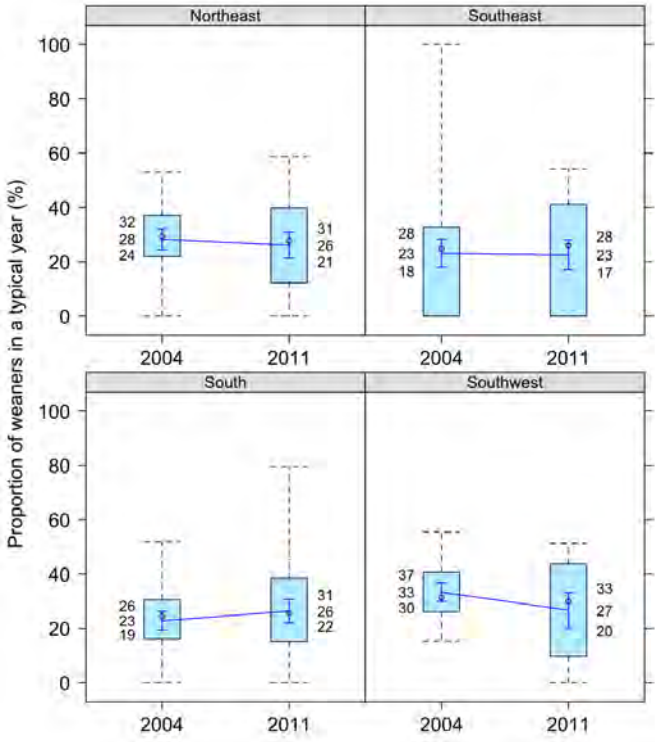
National mean values

Proportion of weaners in a typical year (%)

	2004	2012
Mean values	25.9	25.3

Paired t-test: t=-0.43, df=200, p <0.6664, n=201

Regional box plots



Paired t-tests

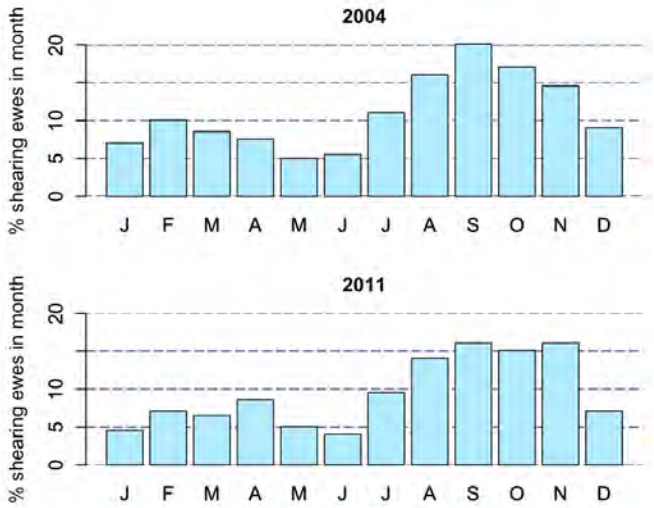
	t	*df*	*p value*	*n*
NE	-0.89	48	0.3772	49
SE	-0.19	53	0.8496	54
S	1.61	65	0.1126	66
SW	-1.88	31	0.0697	32

3.4 Animal husbandry (other than parasite management)

3.4.1 Months in which shearing is done

Respondents provided the month or months in which various classes of sheep were shorn. Since respondents could provide more than one month, the resultant data is multiple response data and consequently not amenable to the usual statistical tests for differences. It should also be noted that changes in the distribution of shearing months may occur solely because respondents have nominated fewer or more months, rather than a change in the time of year shearing is done. The following tables report a selection of months in which there were relatively greater changes between 2004 and 2011.

National distributions of shearing months for ewes



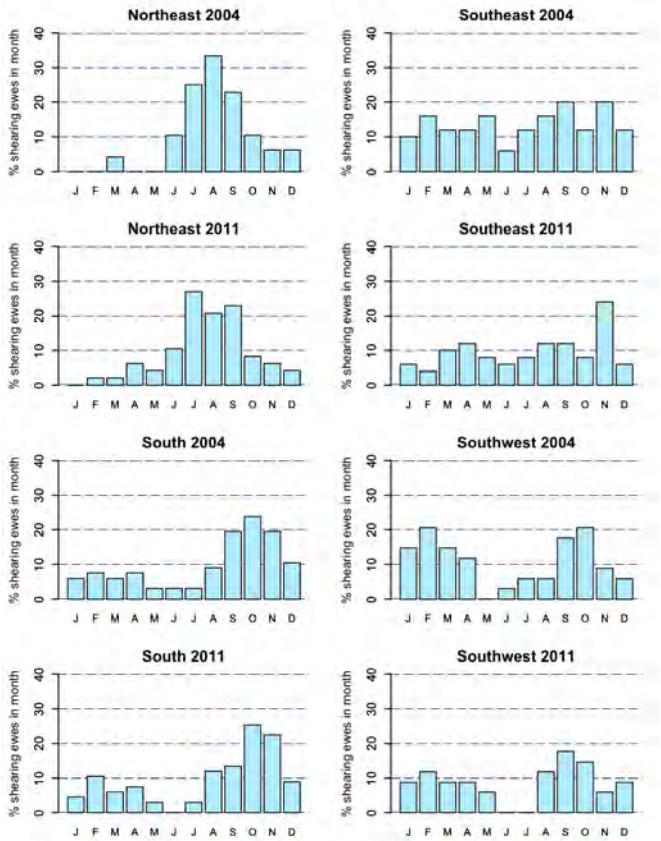
Two greatest changes

Proportion shearing in month (%)

Month	2003	2011	Change
Sep	20.1	16.1	–4.0
Feb	10.1	7.0	–3.0

n=199

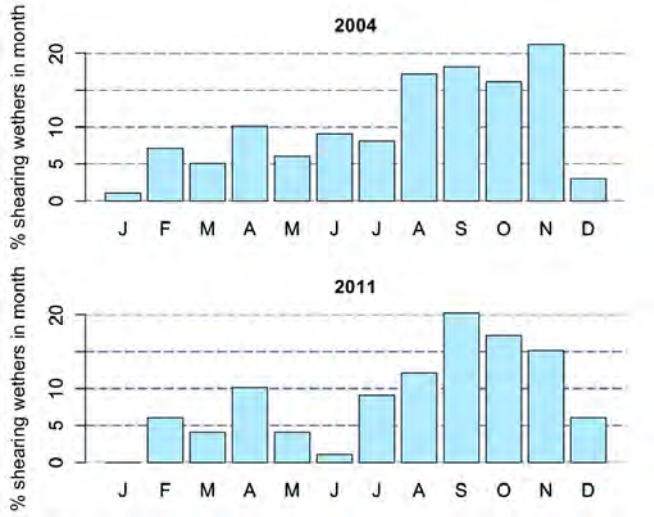
Regional distributions of shearing months for ewes



Two greatest changes in each region

	Month	2003	2011	Change	n
NE	Aug	33.3	20.8	-12.5	48
NE	Apr	0.0	6.2	6.2	48
SE	Feb	16.0	4.0	-12.0	50
SE	May	16.0	8.0	-8.0	50
S	Sep	19.4	13.4	-6.0	67
S	Feb	7.5	10.4	2.9	67
SW	Feb	20.6	11.8	-8.8	34
SW	Jan	14.7	8.8	-5.9	34

National distributions of shearing months for wethers



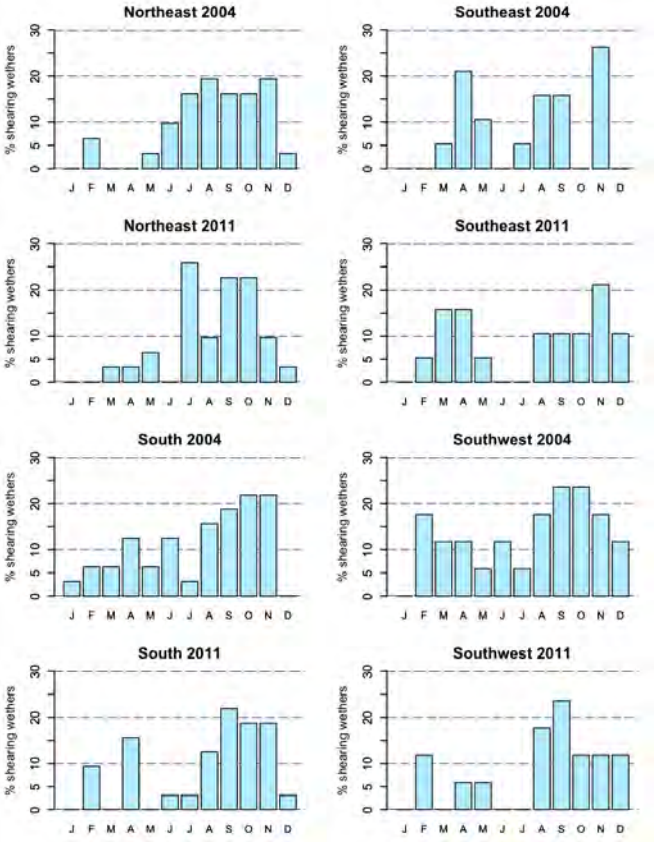
Two greatest changes

Proportion shearing in month (%)

Month	2003	2011	Change
Jun	9.1	1.0	–8.1
Nov	21.2	15.2	–6.0

n=199

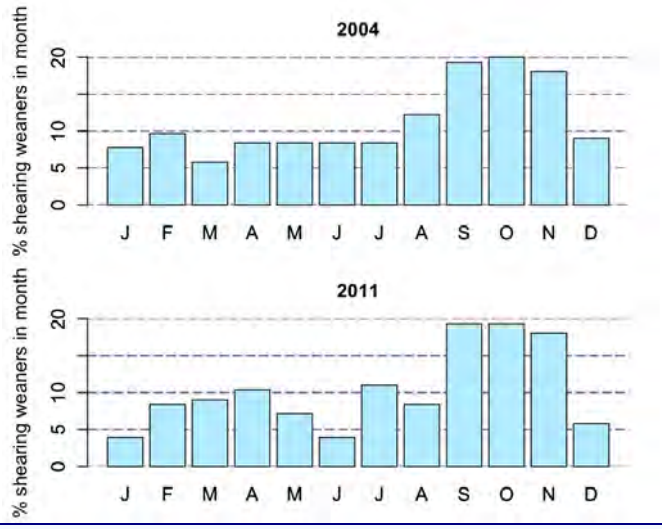
Regional distributions of shearing months for wethers



Two greatest changes in each region

	Month	2003	2011	Change	n
NE	Jun	9.7	0.0	-9.7	31
NE	Aug	19.4	9.7	-9.7	31
SE	Mar	5.3	15.8	10.5	19
SE	Oct	0.0	10.5	10.5	19
S	Jun	12.5	3.1	-9.4	32
S	Mar	6.2	0.0	-6.2	32
SW	Mar	11.8	0.0	-11.8	17
SW	Jun	11.8	0.0	-11.8	17

National distributions of shearing months for weaners



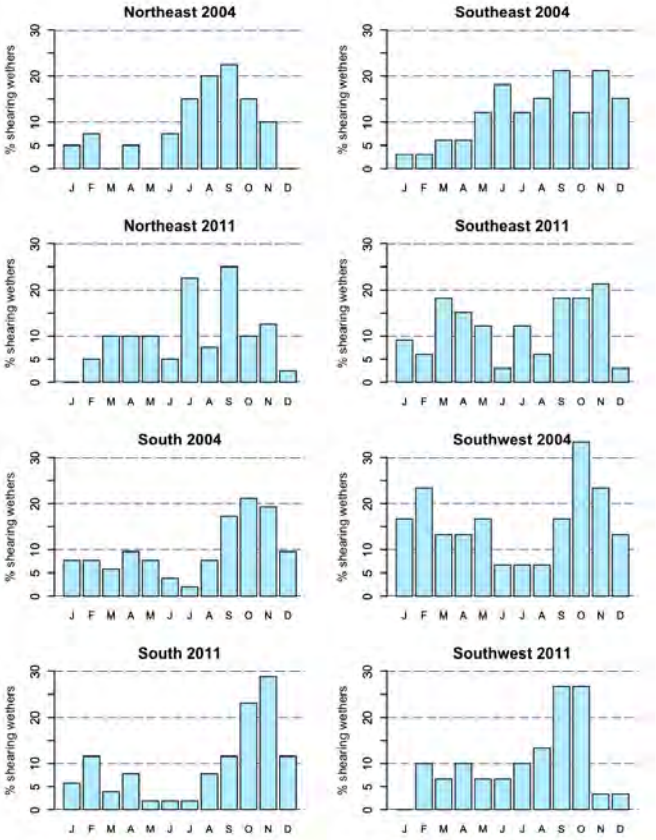
Two greatest changes

Proportion shearing in month (%)

Month	2003	2011	Change
Jun	8.4	3.9	–4.5
Jan	7.7	3.9	–3.8

n=155

Regional distributions of shearing months for weaners



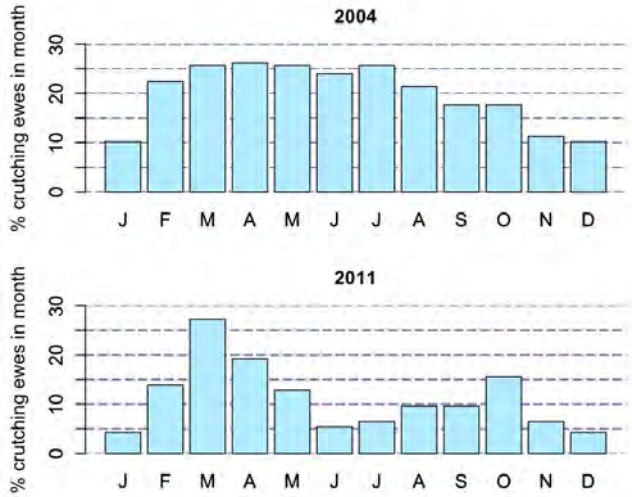
Two greatest changes in each region

	Month	2003	2011	Change	n
NE	Aug	20.0	7.5	-12.5	40
NE	Mar	0.0	10.0	10.0	40
SE	Jun	18.2	3.0	-15.2	33
SE	Mar	6.1	18.2	12.1	33
S	Nov	19.2	28.8	9.6	52
S	May	7.7	1.9	-5.8	52
SW	Nov	23.3	3.3	-20.0	30
SW	Jan	16.7	0.0	-16.7	30

3.4.2 *Months in which crutching is done*

Respondents provided the month or months in which various classes of sheep were crutched. Since respondents could provide more than one month, the resultant data is multiple response data and consequently not amenable to the usual statistical tests for differences. It should also be noted that changes in the distribution of crutching months may occur solely because respondents have nominated fewer or more months, rather than a change in the time of year crutching is done. The following tables report a selection of months in which there were relatively greater changes between 2004 and 2011.

National distributions of crutching months for ewes



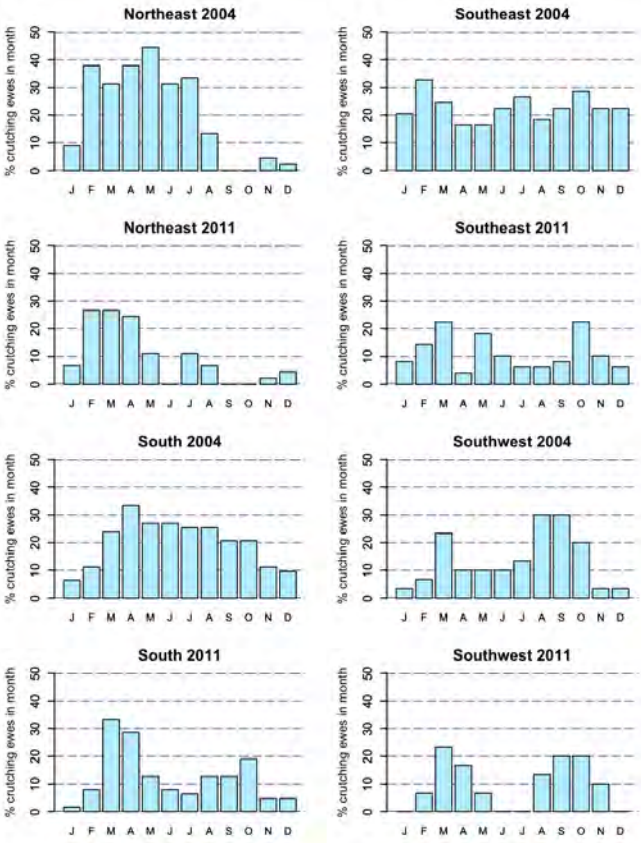
Two greatest changes

Proportion crutching in month (%)

Month	2003	2011	Change
Jul	25.7	6.4	–19.3
Jun	24.1	5.3	–18.8

n=187

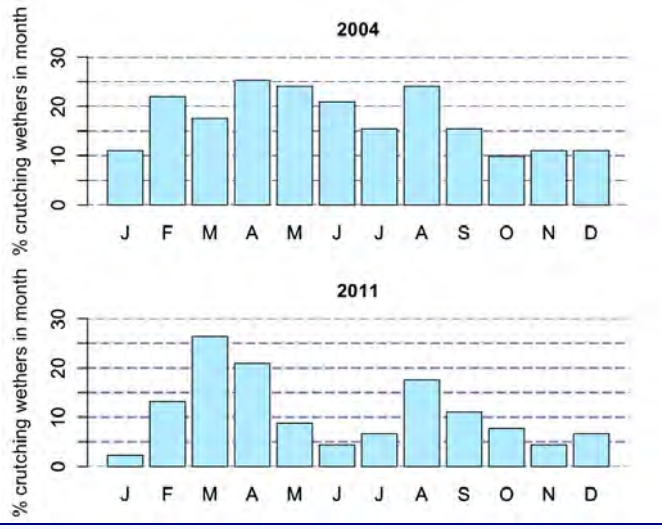
Regional distributions of crutching months for ewes



Two greatest changes in each region

	Month	2003	2011	Change	n
NE	May	44.4	11.1	-33.3	45
NE	Jun	31.1	0.0	-31.1	45
SE	Jul	26.5	6.1	-20.4	49
SE	Feb	32.7	14.3	-18.4	49
S	Jun	27.0	7.9	-19.1	63
S	Jul	25.4	6.3	-19.1	63
SW	Aug	30.0	13.3	-16.7	30
SW	Jul	13.3	0.0	-13.3	30

National distributions of crutching months for wethers



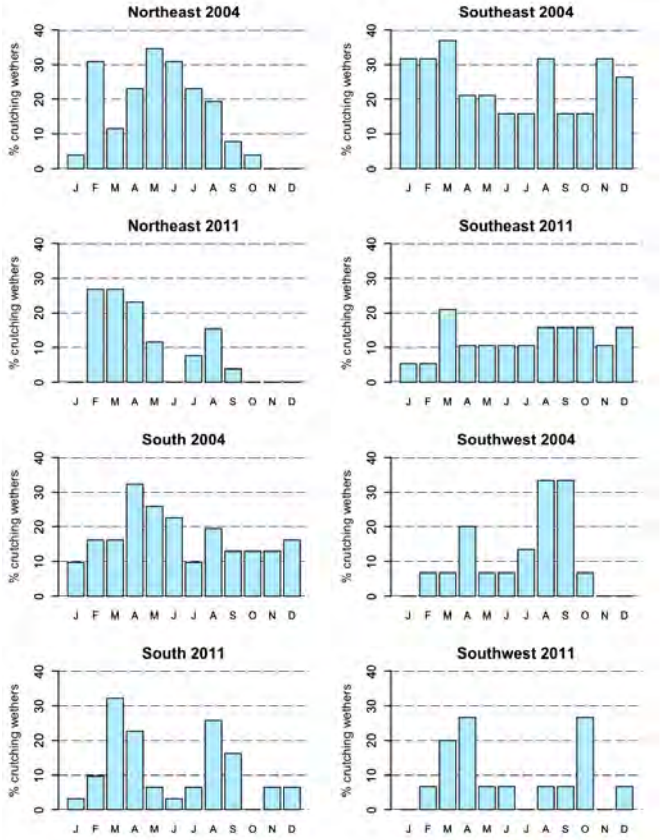
Two greatest changes

Proportion crutching in month (%)

Month	2003	2011	Change
Jun	20.9	4.4	–16.5
May	24.2	8.8	–15.4

n=91

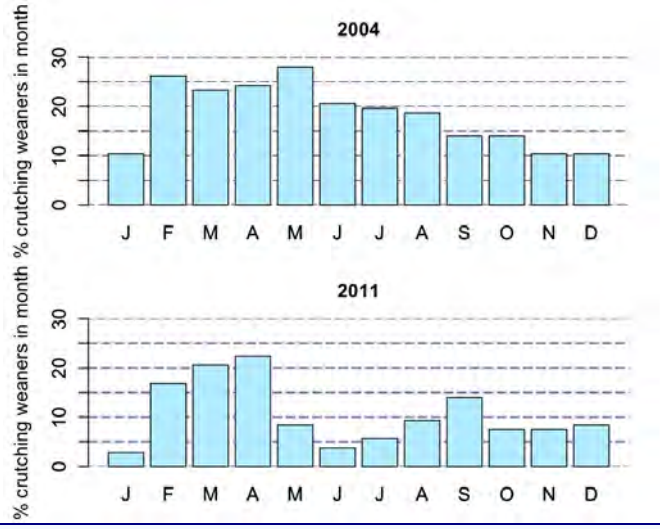
Regional distributions of crutching months for wethers



Two greatest changes in each region

	Month	2003	2011	Change	n
NE	Jun	30.8	0.0	-30.8	26
NE	May	34.6	11.5	-23.1	26
SE	Jan	31.6	5.3	-26.3	19
SE	Feb	31.6	5.3	-26.3	19
S	May	25.8	6.5	-19.3	31
S	Jun	22.6	3.2	-19.4	31
SW	Aug	33.3	6.7	-26.6	15
SW	Sep	33.3	6.7	-26.6	15

National distributions of crutching months for weaners



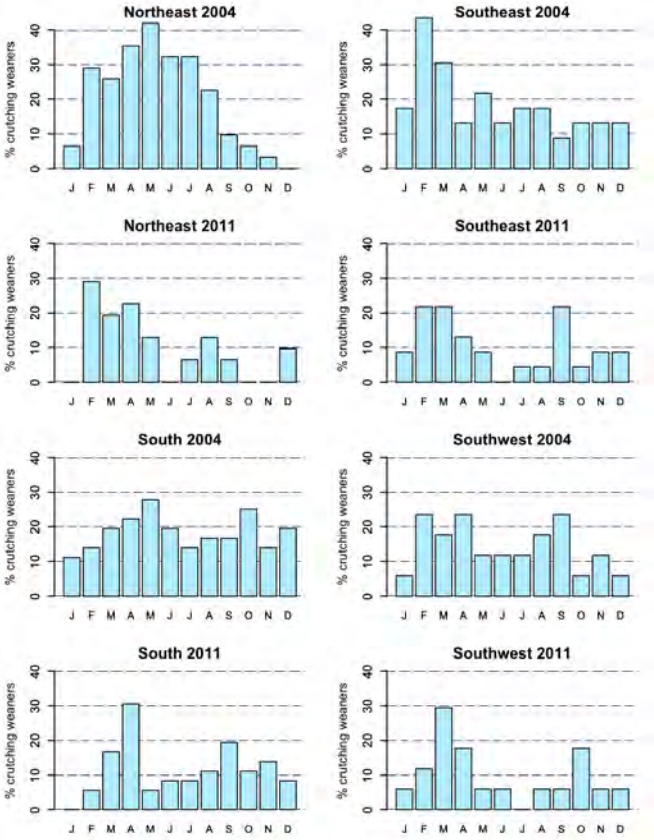
Two greatest changes

Proportion crutching in month (%)

Month	2003	2011	Change
May	28.0	8.4	–19.6
Jun	20.6	3.7	–16.9

n=107

Regional distributions of crutching months for weaners



Two greatest changes in each region

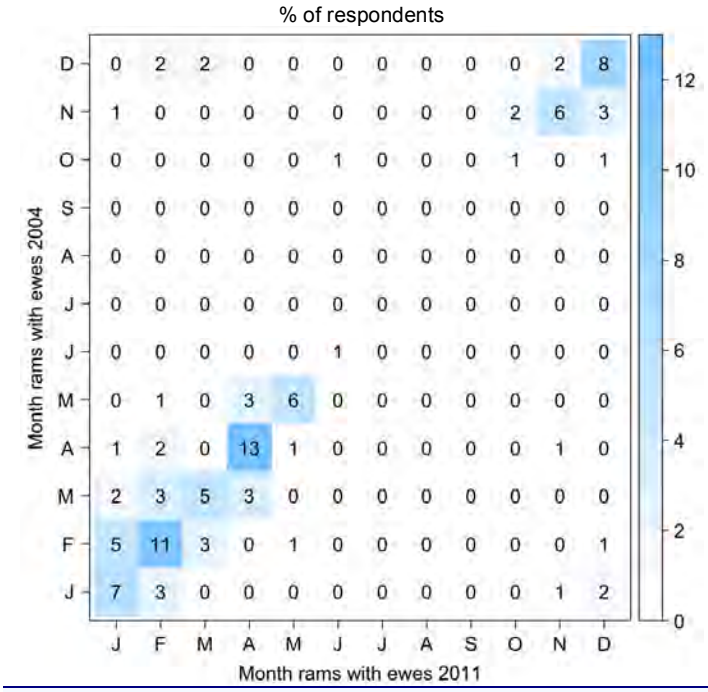
	Month	2003	2011	Change	n
NE	Jun	32.3	0.0	-32.3	31
NE	May	41.9	12.9	-29.0	31
SE	Feb	43.5	21.7	-21.8	23
SE	May	21.7	8.7	-13.0	23
S	May	27.8	5.6	-22.2	36
S	Oct	25.0	11.1	-13.9	36
SW	Sep	23.5	5.9	-17.6	17
SW	Mar	17.6	29.4	11.8	17

3.5 Breeding program

Respondents indicated the timing of mating in the year previous to the survey, the associated marking percentages in previous year and their typical marking percentage.

3.5.1 Month Merino rams put with Merino ewes

National change table



National distributions

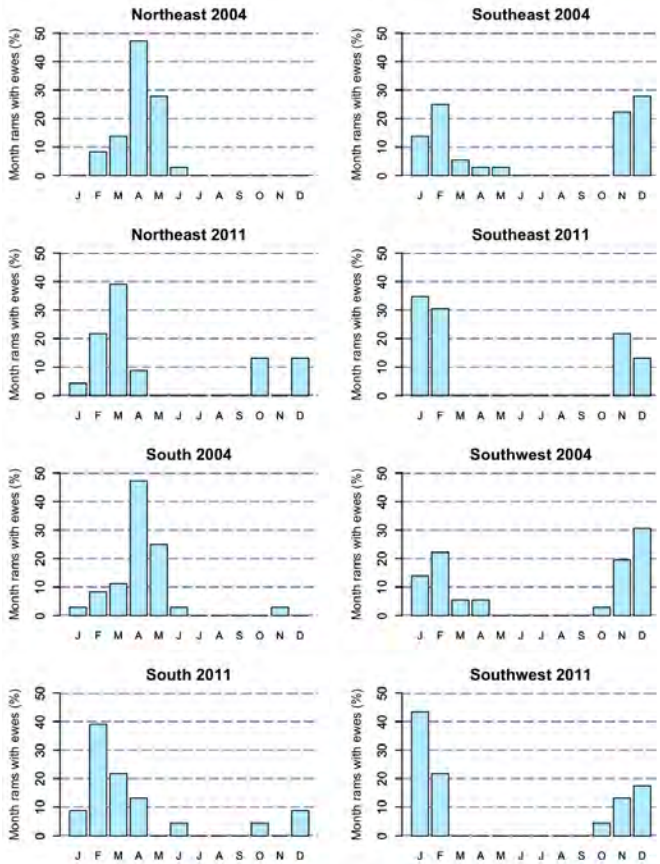
% respondents

Month	2003	2011
Jan	12	15
Feb	20	21
Mar	14	9
Apr	17	19
May	9	8
Jun	1	2
Jul	0	0
Aug	0	0
Sep	0	0
Oct	3	3
Nov	11	9
Dec	14	14

Marginal homogeneity test

χ^2=4.52, p=0.8528, n=118

Regional distributions

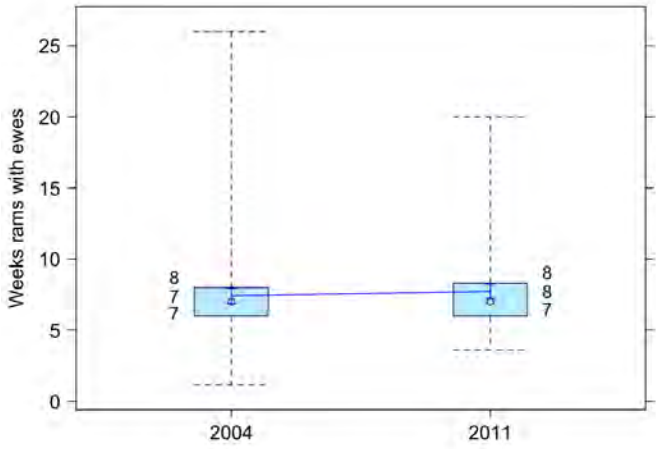


Marginal homogeneity tests

	χ^2	*p value*	*n*
Northeast	*2.26*	*1.0000*	*36*
Southeast	*5.35*	*0.5599*	*23*
South	*2.36*	*1.0000*	*36*
Southwest	*2.67*	*0.8437*	*23*

3.5.2 *Number of weeks Merino rams left with Merino ewes*

National box plots	National mean values

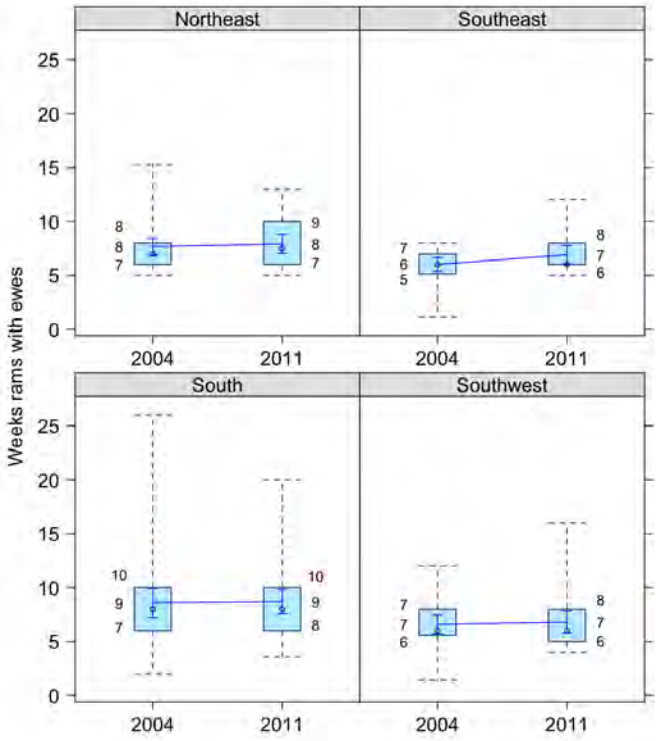


Weeks Merino rams left with Merino ewes

	2004	2011
Mean values	7.4	7.7

Paired t-test: t=1.27, df=126, p=0.2074, n=127

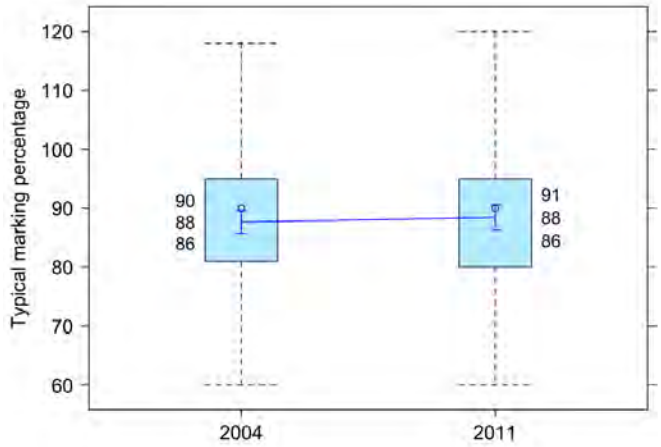
Regional box plots	Paired t-tests



	t	*df*	*p value*	*n*
NE	*0.62*	*37*	*0.5385*	*38*
SE	*1.99*	*23*	*0.0587*	*24*
S	*0.18*	*38*	*0.8589*	*39*
SW	*0.58*	*25*	*0.5656*	*26*

3.5.3 *Typical marking percentages – Merino rams mated with Merino ewes*

National box plots	National mean values

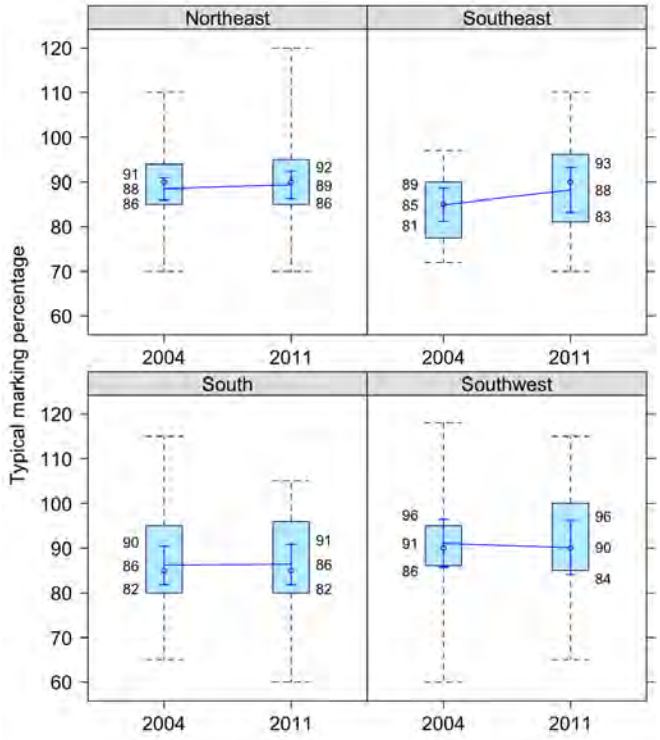


Typical marking percentage

	2004	2011
Mean values	87.7	88.4

Paired t-test: t=1.29, df=102, p=0.2004, n=103

Regional box plots	Paired t-tests

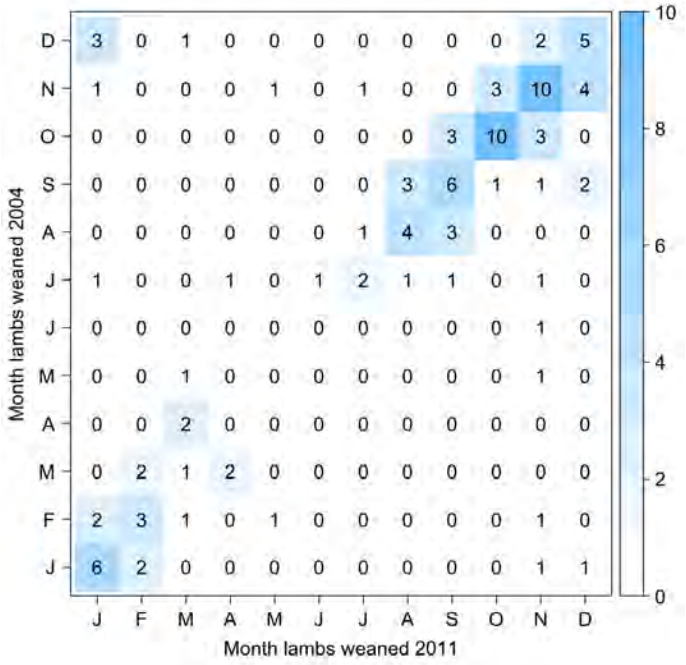


	t	*df*	*p value*	*n*
NE	*0.95*	*32*	*0.3475*	*33*
SE	*2.07*	*19*	*0.0522*	*20*
S	*0.18*	*28*	*0.8554*	*29*
SW	*-0.65*	*20*	*0.5229*	*21*

3.5.4 *Month lambs weaned – Merino rams mated to Merino ewes*

National change table

% of respondents



National distributions

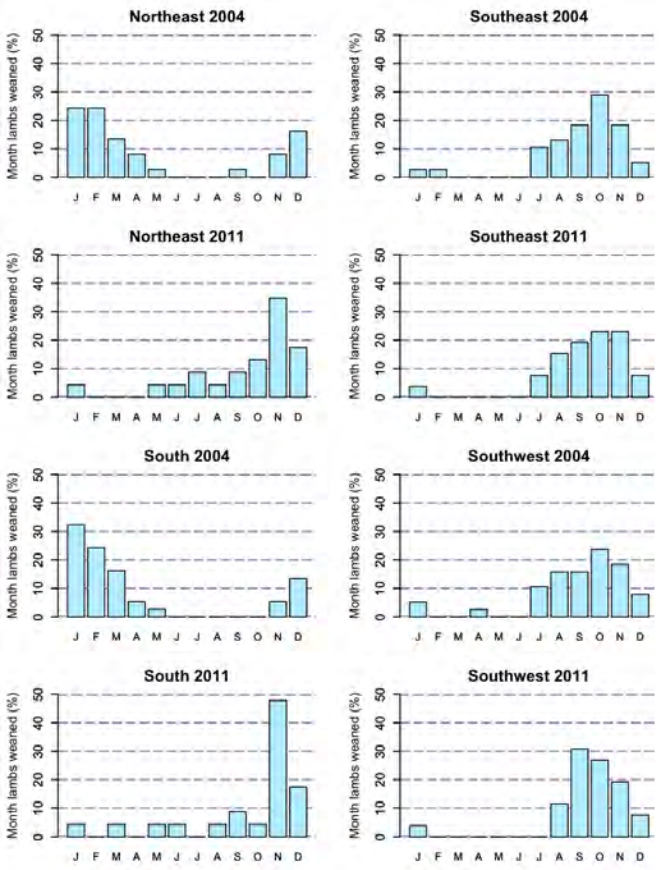
% respondents

Month	2004	2011
Jan	10	13
Feb	8	7
Mar	4	6
Apr	2	2
May	2	2
Jun	1	1
Jul	6	3
Aug	8	8
Sep	12	13
Oct	16	14
Nov	19	20
Dec	11	11

Marginal homogeneity test

$\chi 2$=5.11, p=0.9434, n=124

Regional distributions



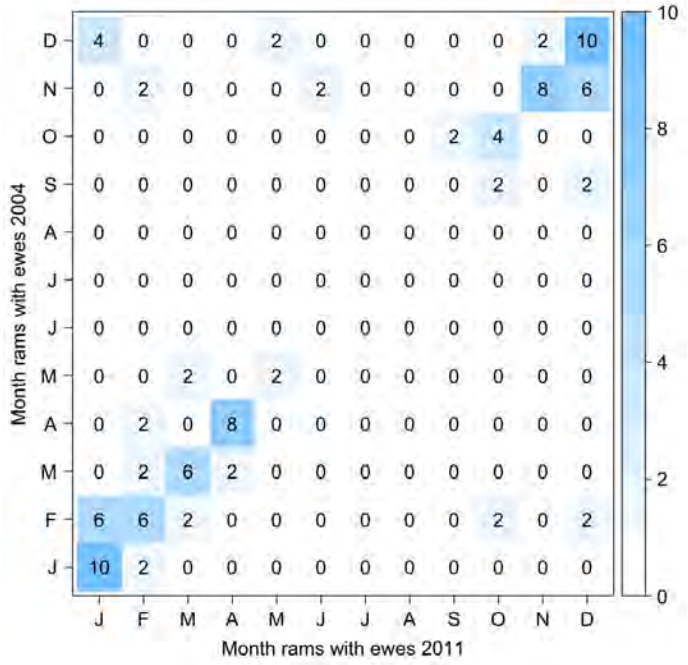
Marginal homogeneity tests

	$\chi 2$	*p value*	*n*
Northeast	*3.07*	*0.9428*	*37*
Southeast	*6.38*	*0.6649*	*23*
South	*4.63*	*0.9290*	*38*
Southwest	*4.20*	*0.8488*	*26*

3.5.5 *Months meat breed rams put with Merino ewes*

National change table

% of respondents



National distributions

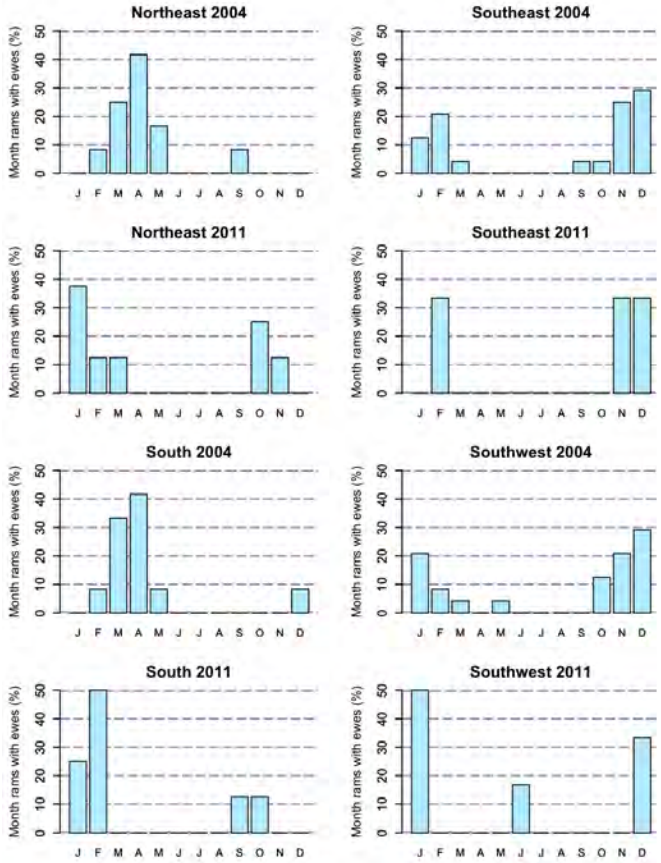
% respondents

Month	2004	2011
Jan	12	20
Feb	18	14
Mar	10	10
Apr	10	10
May	4	4
Jun	0	2
Jul	0	0
Aug	0	0
Sep	4	2
Oct	6	8
Nov	18	10
Dec	18	20

Marginal homogeneity test

$\chi^2=5.88$, $p=0.8475$, $n=50$

Regional distributions

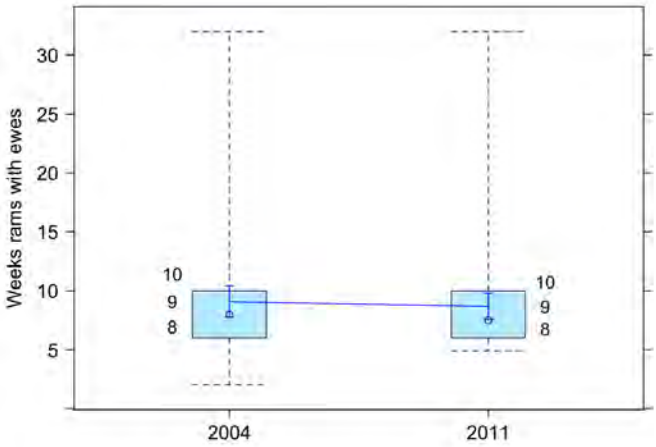


Marginal homogeneity tests

	χ^2	*p value*	*n*
Northeast	*2.00*	*1.0000*	*12*
Southeast	*4.00*	*1.0000*	*8*
South	*6.00*	*0.8130*	*24*
Southwest	*5.00*	*0.4993*	*6*

3.5.6 *Number of weeks meat breed rams left with Merino ewes*

National box plots	National mean values

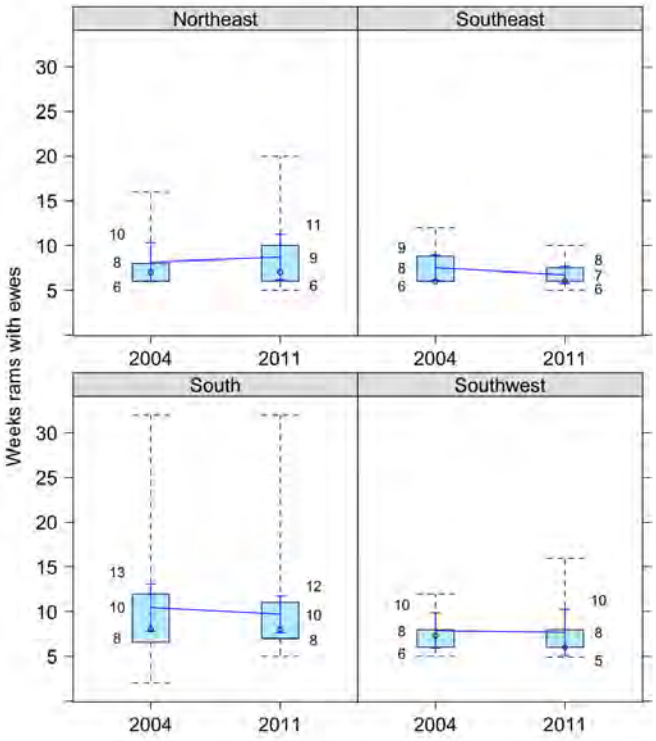


Weeks meat breed rams with Merino ewes

	2004	2011
Mean values	9.1	8.7

Paired t-test: t=-0.80, df=61, p=0.4386, n=62

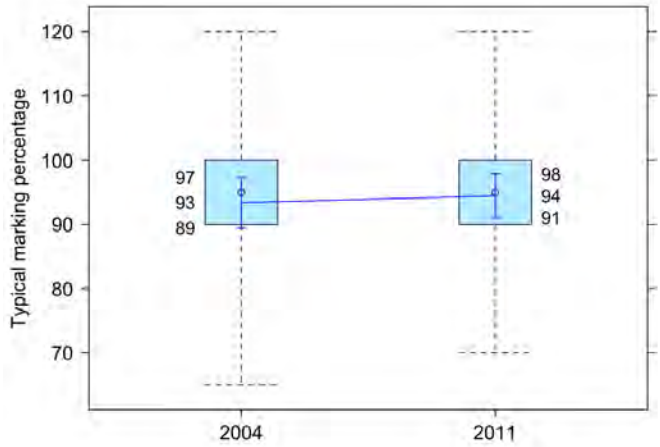
Regional box plots	Paired t-tests



	t	*df*	*p value*	*n*
NE	*0.52*	*12*	*0.6125*	*13*
SE	*-3.14*	*10*	*0.0106*	*11*
S	*-0.78*	*28*	*0.4431*	*29*
SW	*-0.18*	*8*	*0.8597*	*9*

3.5.7 *Typical marking percentages – meat breed rams mated with Merino ewes*

National box plots	National mean values

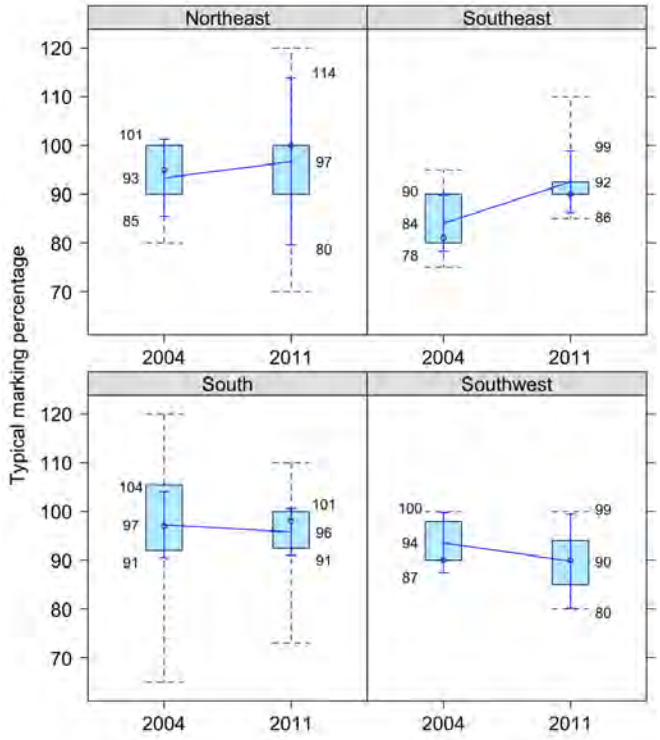


Typical marking percentage

	2004	2011
Mean values	93.4	94.4

Paired t-test: t=0.59, df=37, p=0.5611, n=38

Regional box plots	Paired t-tests

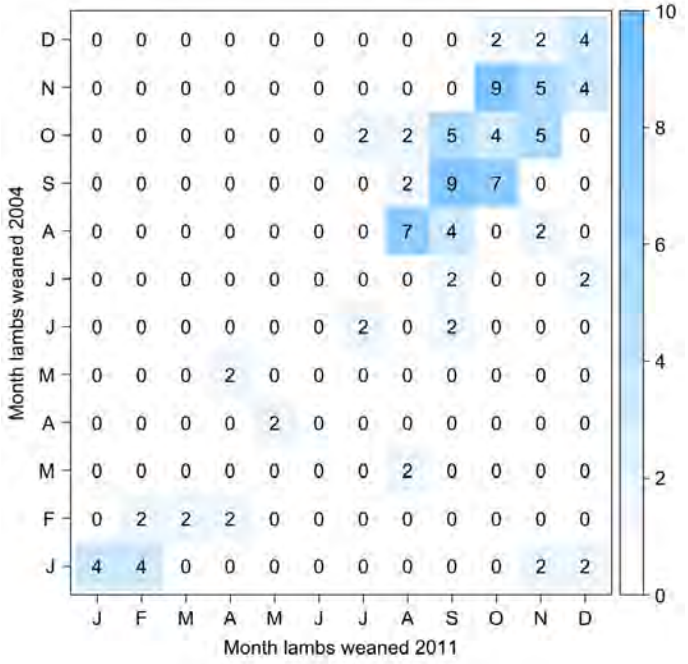


	t	*df*	*p value*	*n*
NE	*0.76*	*5*	*0.4838*	*6*
SE	*2.08*	*7*	*0.0762*	*8*
S	*-0.56*	*18*	*0.5843*	*19*
SW	*-1.47*	*4*	*0.2143*	*5*

3.5.8 *Month lambs weaned – meat breed rams mated to Merino ewes*

National change table

% of respondents



National distributions

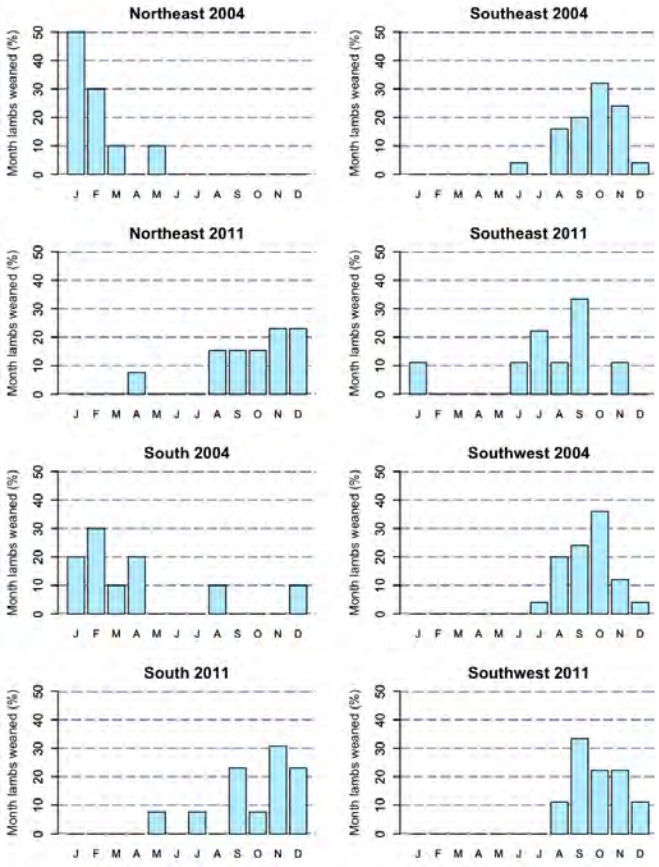
% respondents

Month	2004	2011
Jan	11	4
Feb	5	5
Mar	2	2
Apr	2	4
May	2	2
Jun	4	0
Jul	4	4
Aug	12	12
Sep	18	21
Oct	18	21
Nov	18	16
Dec	7	11

Marginal homogeneity test

χ^2=8.47, p=0.7556, n=57

Regional distributions



Marginal homogeneity tests

	χ^2	p value	n
Northeast	7	0.4993	10
Southeast	4	1.0000	13
South	3.49	0.6570	25
Southwest	6	0.7512	9

3.6 Worm Management Practices

3.6.1 Timing, type of treatments, and products used

In the 2004 and 2012 surveys, respondents completed a table in which they could list treatments for worms in the preceding year, the class of sheep treated, the month of treatment, the type of product and the product name. In the 2004 survey, sheep classes were supplied in the table and there was space for two treatments for unweaned lambs, four treatments each for weaners and adult ewes and three treatments each for maiden ewes and wethers – space for 16 treatments in all. A number of respondents provided information on additional treatments for maiden ewes and wethers, so that the data set for 2004 contained four rather than three treatments each for maiden ewes and wethers, thereby allowing for a maximum of 18 treatments.

In the 2012 survey, to increase the flexibility and possible number of treatments described, respondents could nominate the sheep class for each treatment, and there was space for 20 treatments. However, despite the definition of a standard set of sheep classes on the first page of the questionnaire, this part of the question was poorly answered. A number of respondents gave ambiguous descriptions for the class of sheep, such as "whole flock", or "rest of flock". Where possible in these instances, the class of sheep was inferred from the respondent's answer to an earlier question about flock composition and numbers.

As noted above, the data set for the 2004 survey allowed for up to 18 different treatments. The 2012 survey allowed for up to 20 different treatments. This makes it possible for an increase in the average number of treatments between 2004 and 2012 to be at least partly due to the change in the question format. However, only three respondents in 2012 provided information on more than 16 treatments, and only one respondent in 2012 provided information on more than 18 treatments so the change in question format is highly unlikely to have any effect on the results.

For treatments involving a single class, or several classes, of sheep, there is a greater likelihood of the change in the question format affecting the results. For example, for lambs and weaners, the 2004 survey allowed for up to six treatments, whereas in 2012 it was possible for a respondent to allocate all 20 treatments to lambs and weaners.

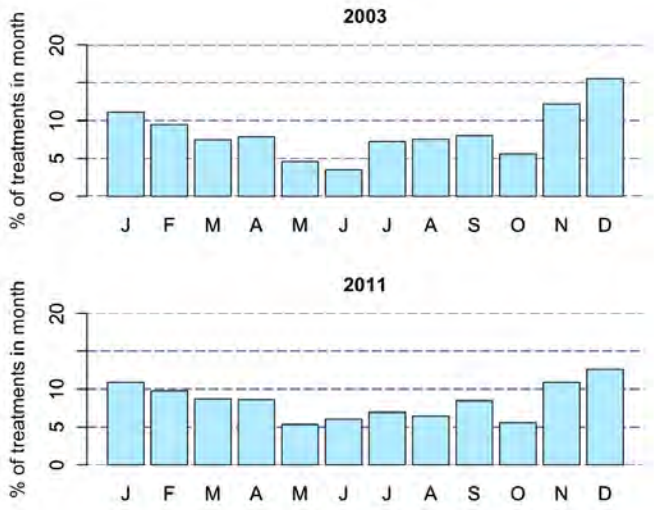
For these reasons, the results for timing, type of treatments and products used are presented for all classes of sheep combined (least likelihood of artefacts due to the question format) and for lambs and weaners combined and maiden ewes and adult ewes combined (higher likelihood of artefacts due to the question format).

3.6.1.1 Month of treatment (all sheep)

The descriptions of treatments in the previous year provided by respondents in the 2004 and 2012 surveys included the month in which the treatment took place. From this data it is possible to compare the 2003 and 2011 proportions of treatments that occurred in each month of the year.

[continued on next page]

National distributions of treatments across months

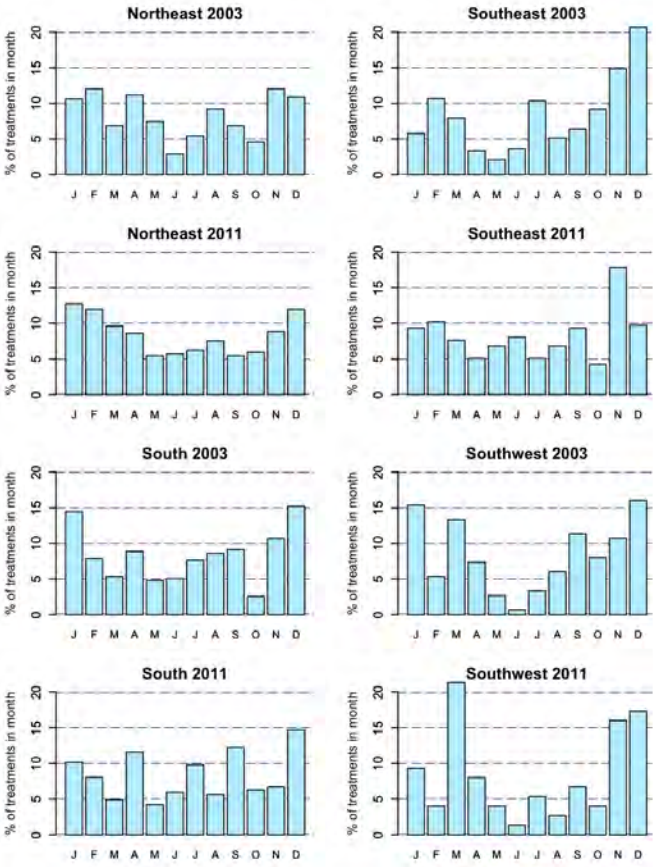


National distributions

Month	% respondents 2003	2011
Jan	11	11
Feb	9	10
Mar	7	9
Apr	8	9
May	5	5
Jun	4	6
Jul	7	7
Aug	8	6
Sep	8	8
Oct	6	5
Nov	12	11
Dec	16	13

$\chi 2=14.45$, df=11, p=0.2093, n=2205

Regional distributions



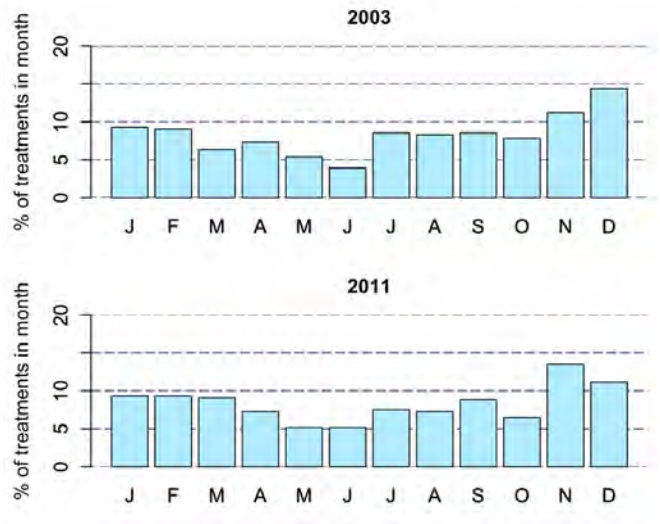
Chi-squared tests

	$\chi 2$	df	p	n
NE	*12.21*	*11*	*0.3479*	*734*
SE	*37.96*	*11*	*0.0001*	*565*
S	*17.28*	*11*	*0.0999*	*681*
SW	*9.24*	-	*0.6213*	*225*

Note: Chi-squared tests are used to assess the significance of the differences in proportion between 2003 and 2011, rather than marginal homogeneity tests because the treatments in each survey cannot be matched (in comparison to respondents which can be matched). Where expected frequencies were less than 5, Monte Carlo simulation was used – these instances can be identified by the lack of a figure for degrees of freedom in the table above.

3.6.1.2 Month of treatment (lambs and/or weaners)

National distributions of treatments across months

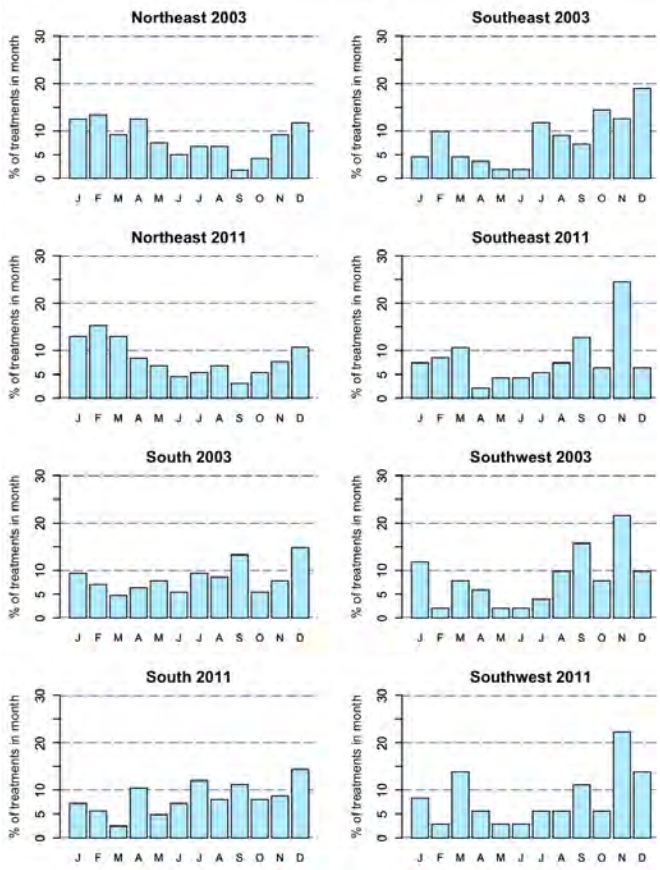


National distributions

	% respondents	
Month	2003	2011
Jan	9	9
Feb	9	9
Mar	6	9
Apr	7	7
May	5	5
Jun	4	5
Jul	9	8
Aug	8	7
Sep	9	9
Oct	8	6
Nov	11	13
Dec	14	11

χ^2=6.18, df=11, p=0.8610, n=796

Regional distributions



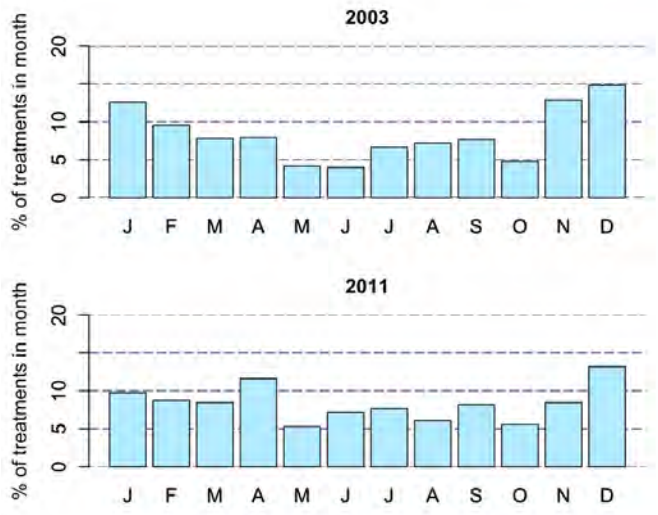
Chi-squared tests

	χ^2	df	p	n
NE	*3.17*	-	*0.9916*	*251*
SE	*23.18*	-	*0.0146*	*205*
S	*5.36*	-	*0.9170*	*253*
SW	*2.56*	-	*0.9964*	*87*

Note: Chi-squared tests are used to assess the significance of the differences in proportion between 2003 and 2011, rather than marginal homogeneity tests because the treatments in each survey cannot be matched (in comparison to respondents which can be matched). Where expected frequencies were less than 5, Monte Carlo simulation was used – these instances can be identified by the lack of a figure for degrees of freedom in the table above.

3.6.1.3 Month of treatment (maiden and/or adult ewes)

National distributions of treatments across months

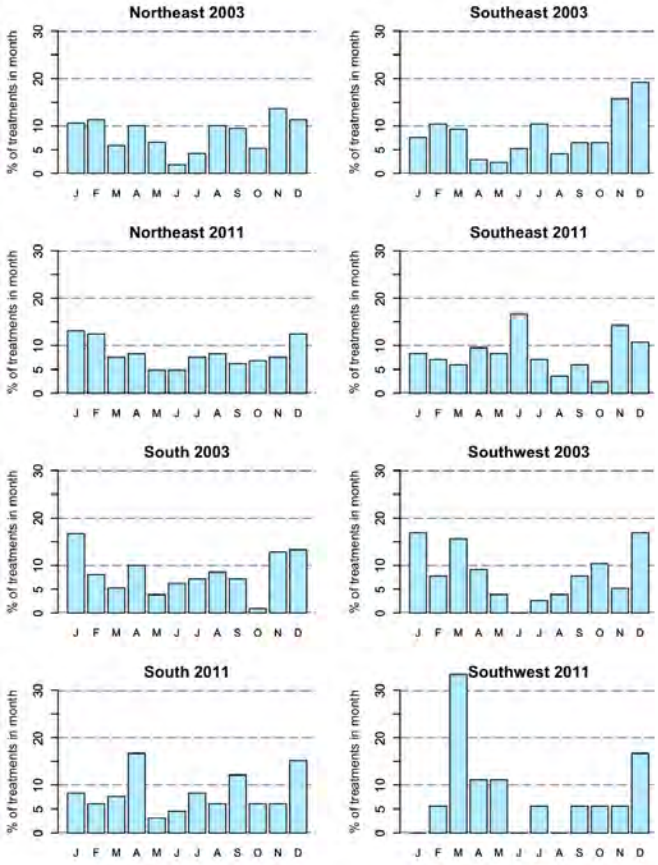


National distributions

	% respondents	
Month	2003	2011
Jan	13	10
Feb	10	9
Mar	8	8
Apr	8	12
May	4	5
Jun	4	7
Jul	7	8
Aug	7	6
Sep	8	8
Oct	5	6
Nov	13	8
Dec	15	13

$\chi 2=16.20$, df=11, p=0.1339, n=796

Regional distributions



Chi-squared tests

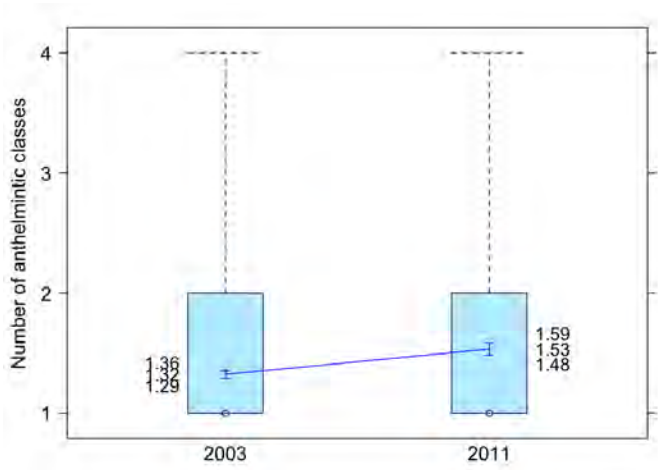
	χ^2	df	p	n
NE	*9.70*	-	*0.5655*	*314*
SE	*24.35*	-	*0.0099*	*256*
S	*22.89*	-	*0.0170*	*342*
SW	*8.64*	-	*0.5861*	*95*

Note: Chi-squared tests are used to assess the significance of the differences in proportion between 2003 and 2011, rather than marginal homogeneity tests because the treatments in each survey cannot be matched (in comparison to respondents which can be matched). Where expected frequencies were less than 5, Monte Carlo simulation was used – these instances can be identified by the lack of a figure for degrees of freedom in the table above.

3.6.1.4 Average number of classes of anthelmintic per treatment (all sheep)

By linking the number of classes of anthelmintic compounds contained within the products named by respondents, to the treatments using these products, it is possible to calculate the average number of classes of anthelmintics across all the treatments described by respondents. Each instance of worm control treatment described by the respondents was counted as a treatment, regardless of the class or classes of sheep to which the treatment was administered.

National box plots	National mean values

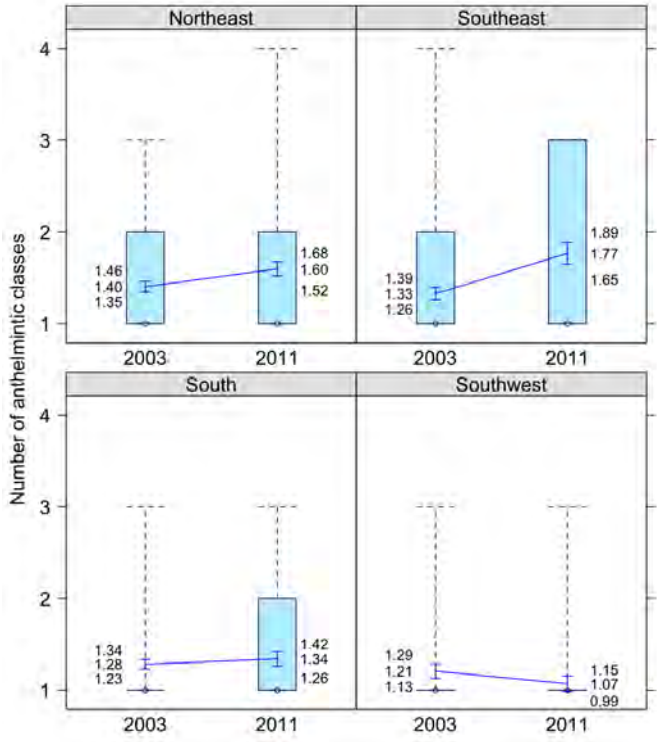


Number of classes per treatment

	2003	2011
Mean values	1.33	1.53

Wilcoxon rank sum test: W=586475, p<0.00005, n=2087

Regional box plots	Wilcoxon rank sum tests



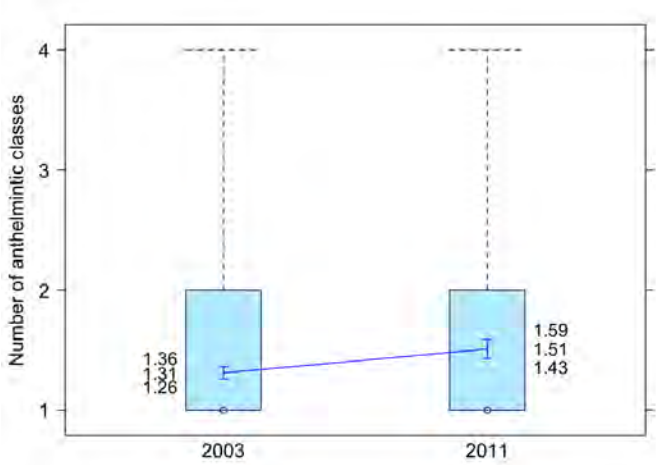
	W	*p value*	*n*
NE	*73903*	*0.0007*	*727*
SE	*44974*	*<0.00005*	*551*
S	*44538*	*0.2913*	*613*
SW	*3464*	*0.0232*	*196*

Note: Wilcoxon rank sum tests are used instead of paired t-tests, because the 2003 and 2011 per treatment data contains different numbers of treatments in each year and does not constitute true longitudinal data. Also the distributions of the number of anthelmintic classes, highly skewed, are not normally distributed. However, the data is derived from the same set of respondents in each year.

3.6.1.5 Average number of classes of anthelmintic per treatment (lambs and/or weaners)

Each instance of a worm control treatment described by the respondents that was administered to lambs and/or weaners was counted as a treatment. Such treatments may, or may not, have included other classes of sheep at the same time.

National box plots



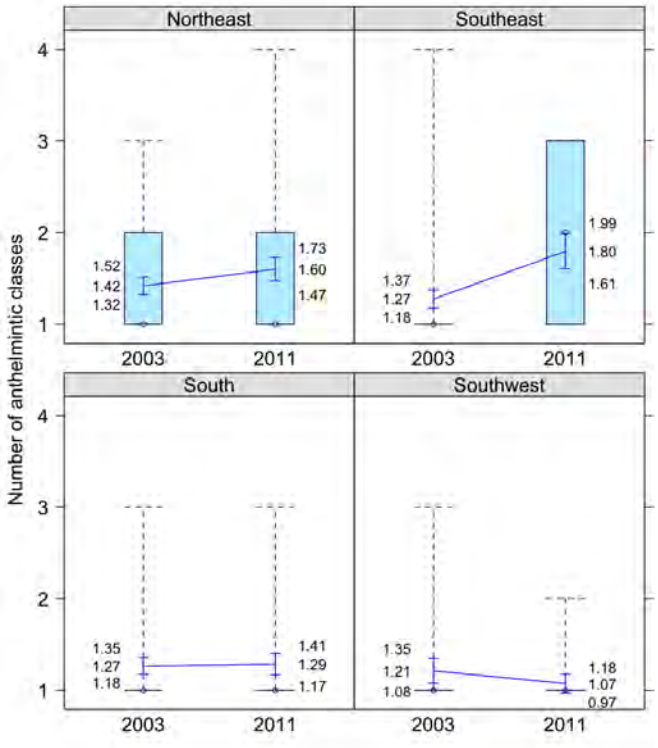
National mean values

Number of classes per treatment

	2003	2011
Mean values	1.31	1.51

Wilcoxon rank sum test: W=77282, p=0.0003, n=749

Regional box plots



Wilcoxon rank sum tests

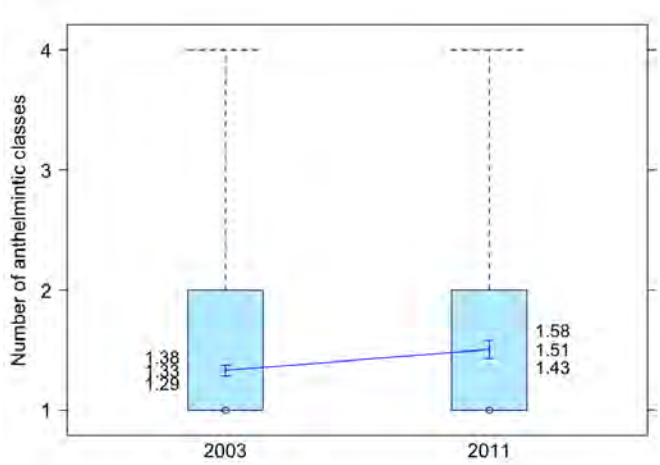
	W	*p value*	*n*
NE	*9383*	*0.0532*	*259*
SE	*5980.5*	*<0.00005*	*194*
S	*5998*	*0.9597*	*222*
SW	*559*	*0.1722*	*74*

Note: Wilcoxon rank sum tests are used instead of paired t-tests, because the 2003 and 2011 per treatment data contains different numbers of treatments in each year and does not constitute true longitudinal data. Also the distributions of the number of anthelmintic classes, highly skewed, are not normally distributed. However, the data is derived from the same set of respondents in each year.

3.6.1.6 Average number of classes of anthelmintic per treatment (maiden and/or adult ewes)

Each instance of a worm control treatment described by the respondents that was administered to maiden and/or adult was counted as a treatment. Such treatments may, or may not, have included other classes of sheep at the same time.

National box plots



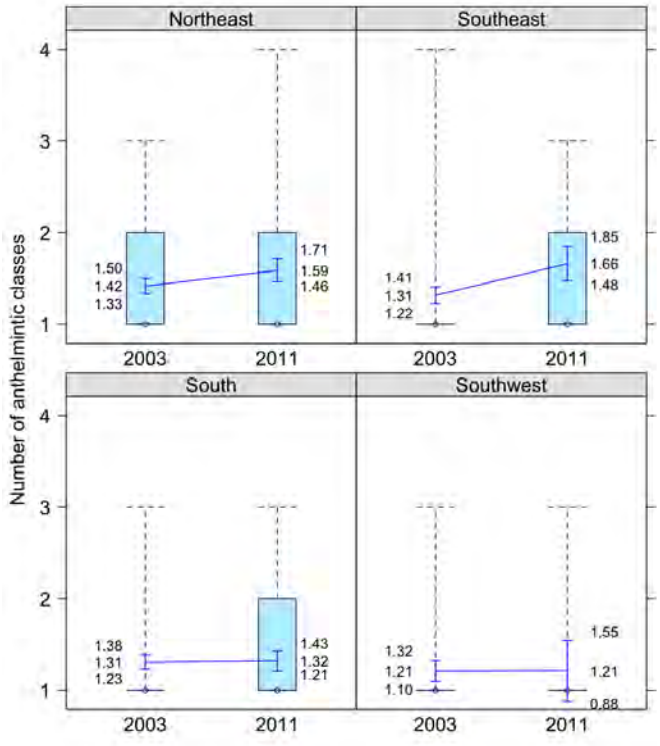
National mean values

Number of classes per treatment

	2003	2011
Mean values	1.33	1.51

Wilcoxon rank sum test: W=122653, p=0.0001, n=994

Regional box plots



Wilcoxon rank sum tests

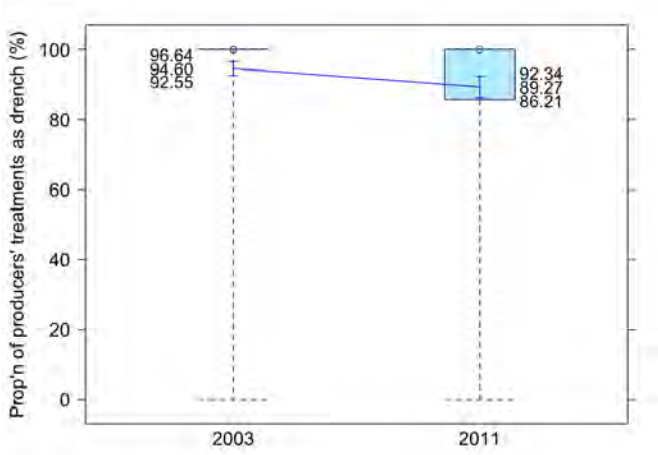
	W	*p value*	*n*
NE	*14914.5*	*0.0421*	*333*
SE	*8521.5*	*0.0005*	*258*
S	*11303.5*	*0.6928*	*318*
SW	*481.5*	*0.7884*	*85*

Note: Wilcoxon rank sum tests are used instead of paired t-tests, because the 2003 and 2011 per treatment data contains different numbers of treatments in each year and does not constitute true longitudinal data. Also the distributions of the number of anthelmintic classes, highly skewed, are not normally distributed. However, the data is derived from the same set of respondents in each year.

3.6.1.7 Use of drench, capsules and injectables (all sheep)

In the 2004 survey, respondents indicated whether each treatment involved drenching or capsules. In 2012, injectables was added to the choices of treatment types. For the treatments listed by each respondent, it is possible to calculate the proportions of treatments that were drench, capsules or injectables.

National box plots – drenches, all sheep



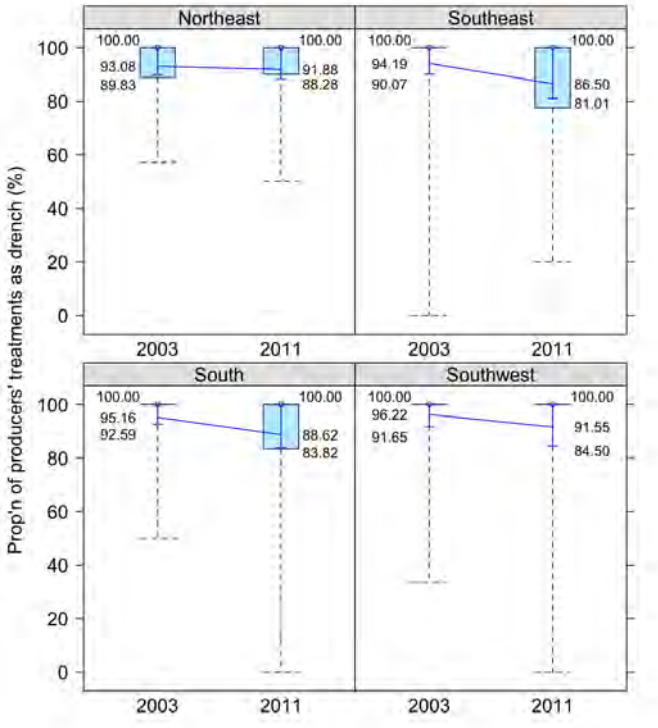
National mean values

Proportion of treatments that were drenches

	2003	2011
Mean values	94.60	89.27

Wilcoxon signed rank test: V=347, p<0.00005, n=180

Regional box plots – drenches, all sheep

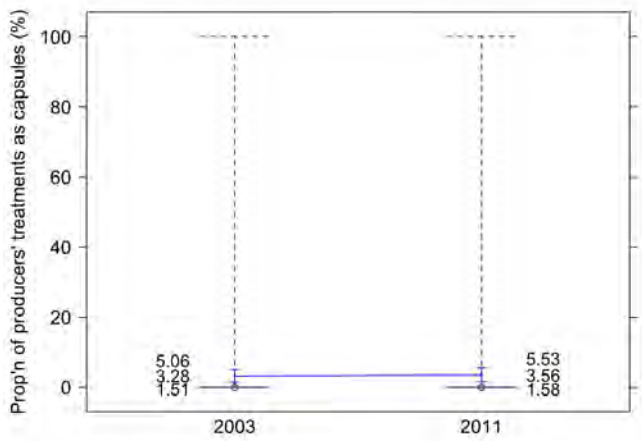


Wilcoxon signed rank tests

	V	*p value*	*n*
NE	*90.5*	*0.8846*	*41*
SE	*189.5*	*0.0105*	*48*
S	*213.0*	*0.0233*	*62*
SW	*12.0*	*0.2807*	*29*

Note: Wilcoxon signed rank tests are used instead of paired t-tests, as the distribution of proportion of treatments that were drenches is highly skewed.

National box plots – capsules, all sheep



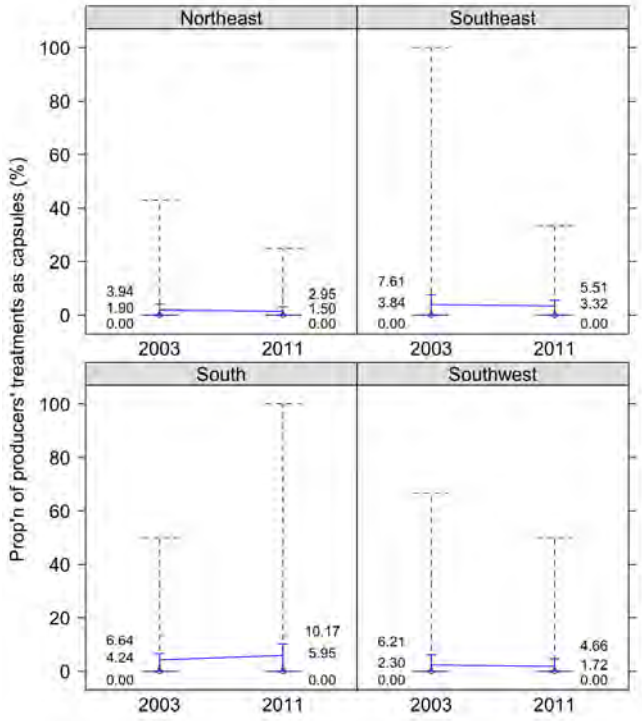
National mean values

Proportion of treatments that were capsules

	2003	2011
Mean values	3.28	3.56

Wilcoxon signed rank test: V=248, p=0.7575, n=180

Regional box plots – capsules, all sheep

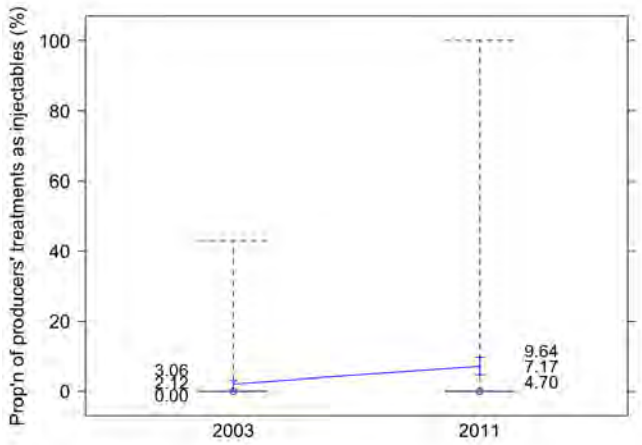


Wilcoxon signed rank tests

	V	*p value*	*n*
NE	*8.5*	*0.8923*	*41*
SE	*29.5*	*0.7887*	*48*
S	*40.0*	*0.7264*	*62*
SW*	–	–	*29*

**number of instances with different values in 2003 and 2011 too few for a valid Wilcoxon test.*
Note: Wilcoxon signed rank tests are used instead of paired t-tests, as the distribution of proportion of treatments that were capsules is highly skewed.

National box plots – injectables, all sheep



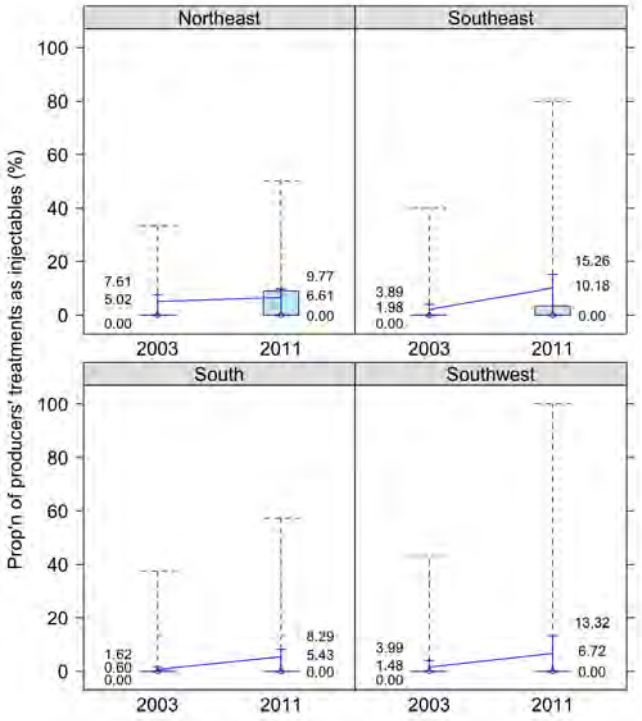
National mean values

Percentage of treatments that were injectables

	2003	2011
Mean values	2.12	7.17

Wilcoxon signed rank test: V=955, p<0.00005, n=180

Regional box plots – injectables, all sheep



Wilcoxon signed rank tests

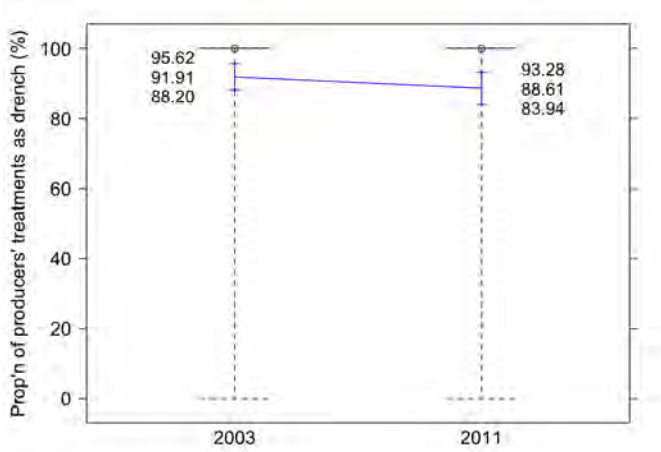
	V	*p value*	*n*
NE	*62.0*	*0.7761*	*41*
SE	*5.5.0*	*0.0057*	*48*
S	*1.0*	*0.0050*	*62*
SW*	–	–	*29*

**number of instances with different values in 2003 and 2011 too few for a valid Wilcoxon test.*
Note: Wilcoxon signed rank tests are used instead of paired t-tests, as the distribution of proportion of treatments that were injectables is highly skewed.

3.6.1.8 Use of drench, capsules and injectables (lambs and/or weaners)

In the 2004 survey, respondents indicated whether each treatment involved drenching or capsules. In 2012, injectables was added to the choices of treatment types. Respondents also indicated the class of sheep to which each treatment was administered. For the treatments listed by each respondent, it is possible to calculate the proportions of treatments for lambs and/or weaners that were drench, capsules or injectables.

National box plots – drenches, lambs and/or weaners



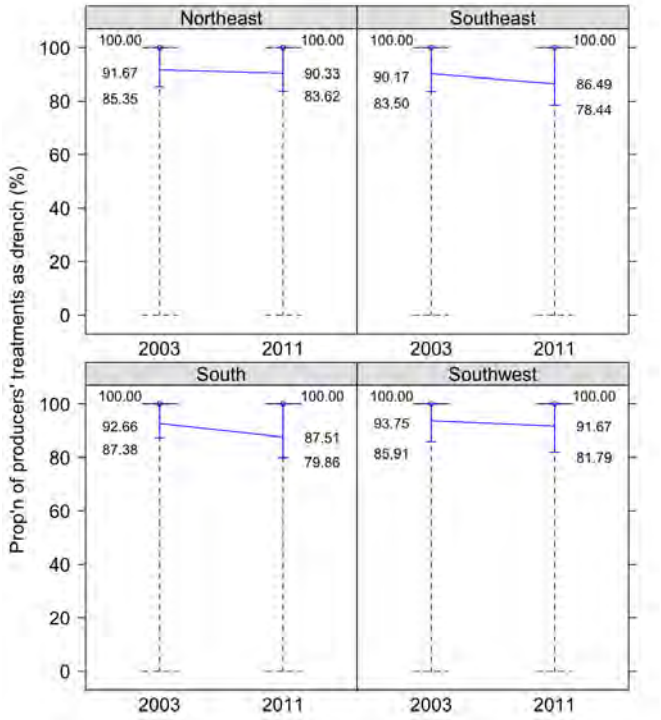
National mean values

Proportion of treatments that were drenches

	2003	2011
Mean values	91.91	88.61

Wilcoxon signed rank test: V=243.0, p=0.2397, n=137

Regional box plots – drenches, lambs and/or weaners

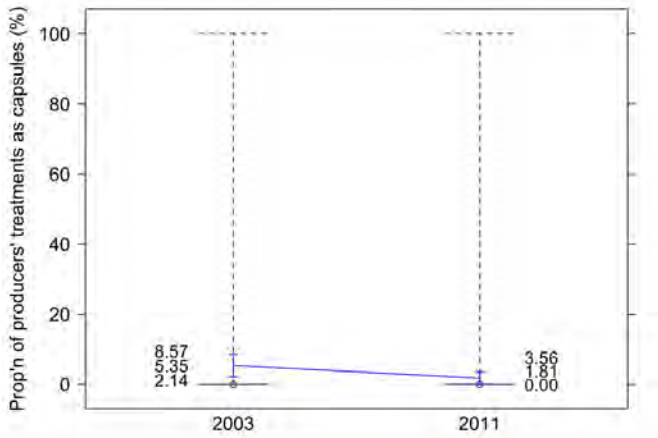


Wilcoxon signed rank tests

	V	*p value*	*n*
NE	*25.0*	*0.8119*	*32*
SE	*54.5*	*0.5500*	*39*
S	*43.0*	*0.3955*	*42*
SW*	–	–	*24*

**number of instances with different values in 2003 and 2011 too few for a valid Wilcoxon test.*
Note: Wilcoxon signed rank tests are used instead of paired t-tests, as the distribution of proportion of treatments that were drenches is highly skewed.

National box plots – capsules, lambs and/or weaners



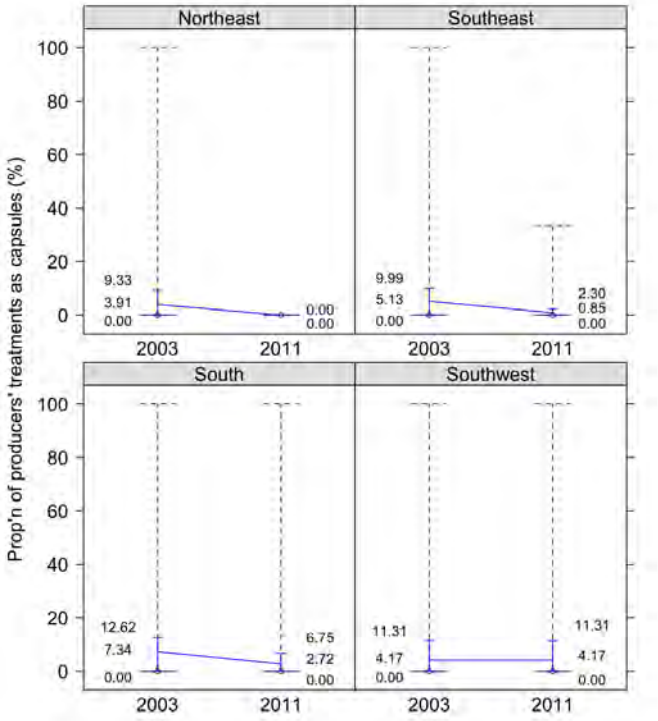
National mean values

Proportion of treatments that were capsules

	2003	2011
Mean values	5.35	1.81

Wilcoxon signed rank test: V=8.0, p=0.0287, n=137

Regional box plots – capsules, lambs and/or weaners

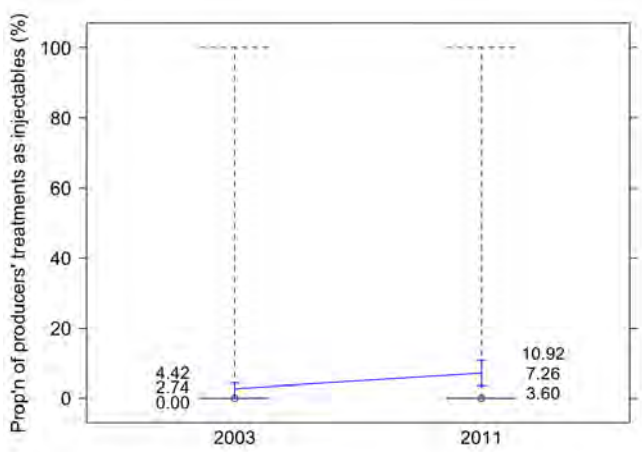


Wilcoxon signed rank tests

	V	*p value*	*n*
NE*	–	–	*32*
SE*	–	–	*39*
S	*1.06*	*0.2891*	*42*
SW*	–	–	*24*

**number of instances with different values in 2003 and 2011 too few for a valid Wilcoxon test.*
Note: Wilcoxon signed rank tests are used instead of paired t-tests, as the distribution of proportion of treatments that were capsules is highly skewed. An upper confidence limit for the Northeast region in 2011 could not be calculated as there was no use of capsules.

National box plots – injectables, lambs and/or weaners



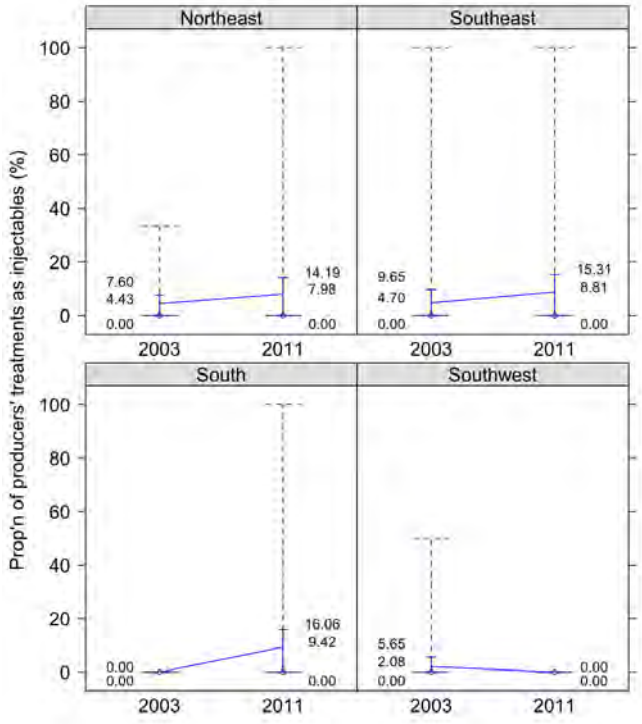
National mean values

Percentage of treatments that were injectables

	2003	2011
Mean values	2.74	9.24

Wilcoxon signed rank test: V=325, p=0.7575, n=151

Regional box plots – injectables, lambs and/or weaners



Wilcoxon signed rank tests

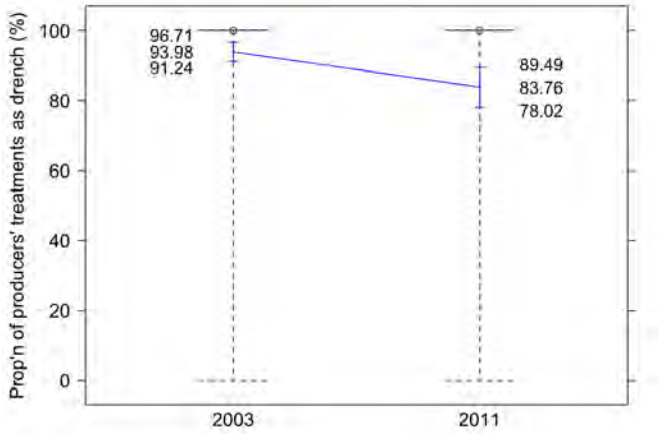
	V	*p value*	*n*
NE	*28.0*	*0.0215*	*32*
SE	*28.0*	*0.0220*	*39*
S	*28.0*	*0.0223*	*42*
SW*	–	–	*25*

**number of instances with different values in 2003 and 2011 too few for a valid Wilcoxon test.*
Note: Wilcoxon signed rank tests are used instead of paired t-tests, as the distribution of proportion of treatments that were injectables is highly skewed.

3.6.1.9 Use of drench, capsules and injectables (maiden and/or adult ewes)

In the 2004 survey, respondents indicated whether each treatment involved drenching or capsules. In 2012, injectables was added to the choices of treatment types. Respondents also indicated the class of sheep to which each treatment was administered. For the treatments listed by each respondent, it is possible to calculate the proportions of treatments for maiden and/or adult ewes that were drench, capsules or injectables.

National box plots – drenches, ewes



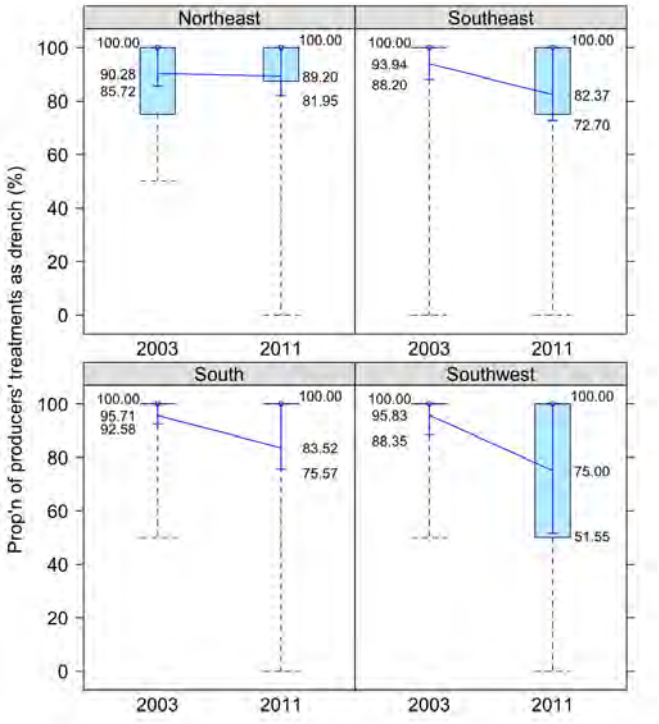
National mean values

Proportion of treatments that were drenches

	2003	2011
Mean values	93.98	83.76

Wilcoxon signed rank test: V=220.5, p=0.0023, n=127

Regional box plots – drenches, ewes

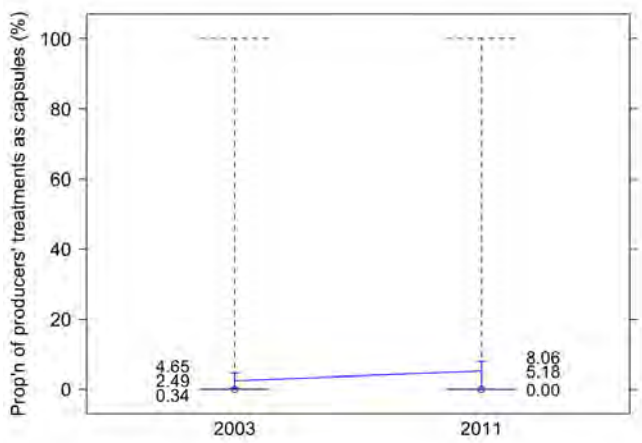


Wilcoxon signed rank tests

	V	*p value*	*n*
NE	*43.0*	*0.8881*	*30*
SE	*52.0*	*0.0980*	*33*
S	*91.5*	*0.0149*	*52*
SW*	–	–	*12*

**number of instances with different values in 2003 and 2011 too few for a valid Wilcoxon test.*
Note: Wilcoxon signed rank tests are used instead of paired t-tests, as the distribution of proportion of treatments that were drenches is highly skewed.

National box plots – capsules, ewes



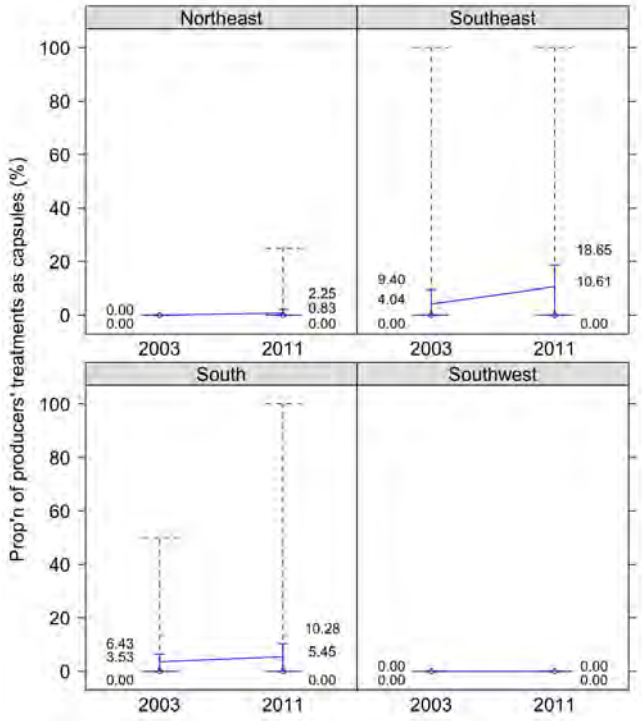
National mean values

Proportion of treatments that were capsules

	2003	2011
Mean values	2.49	5.18

Wilcoxon signed rank test: V=66.5, p=0.1477, n=127

Regional box plots – capsules, ewes

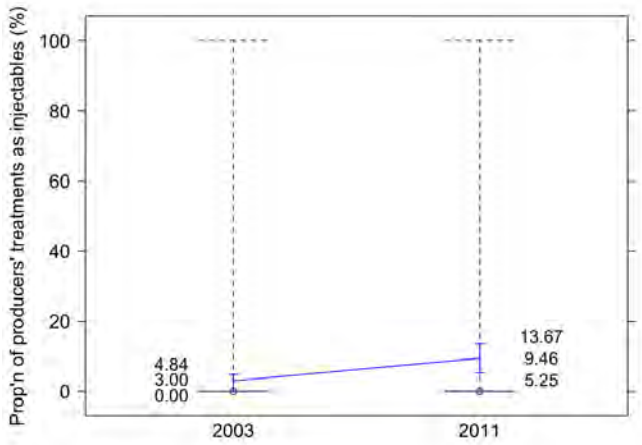


Wilcoxon signed rank tests

	V	*p value*	*n*
NE*	–	–	*30*
SE	*7.0*	*0.2650*	*33*
S	*5.0*	*0.5862*	*52*
SW*	-	-	-

**number of instances with different values in 2003 and 2011 too few for a valid Wilcoxon test.*
Note: Wilcoxon signed rank tests are used instead of paired t-tests, as the distribution of proportion of treatments that were capsules is highly skewed.

National box plots – injectables, ewes



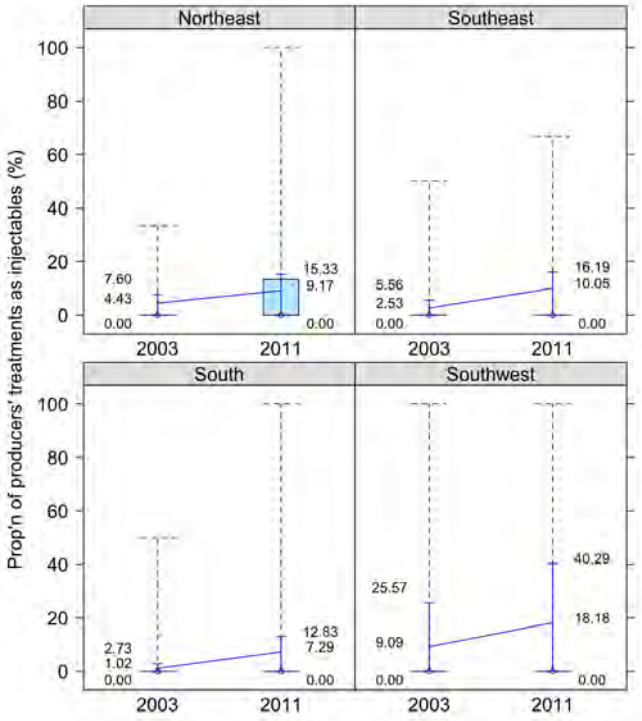
National mean values

Percentage of treatments that were injectables

	2003	2011
Mean values	3.00	9.46

Wilcoxon signed rank test: V=276.0, p<0.00005, n=125

Regional box plots – injectables, ewes



Wilcoxon signed rank tests

	V	*p value*	*n*
NE	*45.0*	*0.0090*	*32*
SE	*28.0*	*0.0220*	*33*
S*	–	–	*49*
SW*	–	–	*11*

**number of instances with different values in 2003 and 2011 too few for a valid Wilcoxon test.*
Note: Wilcoxon signed rank tests are used instead of paired t-tests, as the distribution of proportion of treatments that were capsules is highly skewed.

3.6.2 Anthelminthic product classes in use (all sheep)

Product class	Proportion of products used in 2003 (%)	Proportion of products used in 2012 (%)
BZ Albendazole	5.4	12.7
BZ Fenbendazole	0.4	3.9
BZ Oxfendazole	0.9	3.9
BZ unspecified	11.0	0.5
Closantel	5.0	4.8
Levamisole	19.4	21.4
ML - Moxidectin LA	0.0	1.7
ML Abamectin	5.2	14.0
ML Ivermectin	18.1	4.6
ML Moxidectin	21.9	17.7
ML unspecified	0.7	1.6
Monepantel	0.0	1.9
Naphthalophos	6.3	5.8
Oxyclosanide	0.4	0.0
Praziquantel	2.4	1.3
Pyraclofos	0.0	2.0
Triclabendazole	1.5	0.9
Unspecified drench	1.4	1.5

Note: for some respondents, some products may have been administered with other products.

3.6.3 Anthelminthic product classes in use (lambs and/or weaners)

Product class	Proportion of products used in 2003 (%)	Proportion of products used in 2012 (%)
BZ Albendazole	6.7	11.2
BZ Fenbendazole	0.2	4.3
BZ Oxfendazole	0.5	3.3
BZ unspecified	10.3	0.2
Closantel	3.2	4.1
Levamisole	17.7	20.7
ML - Moxidectin LA	0.0	2.1
ML Abamectin	6.4	15.9
ML Ivermectin	17.2	3.7
ML Moxidectin	22.3	19.9
ML unspecified	1.1	2.3
Monepantel	0.0	1.4
Naphthalophos	5.0	4.3
Oxyclosanide	0.2	0.0
Praziquantel	5.3	2.9
Pyraclofos	0.0	0.6
Triclabendazole	1.6	0.4
Unspecified drench	2.5	2.5

Note: for some respondents, some products may have been administered with other products. The group to which the product was administered may have included other sheep in addition to lambs and/or weaners.

3.6.4 *Anthelminthic product classes in use (maiden and/or adult ewes)*

Product class	Proportion of products used in 2003 (%)	Proportion of products used in 2012 (%)
BZ Albendazole	4.8	13.3
BZ Fenbendazole	0.3	3.3
BZ Oxfendazole	1.0	3.3
BZ unspecified	11.6	0.6
Closantel	5.5	5.6
Levamisole	20.2	20.1
ML - Moxidectin LA	0.0	1.7
ML Abamectin	4.6	15.9
ML Ivermectin	19.0	2.9
ML Moxidectin	22.2	17.4
ML unspecified	0.6	1.7
Monepantel	0.0	1.5
Naphthalophos	6.6	6.2
Oxyclosanide	0.5	0.0
Praziquantel	1.0	0.2
Pyraclofos	0.0	2.7
Triclabendazole	1.5	1.4
Unspecified drench	0.7	2.1

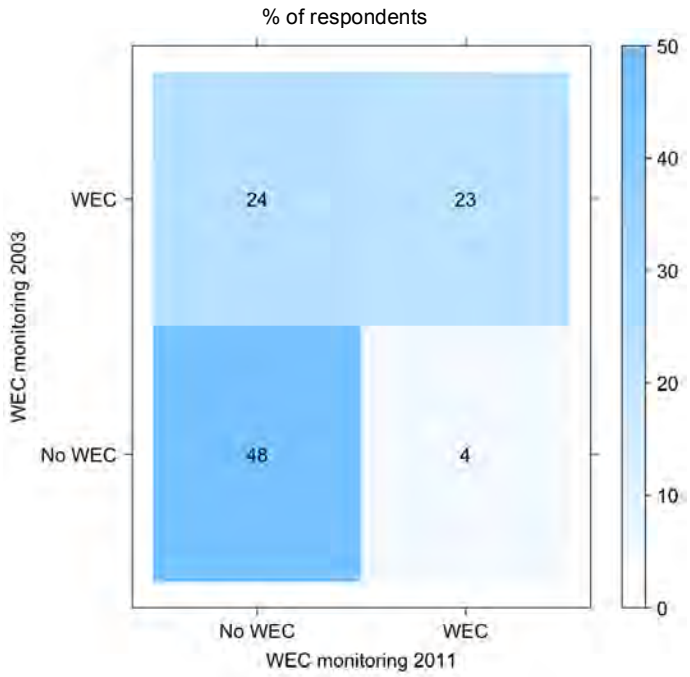
Note: for some respondents, some products may have been administered with other products. The group to which the product was administered may have included other sheep in addition to maiden and/or adult ewes.

[continued on next page]

3.6.5 *Whether or not any worm egg counts monitored for any class of sheep*

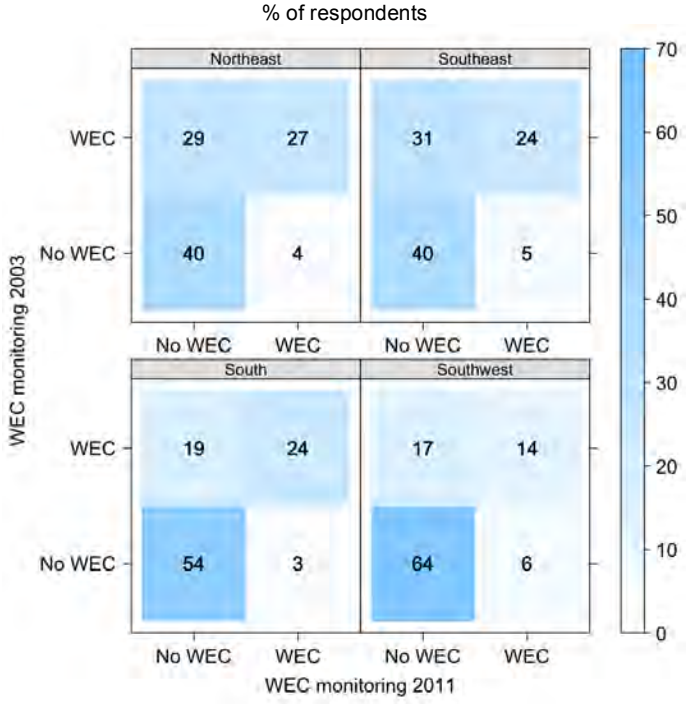
In the 2004 and 2012 surveys, respondents indicated the number of times they had monitored worm egg counts for various sheep classes in the previous year. The question was asked slightly differently in 2004 and 2012, with the latter requiring more information than the former. This may have reduced the responses to this question in 2012, giving the appearance of a fall in the amount of monitoring.

National change table	McNemar's test



$\chi^2=29.82$ *df=1,* $p<0.0005$, *n=219*

Regional change tables	Exact McNemar's tests



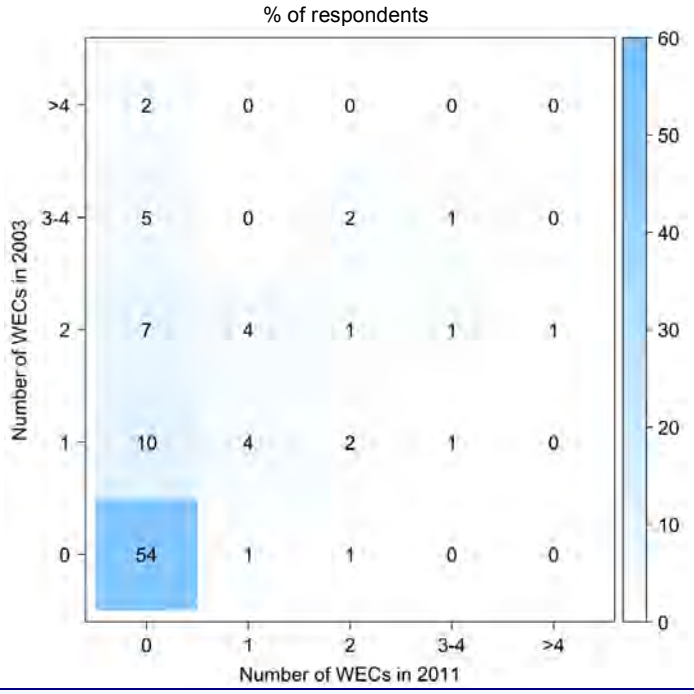
	p value	*n*
NE	*0.0013*	*55*
SE	*0.0015*	*58*
S	*0.0074*	*70*
SW	*0.2891*	*36*

3.6.6 *Number of times worm egg counts monitored*

In the 2004 survey, respondents were not asked to provide monitoring information for lambs, only for weaners. In the 2012 survey, lambs and weaners appeared as a single class in the worm egg count monitoring question. The numbers of respondents providing monitoring information for wethers was too low for reporting results. For these reasons, only the number of times worm egg counts for adult ewes is reported.

3.6.6.1 Adult ewes

National change table



National distributions

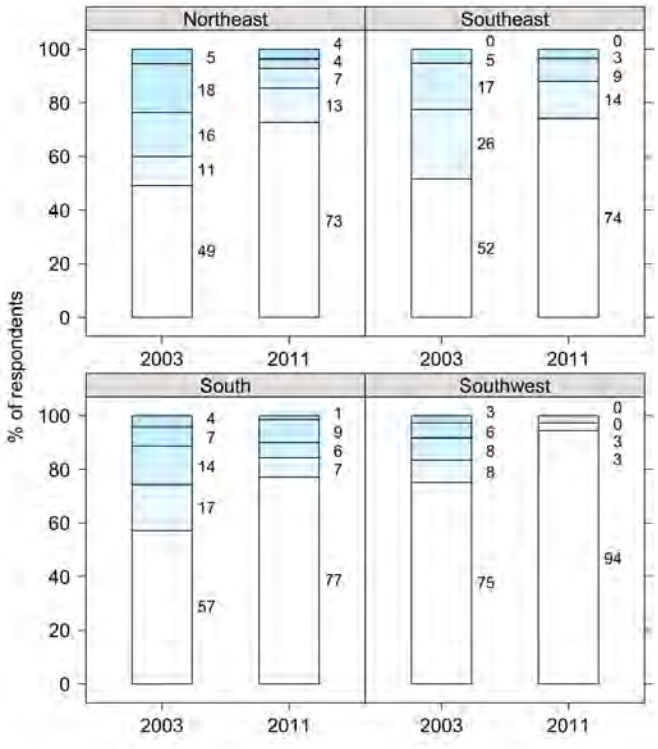
% respondents

Number of WECs in year	2004	2011
None or not answered	57	78
1	16	10
2	15	6
3–4	9	5
More than 4	3	1

Marginal homogeneity test

χ^2=38.26, p<0.00005, n=219

Regional distributions



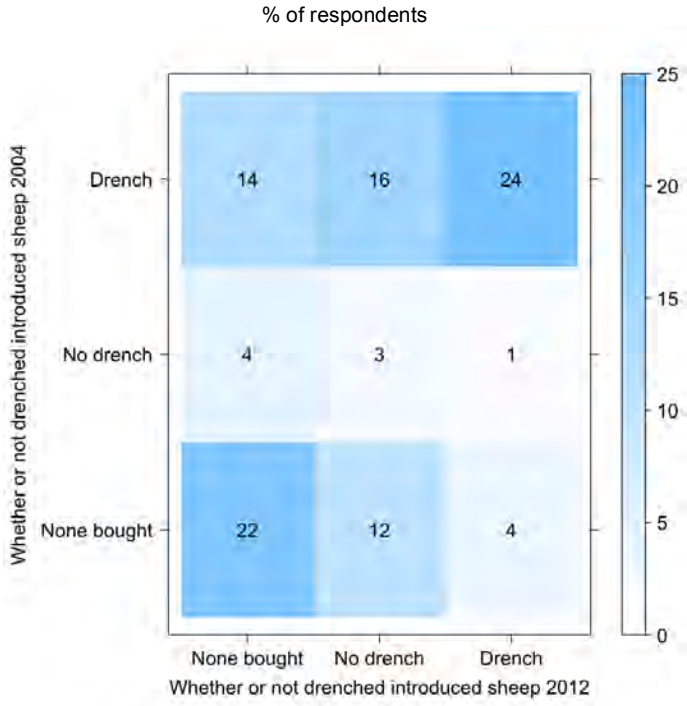
Marginal homogeneity tests

	χ^2	*p value*	*n*
Northeast	*11.97*	*0.0098*	*55*
Southeast	*10.08*	*0.0116*	*58*
South	*13.12*	*0.0035*	*70*
Southwest	*7.77*	*0.0708*	*36*

3.6.7 *Drenching of newly arrived sheep*

The 2004 survey asked whether any sheep were brought onto the property, and if so whether they were drenched and the type of drench used. The 2012 survey asked for a greater level of detail about the class and numbers of sheep brought onto the property and the quarantine treatments they received, if any. A number of 2012 respondents indicated they purchased sheep drenched by the vendor before transport. Since this information was not collected in the 2004 survey, a decrease in the proportion of respondents drenching newly arrived sheep could reflect an increase in vendor drenching.

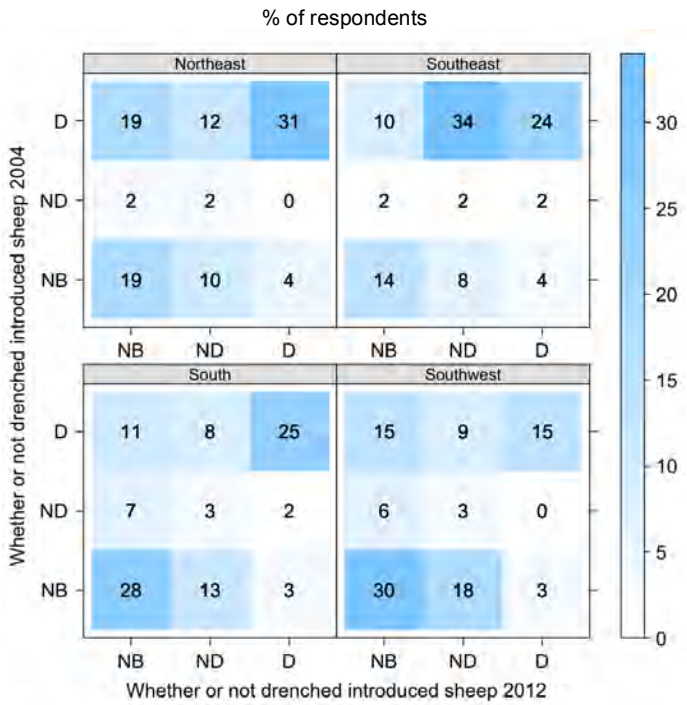
National change table	National distributions



Among those buying sheep:
Proportion drenching 2004 = 87.4%
Proportion drenching 2012 = 48.7%

Marginal homogeneity test
$\chi^2=43.33$, $p<0.00005$, $n=192$

Regional change tables	Marginal homogeneity tests



	% drench 2004	*% drench 2012*	*p*	*n*
NE	*94*	*59*	*0.0008*	*48*
SE	*92*	*41*	*<0.00005*	*50*
S	*79*	*55*	*0.0286*	*61*
SW	*81*	*38*	*0.0180*	*33*

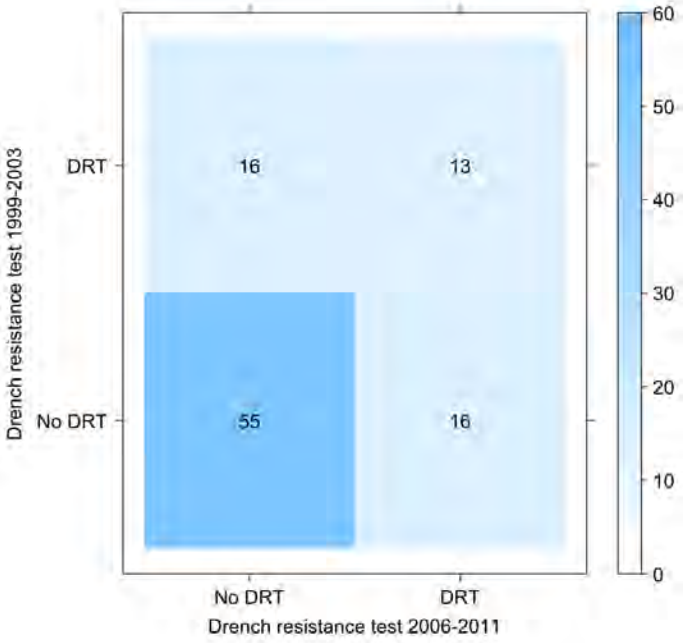
NB = Not bought
ND = No drench
D = Drench

3.6.8 *Drench resistance testing in six years previous to survey*

The 2004 survey asked whether any drench resistance test had been done in the past, and if so, in what year. The 2012 survey asked, for four types of test, in which the years 2006 to 2011 had tests been conducted. From this information, it was possible to determine whether any test had been done in the six years previous to the surveys in 2004 and 2012.

National change table	McNemar's test

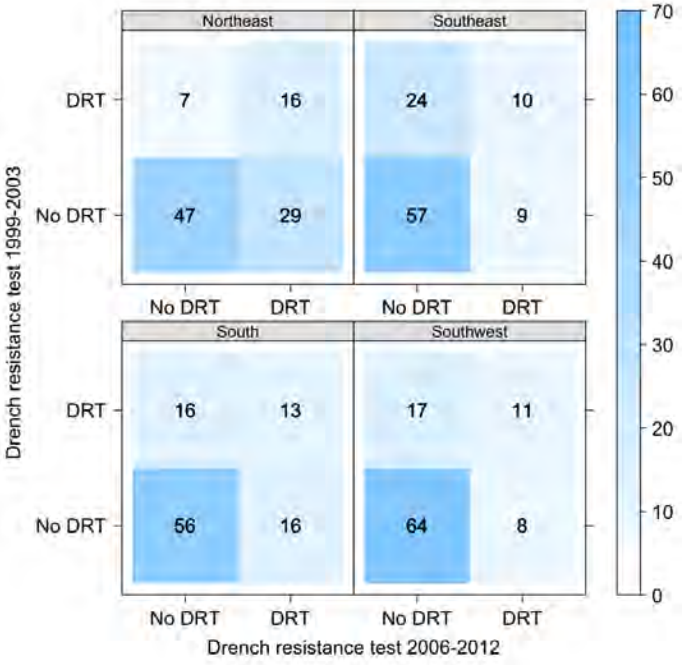
% of respondents



$\chi 2=0, df=1, p=1.0000, n=219$

Regional change tables	Exact McNemar's tests

% of respondents



	p value	*n*
NE	*0.0118*	*55*
SE	*0.0636*	*58*
S	*1.0000*	*70*
SW	*0.5078*	*36*

It should be noted that a much higher proportion for respondents who carried out drench resistance tests in the years previous to the 2004 survey was reported in 2005 (Section 3.7.4 of Reeve, I. and Thompson, L.J. 2005. 2004 Benchmark Survey. Report to Australian Wool Innovation Ltd. Institute for Rural Futures, University of New England, Armidale). This proportion of 48 per cent nationally included all drench resistant tests carried out by respondents, regardless of how long ago this had been done. The proportion in the level plot above of 29 per cent nationally for 2004 includes only those drench resistance tests carried out in the previous six years, to ensure comparability with the 2012 survey which only asked for information about tests in the previous six years.

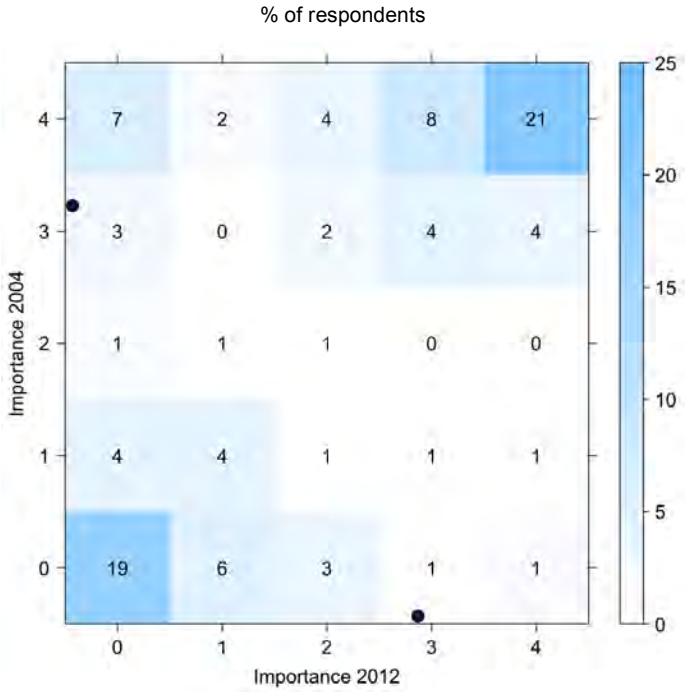
3.6.9 Factors important in deciding when to drench ewes

Respondents were asked to rate the importance, in deciding when to drench ewes, of each item in a list of factors.

3.6.9.1 Factor, ewes: Results from faecal worm egg count

[continued on next page]

National change table



National distributions

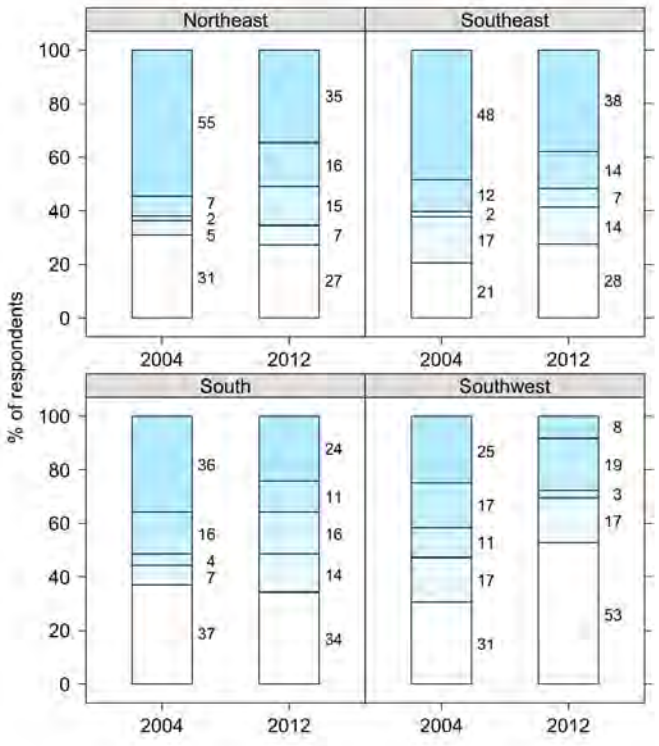
% respondents

Importance	2004	2012
4–very important	42	28
3–important	13	15
2–somewhat important	4	11
1–not important	11	13
0–item not answered	30	34

Marginal homogeneity test

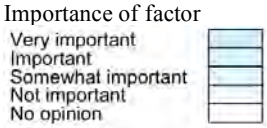
χ^2=21.47, p=0.0001, n=219

Regional distributions



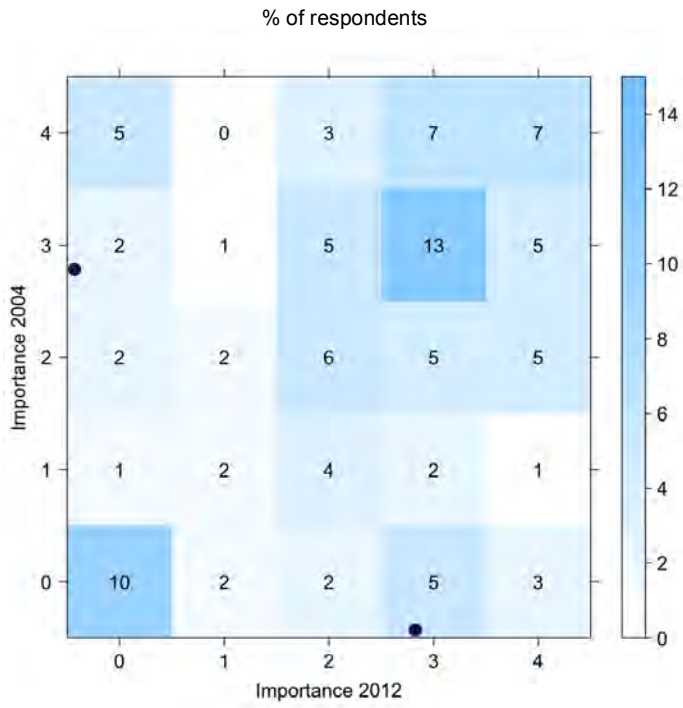
Marginal homogeneity tests

	χ^2	*p value*	*n*
Northeast	*12.91*	*0.0039*	*55*
Southeast	*4.82*	*0.3179*	*58*
South	*12.29*	*0.0110*	*70*
Southwest	*7.56*	*0.0952*	*36*



3.6.9.2 Factor, ewes: Condition score of sheep

National change table



National distributions

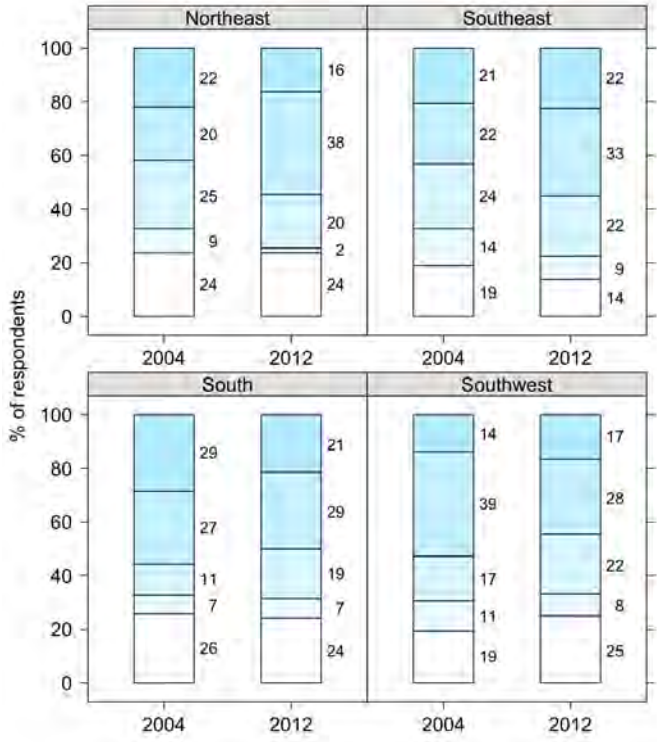
% respondents

Importance	2004	2011
4–very important	22	20
3–important	26	32
2–somewhat important	19	21
1–not important	10	6
0–item not answered	22	21

Marginal homogeneity test

χ^2=4.31, p=0.3711, n=219

Regional distributions

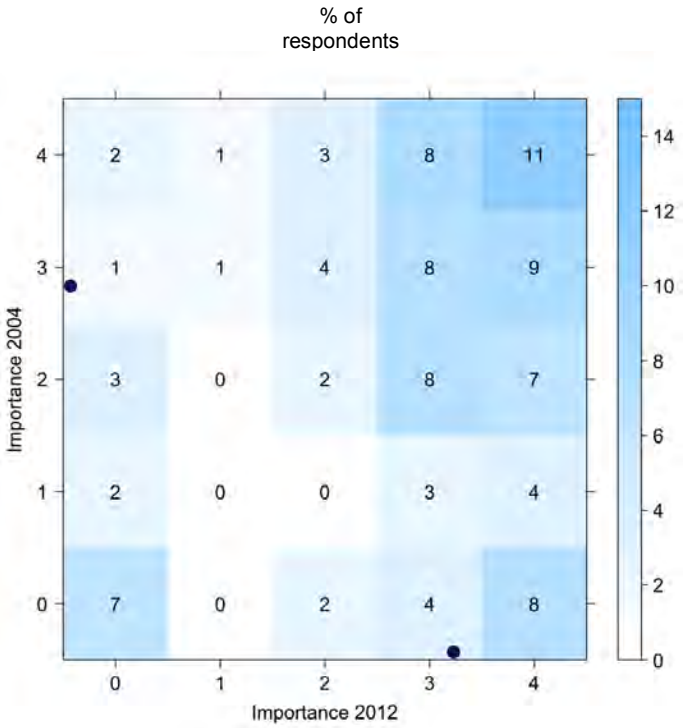


Marginal homogeneity tests

	χ^2	*p value*	*n*
Northeast	*8.18*	*0.0742*	*55*
Southeast	*3.26*	*0.5165*	*58*
South	*2.84*	*0.6027*	*70*
Southwest	*1.77*	*0.8130*	*36*

3.6.9.3 Factor, ewes: Time of year

National change table

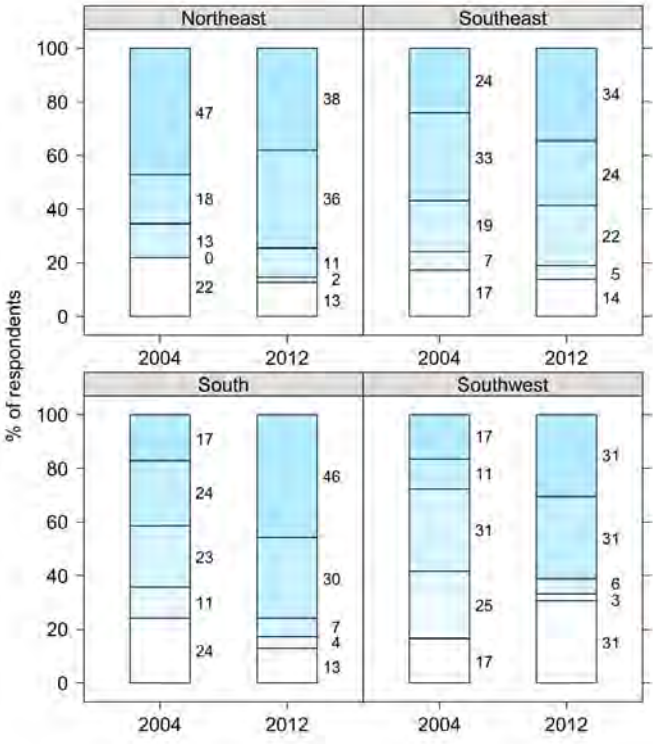


National distributions

	% respondents	
Importance	2004	2011
4–very important	22	20
3–important	26	32
2–somewhat important	19	21
1–not important	10	6
0–item not answered	22	21

Marginal homogeneity test
$\chi 2=4.31$, $p=0.3711$, $n=219$

Regional distributions

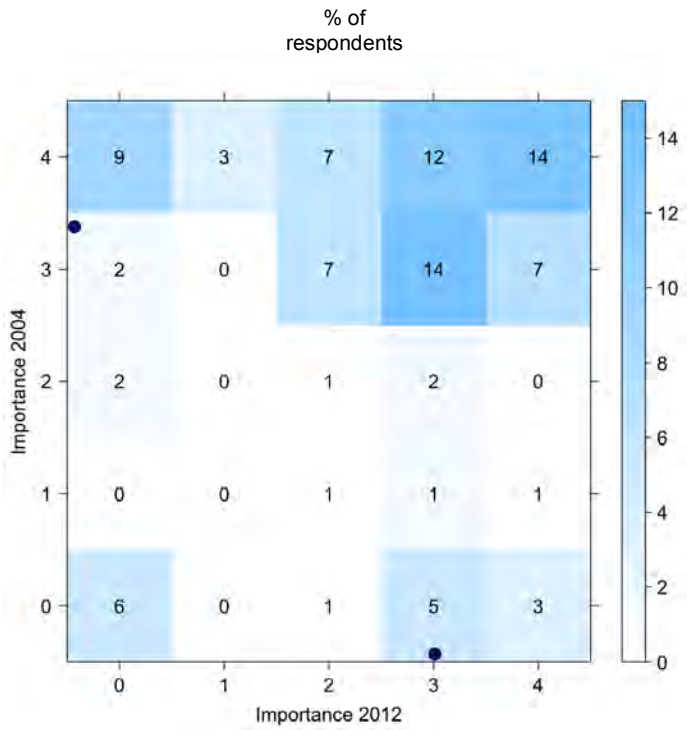


Marginal homogeneity tests

	$\chi 2$	*p value*	*n*
Northeast	*8.18*	*0.0742*	*55*
Southeast	*3.26*	*0.5165*	*58*
South	*2.84*	*0.6027*	*70*
Southwest	*1.77*	*0.8130*	*36*

3.6.9.4 Factor, ewes: seasonal weather conditions

National change table



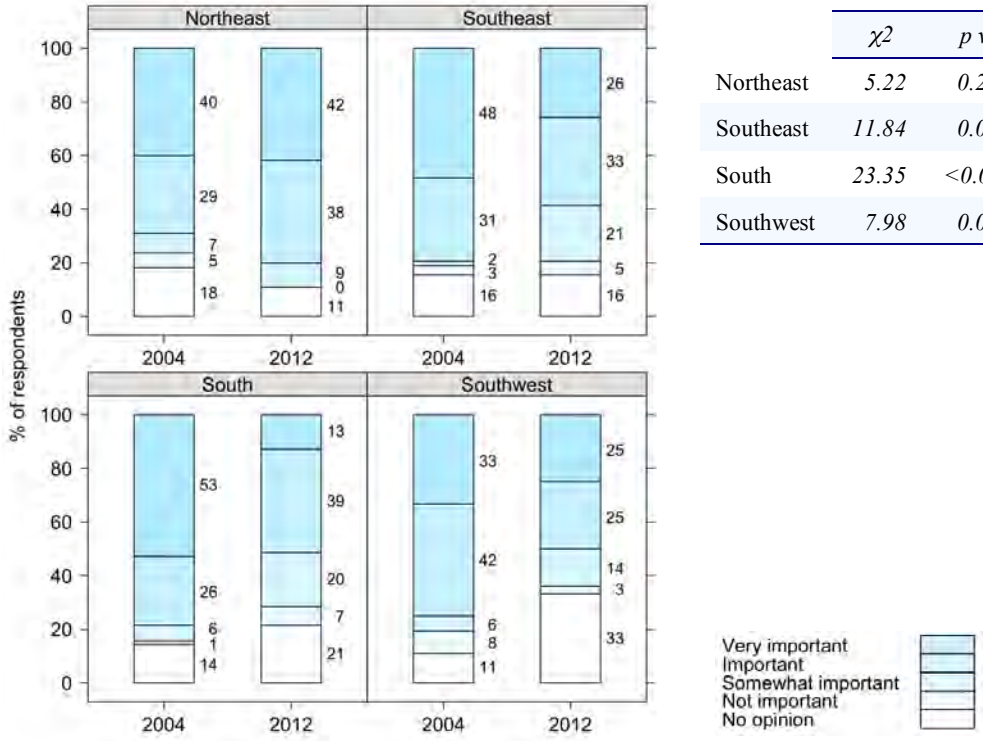
National distributions

	% respondents	
Importance	2004	2011
4–very important	45	26
3–important	31	35
2–somewhat important	5	16
1–not important	4	4
0–item not answered	15	19

Marginal homogeneity test

χ^2=27.73, p<0.00005, n=219

Regional distributions

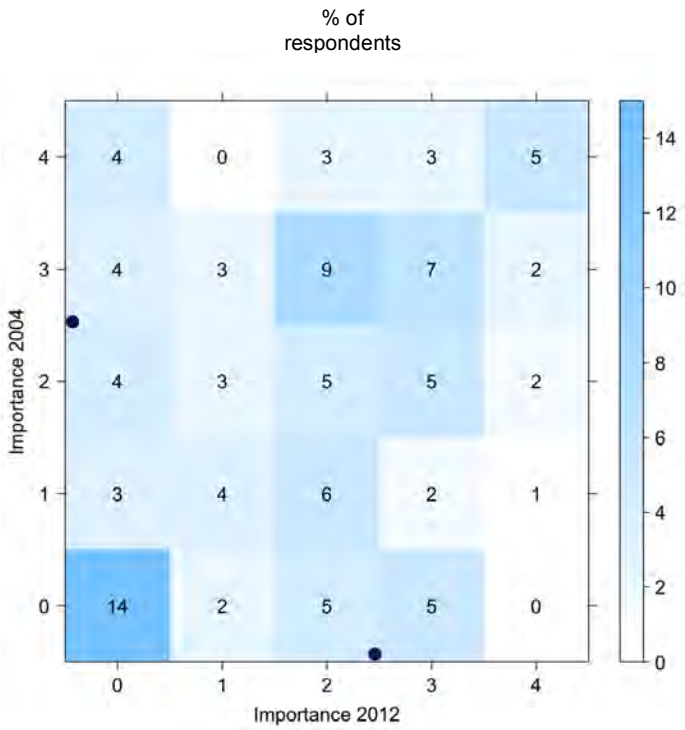


Marginal homogeneity tests

	χ^2	*p value*	*n*
Northeast	*5.22*	*0.2764*	*55*
Southeast	*11.84*	*0.0125*	*58*
South	*23.35*	*<0.00005*	*70*
Southwest	*7.98*	*0.0752*	*36*

3.6.9.5 Factor, ewes: availability of pasture

National change table

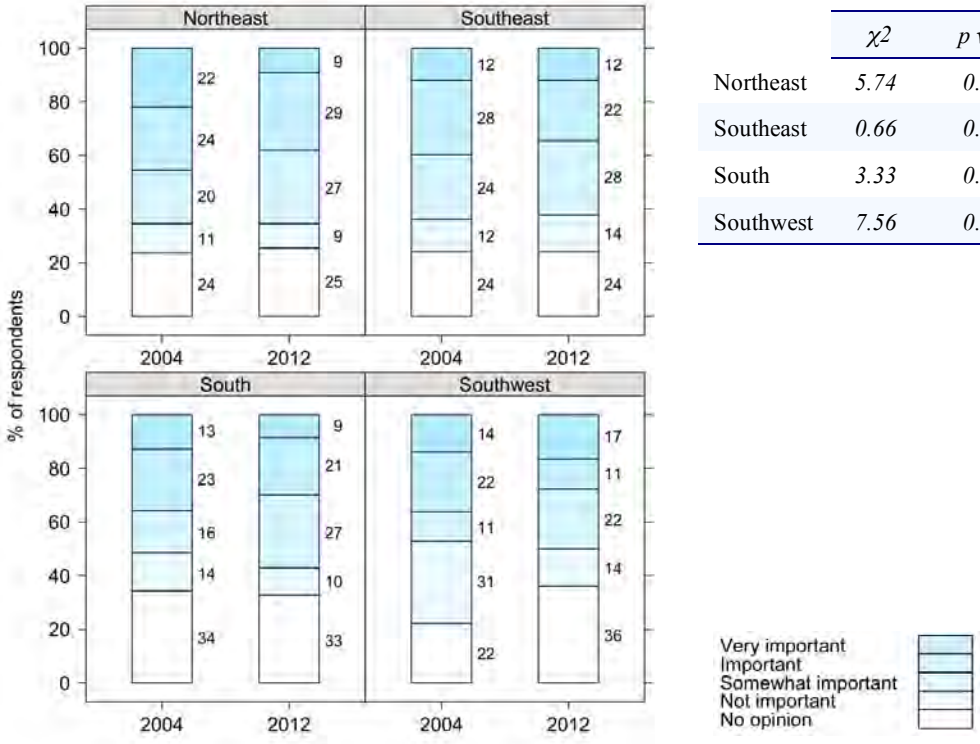


National distributions

	% respondents	
Importance	2004	2011
4–very important	15	11
3–important	24	22
2–somewhat important	18	26
1–not important	16	11
0–item not answered	27	29

Marginal homogeneity test
$\chi 2=6.77$, $p=0.1469$, $n=219$

Regional distributions

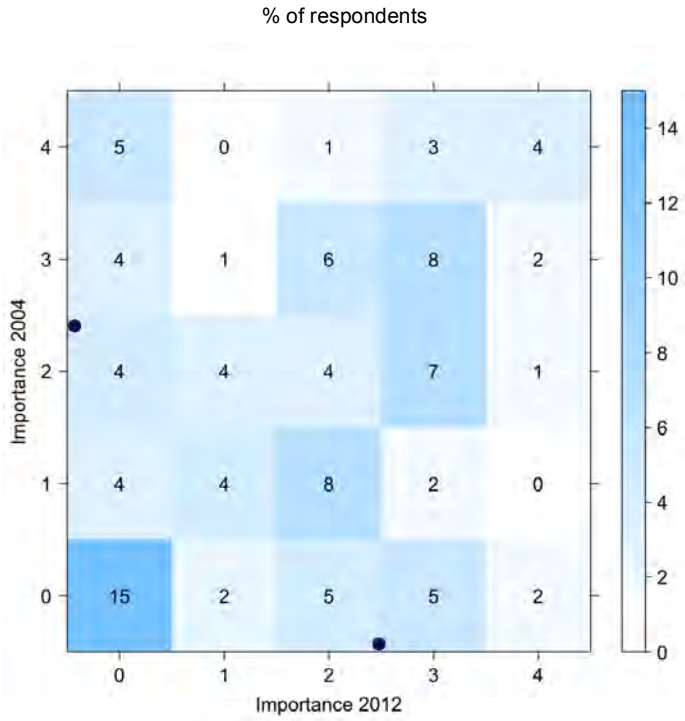


Marginal homogeneity tests

	$\chi 2$	*p value*	*n*
Northeast	*5.74*	*0.2228*	*55*
Southeast	*0.66*	*0.9679*	*58*
South	*3.33*	*0.5157*	*70*
Southwest	*7.56*	*0.0978*	*36*

3.6.9.6 Factor, ewes: quality of pasture

National change table



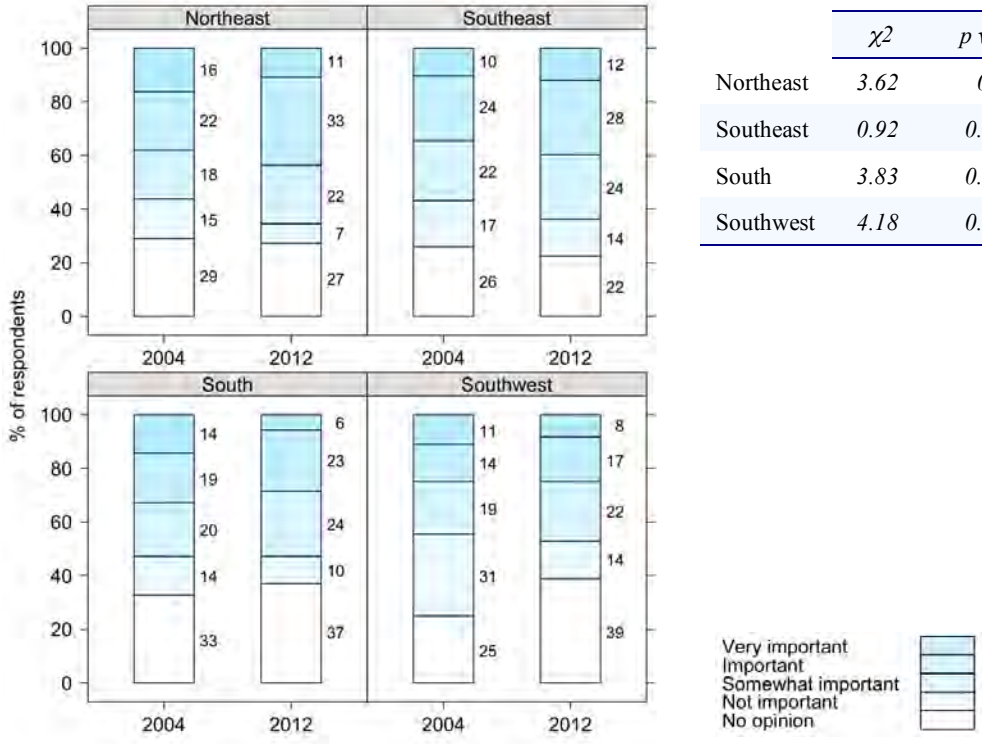
National distributions

% respondents

Importance	2004	2011
4–very important	13	9
3–important	20	26
2–somewhat important	20	23
1–not important	18	11
0–item not answered	29	31

Marginal homogeneity test
χ^2=8.41, p=0.0764, n=219

Regional distributions



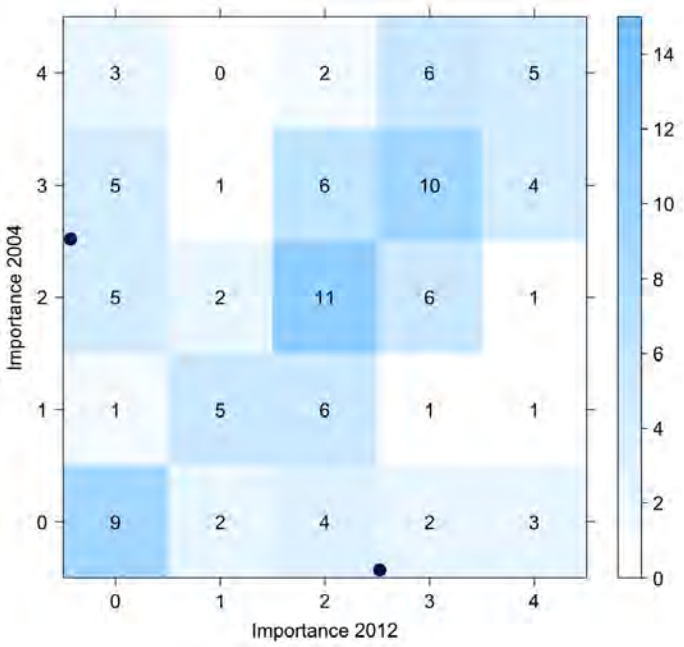
Marginal homogeneity tests

	χ^2	*p value*	*n*
Northeast	*3.62*	*0.472*	*55*
Southeast	*0.92*	*0.9253*	*58*
South	*3.83*	*0.4401*	*70*
Southwest	*4.18*	*0.4135*	*36*

3.6.9.7 Factor, ewes: presence of daggy sheep in mob

National change table	National distributions

% of respondents

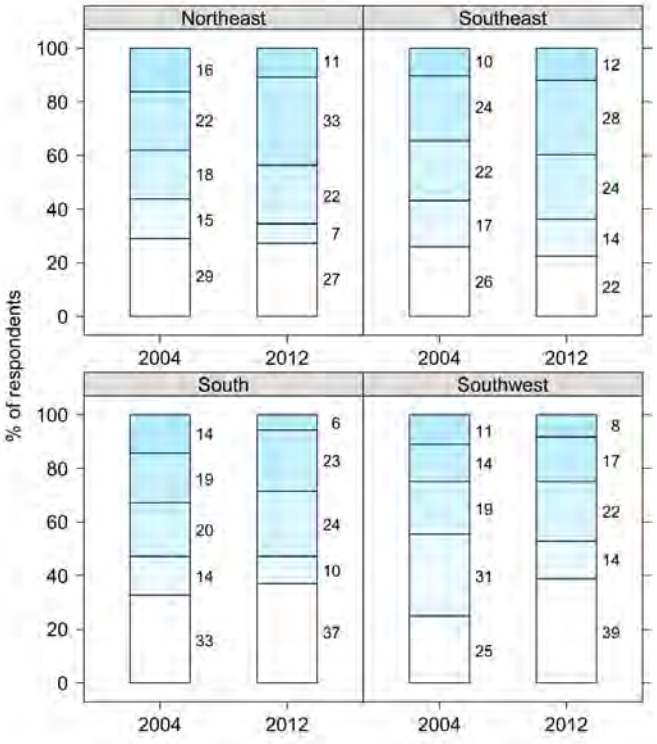


% respondents

Importance	2004	2011
4–very important	15	13
3–important	26	25
2–somewhat important	25	29
1–not important	14	11
0–item not answered	20	22

Marginal homogeneity test
$\chi 2=3.01$, $p=0.5625$, $n=219$

Regional distributions	Marginal homogeneity tests



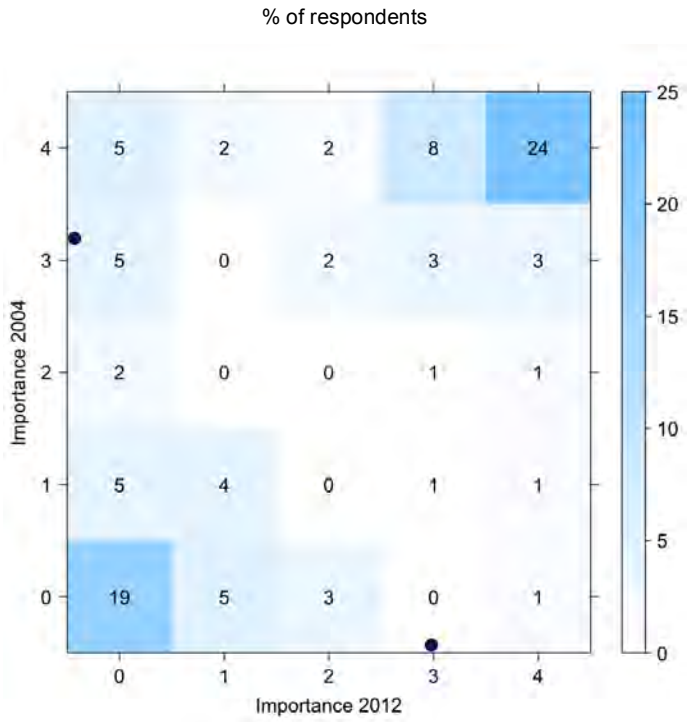
	$\chi 2$	*p value*	*n*
Northeast	*1.23*	*0.8933*	*55*
Southeast	*0.98*	*0.9306*	*58*
South	*7.2*	*0.1208*	*70*
Southwest	*6.17*	*0.1816*	*36*

3.6.10 *Factors important in deciding when to drench weaners*

Respondents were asked to rate the importance, in deciding when to drench weaners, of each item in a list of factors, the same factors as for the similar question for ewes.

3.6.10.1 Factor, weaners: Results from faecal worm egg count

National change table



National distributions

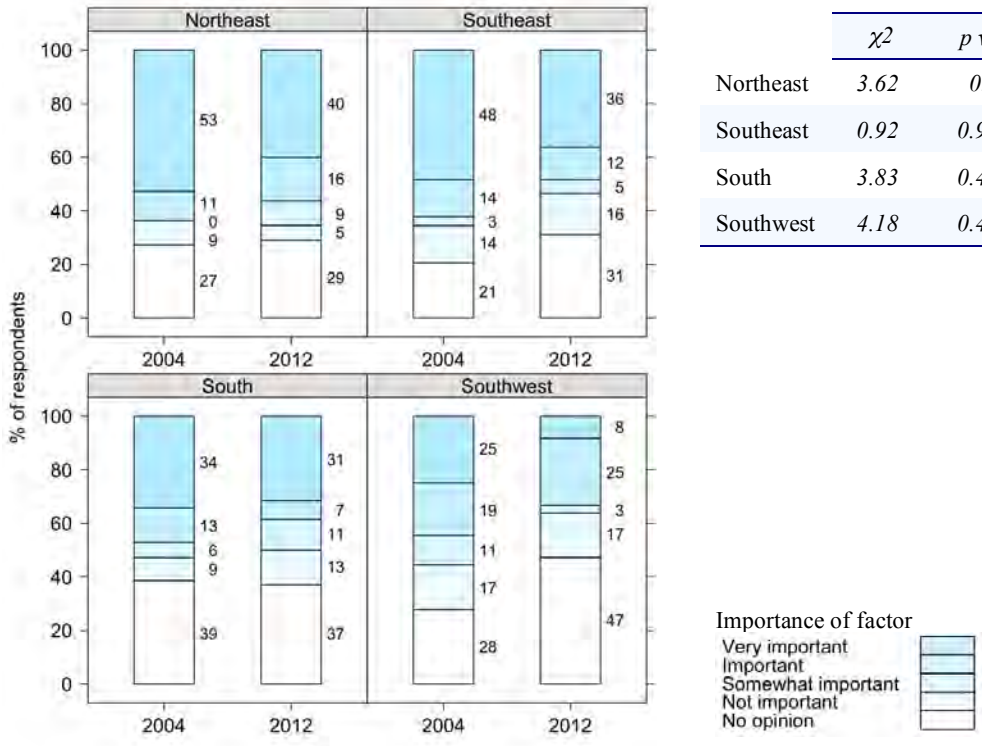
% respondents

Importance	2004	2012
4–very important	*41*	*31*
3–important	*14*	*14*
2–somewhat important	*5*	*8*
1–not important	*11*	*12*
0–item not answered	*29*	*35*

Marginal homogeneity test

χ^2=12.33, p=0.0133, n=219

Regional distributions

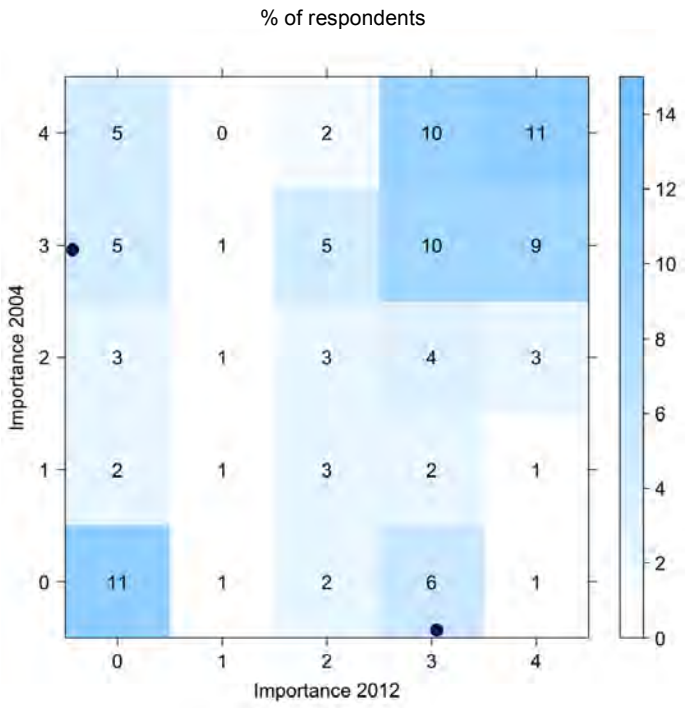


Marginal homogeneity tests

	χ^2	*p value*	*n*
Northeast	*3.62*	*0.472*	*55*
Southeast	*0.92*	*0.9253*	*58*
South	*3.83*	*0.4401*	*70*
Southwest	*4.18*	*0.4135*	*36*

3.6.10.2 Factor, weaners: Condition score of sheep

National change table



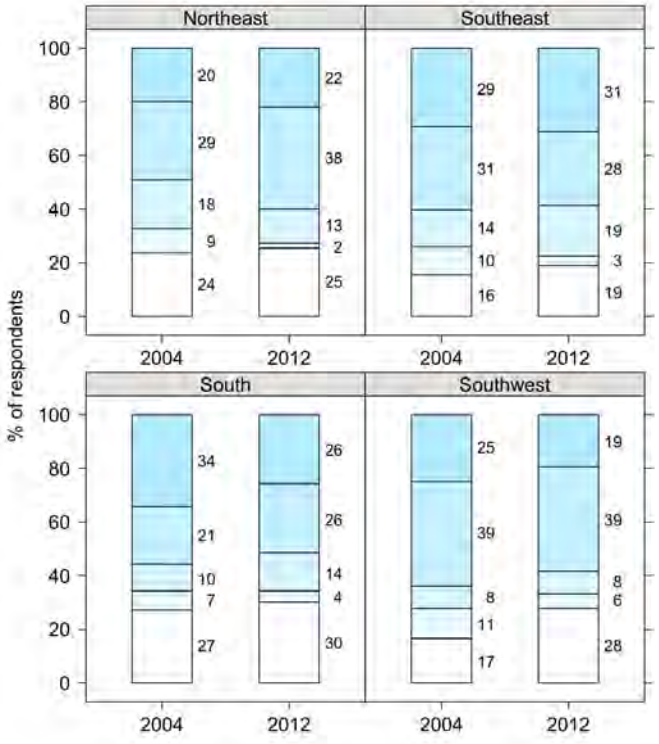
National distributions

% respondents

Importance	2004	2011
4–very important	*28*	*25*
3–important	*29*	*32*
2–somewhat important	*13*	*14*
1–not important	*9*	*4*
0–item not answered	*21*	*26*

Marginal homogeneity test
$\chi 2=7.12$, $p=0.1308$, $n=219$

Regional distributions

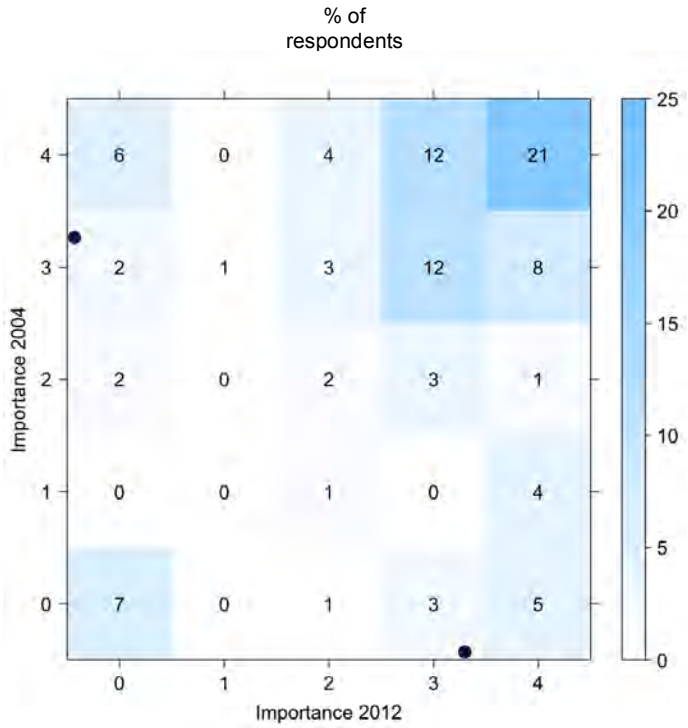


Marginal homogeneity tests

	$\chi 2$	*p value*	*n*
Northeast	*5.38*	*0.265*	*55*
Southeast	*2.41*	*0.6761*	*58*
South	*2.77*	*0.6121*	*70*
Southwest	*2.72*	*0.6488*	*36*

3.6.10.3 Factor, weaners: Time of year

National change table

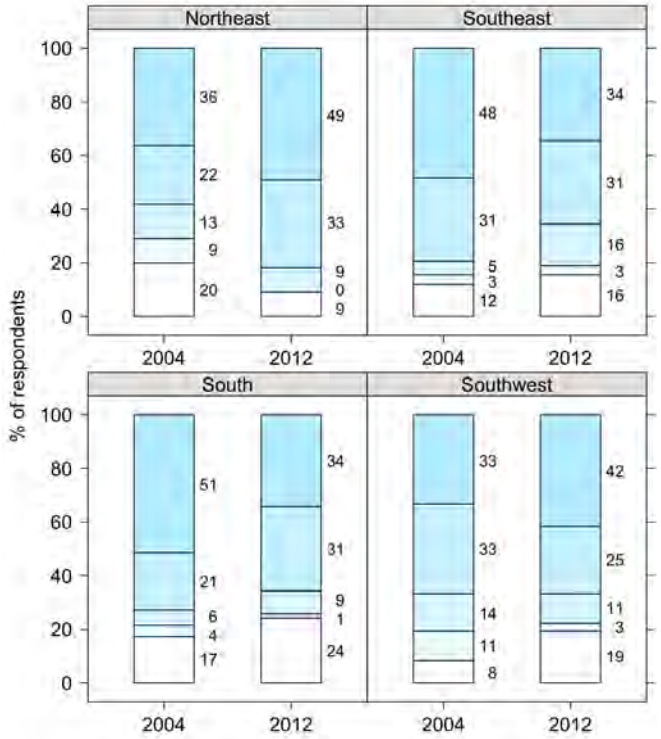


National distributions

	% respondents	
Importance	2004	2011
4–very important	*44*	*39*
3–important	*26*	*31*
2–somewhat important	*9*	*11*
1–not important	*6*	*2*
0–item not answered	*15*	*17*

Marginal homogeneity test
χ^2=8.49, p=0.074, n=219

Regional distributions

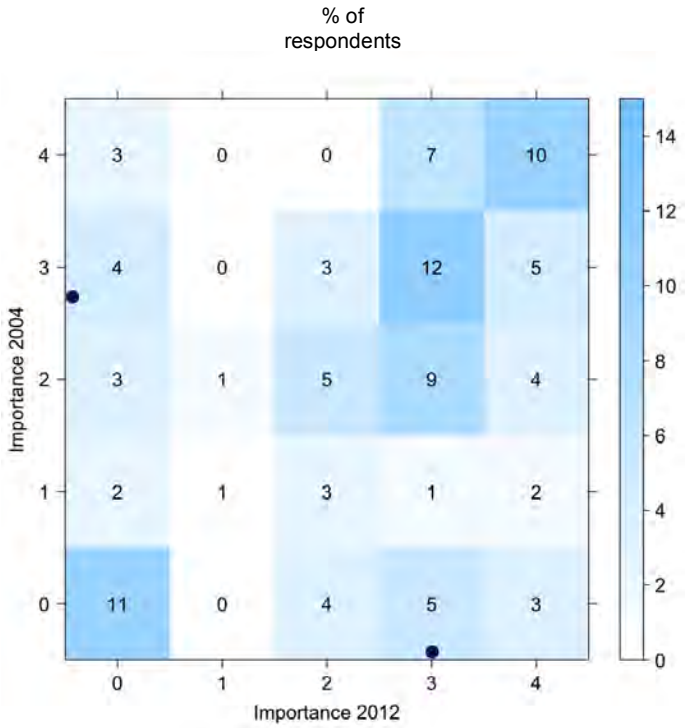


Marginal homogeneity tests

	χ^2	*p value*	*n*
Northeast	*5.38*	*0.265*	*55*
Southeast	*2.41*	*0.6761*	*58*
South	*2.77*	*0.6121*	*70*
Southwest	*2.72*	*0.6488*	*36*

3.6.10.4 Factor, weaners: seasonal weather conditions

National change table

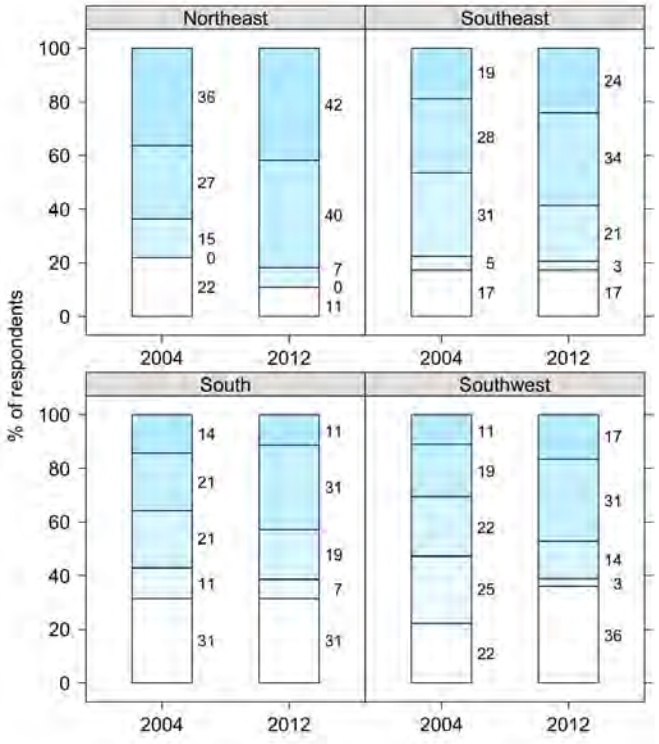


National distributions

	% respondents	
Importance	2004	2011
4–very important	*21*	*23*
3–important	*24*	*34*
2–somewhat important	*22*	*16*
1–not important	*9*	*4*
0–item not answered	*24*	*23*

Marginal homogeneity test
$\chi 2=15.31$, $p=0.0036$, $n=219$

Regional distributions

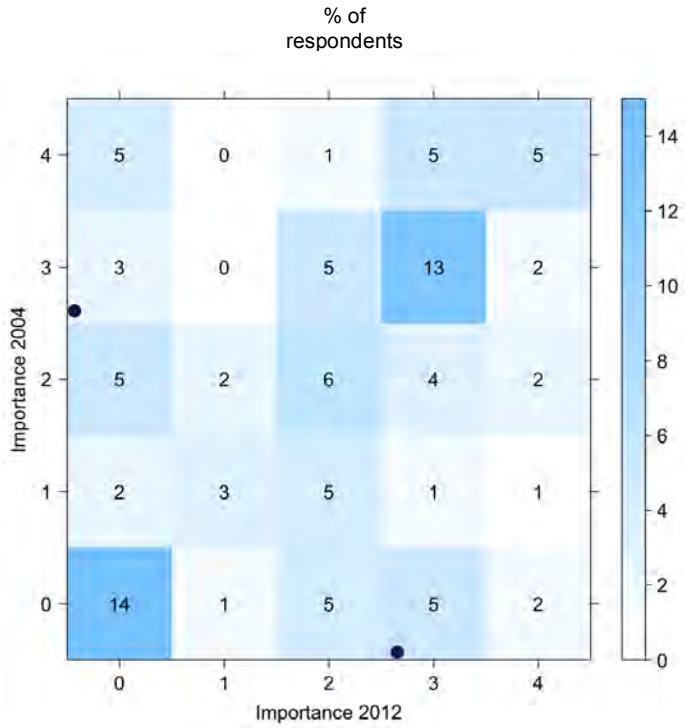


Marginal homogeneity tests

	$\chi 2$	*p value*	*n*
Northeast	*5.74*	*0.1253*	*55*
Southeast	*2.52*	*0.6646*	*58*
South	*2.77*	*0.6041*	*70*
Southwest	*11.91*	*0.0062*	*36*

3.6.10.5 Factor, weaners: availability of pasture

National change table

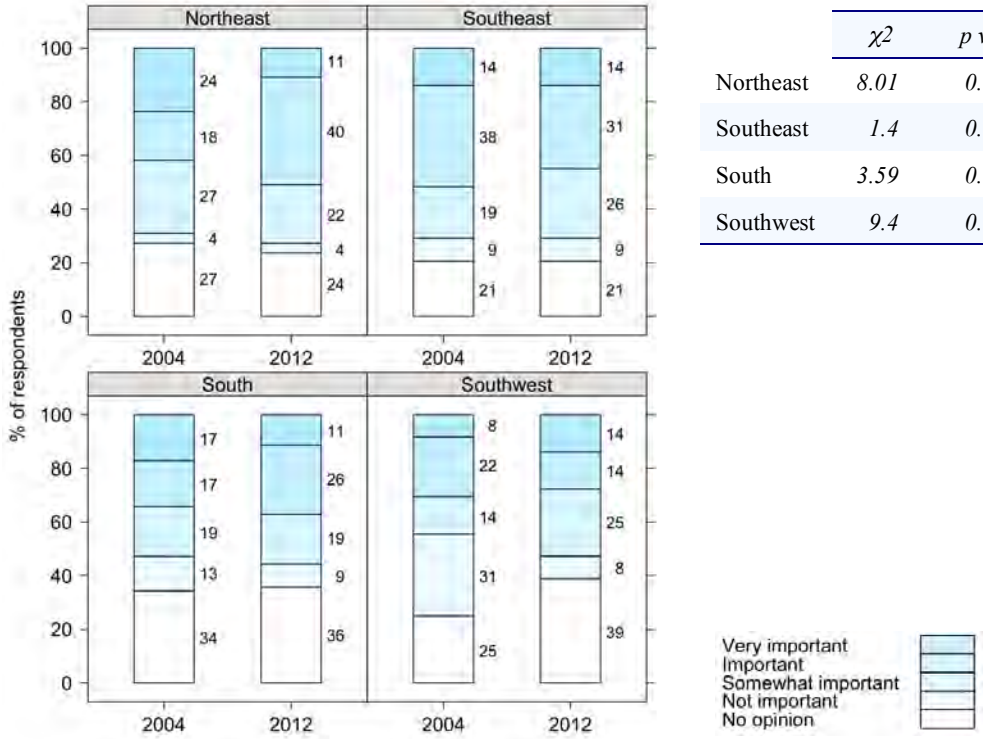


National distributions

	% respondents	
Importance	2004	2011
4–very important	*16*	*12*
3–important	*24*	*29*
2–somewhat important	*20*	*22*
1–not important	*12*	*7*
0–item not answered	*27*	*29*

Marginal homogeneity test
χ^2=7.26, p=0.122, n=219

Regional distributions



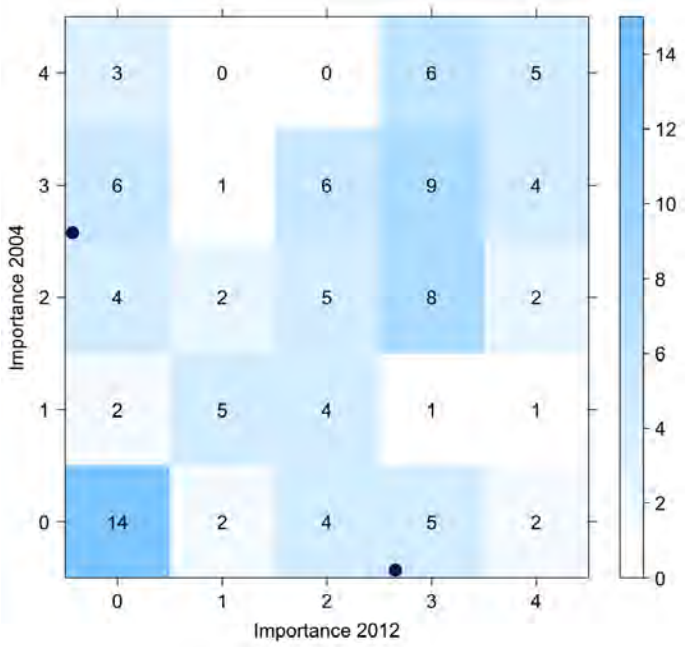
Marginal homogeneity tests

	χ^2	*p value*	*n*
Northeast	*8.01*	*0.0822*	*55*
Southeast	*1.4*	*0.8479*	*58*
South	*3.59*	*0.4789*	*70*
Southwest	*9.4*	*0.0381*	*36*

3.6.10.6 Factor, weaners: quality of pasture

National change table

% of respondents



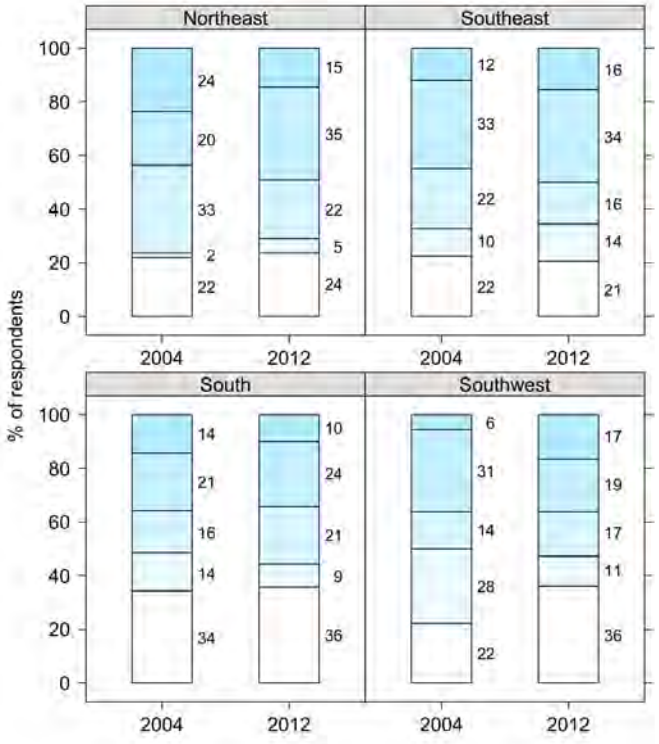
National distributions

% respondents

Importance	2004	2011
4–very important	*15*	*14*
3–important	*26*	*29*
2–somewhat important	*21*	*19*
1–not important	*12*	*10*
0–item not answered	*26*	*29*

Marginal homogeneity test
$\chi 2=2.59$, $p=0.6332$, $n=219$

Regional distributions

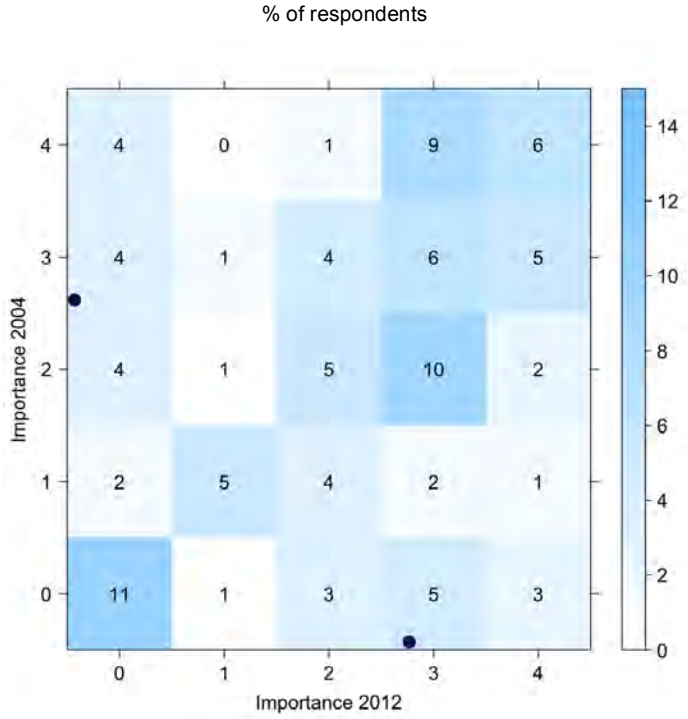


Marginal homogeneity tests

	$\chi 2$	*p value*	*n*
Northeast	*4.99*	*0.3032*	*55*
Southeast	*1.5*	*0.8369*	*58*
South	*3.12*	*0.5502*	*70*
Southwest	*10.7*	*0.0193*	*36*

3.6.10.7 Factor, weaners: presence of daggy sheep in mob

National change table



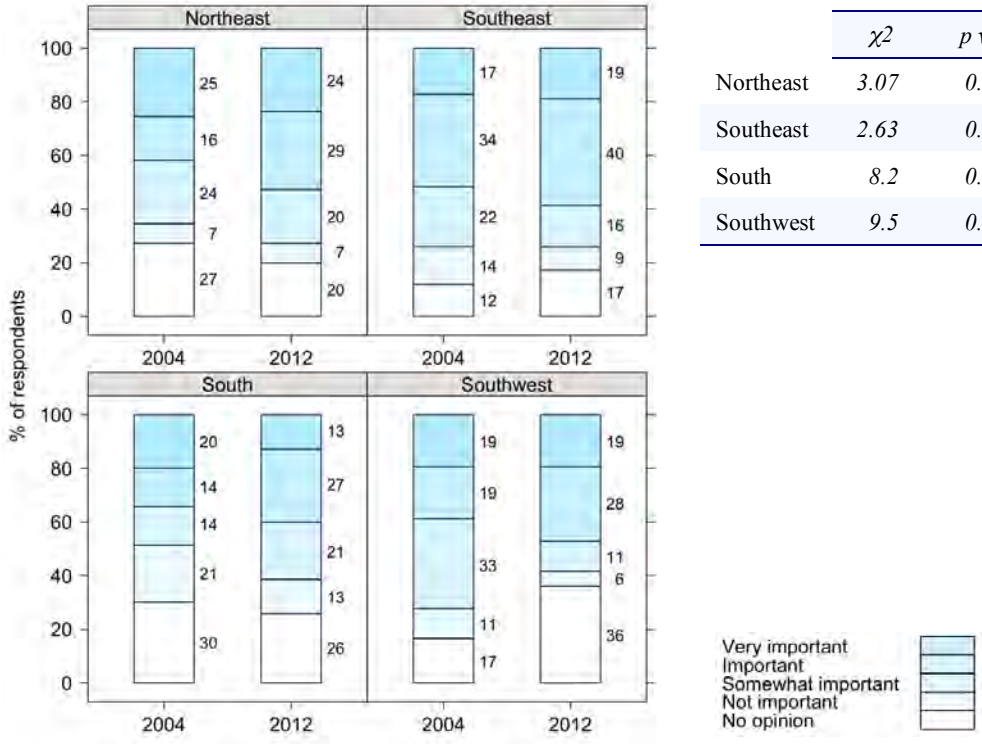
National distributions

% respondents

Importance	2004	2011
4–very important	*21*	*18*
3–important	*21*	*31*
2–somewhat important	*22*	*18*
1–not important	*14*	*9*
0–item not answered	*22*	*24*

Marginal homogeneity test
χ^2*=9.64, p=0.044, n=219*

Regional distributions



Marginal homogeneity tests

	χ^2	*p value*	*n*
Northeast	*3.07*	*0.5961*	*55*
Southeast	*2.63*	*0.6412*	*58*
South	*8.2*	*0.0786*	*70*
Southwest	*9.5*	*0.0402*	*36*

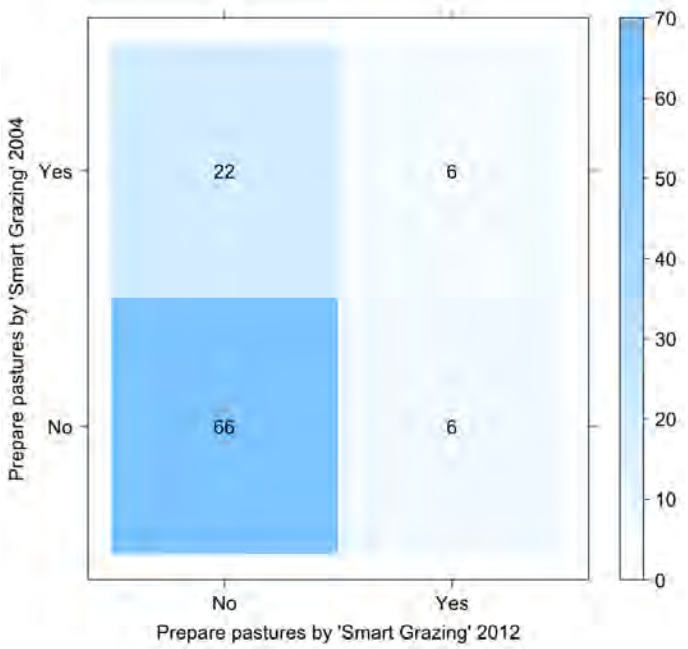
3.6.11 *Treatments and techniques for worm control*

The question on this topic in the 2004 and 2012 surveys included three items that were identical or very similar in each survey.

3.6.11.1 Smart grazing

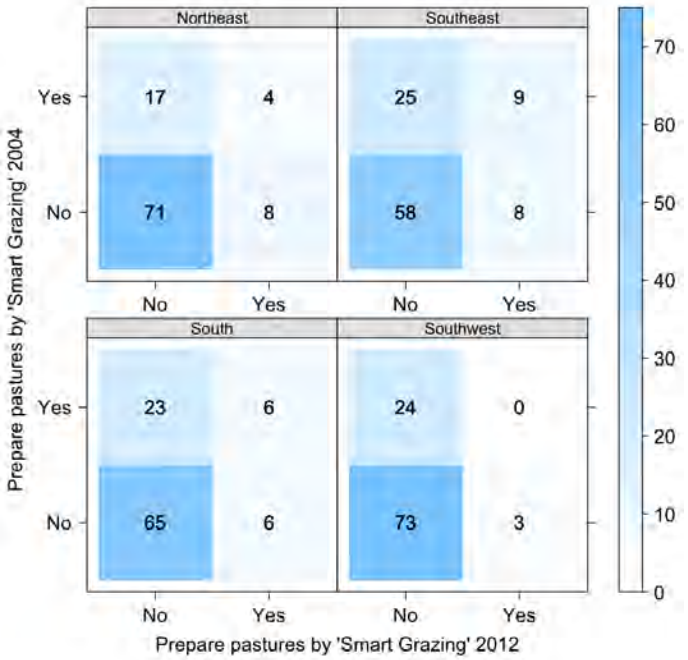
The item wording in 2004 was "Prepare pastures by 'Smart grazing'", in 2012 the wording was "Prepare clean pastures using 'Smart Grazing' techniques".

National change table	McNemar's test
% of respondents	$\chi 2=15.79, df=1, p<0.00005, n=200$



Regional change tables	Exact McNemar's tests

% of respondents



	p value	*n*
NE	*0.3877*	*48*
SE	*0.0490*	*53*
S	*0.0192*	*66*
SW	*0.0391*	*33*

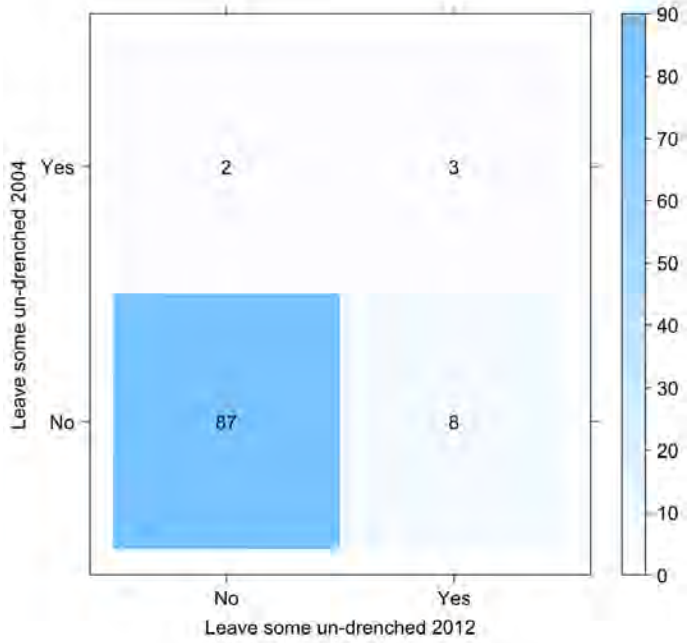
3.6.11.2 Leaving some sheep un-drenched

The item wording in 2004 was “Leave some sheep undrenched at summer treatments”, in 2012 the wording was “Leave some sheep un-drenched”.

National change table	Exact McNemar’s test

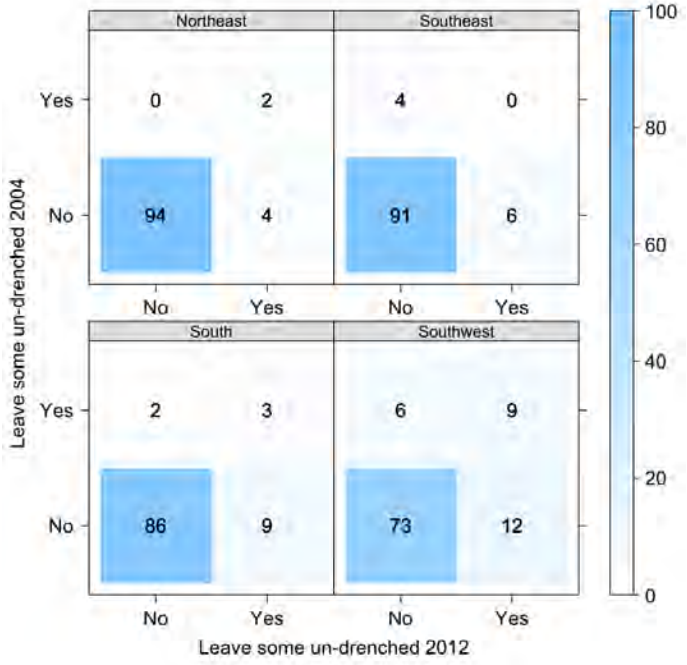
% of respondents

p=0.0414, n=200



Regional change tables	Exact McNemar’s tests

% of respondents

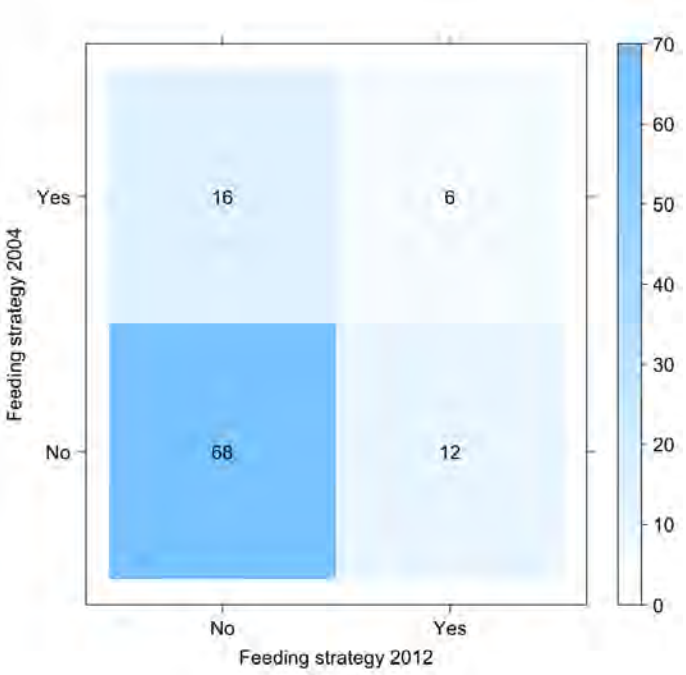


	p value	*n*
NE	*0.5000*	*48*
SE	*1.0000*	*53*
S	*0.1250*	*66*
SW	*0.6875*	*33*

3.6.11.3 Feeding strategy

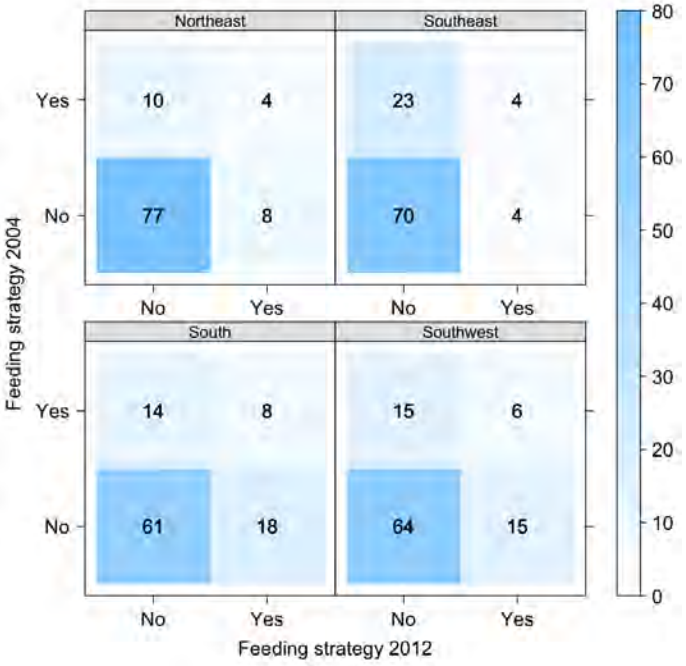
The item wording in 2004 and 2012 was identical: “Feeding strategy”.

National change table	McNemar’s test
% of respondents	$\chi 2=0.91$, $df=1$, $p=0.3408$, $n=200$



Regional change tables	Exact McNemar’s tests

% of respondents

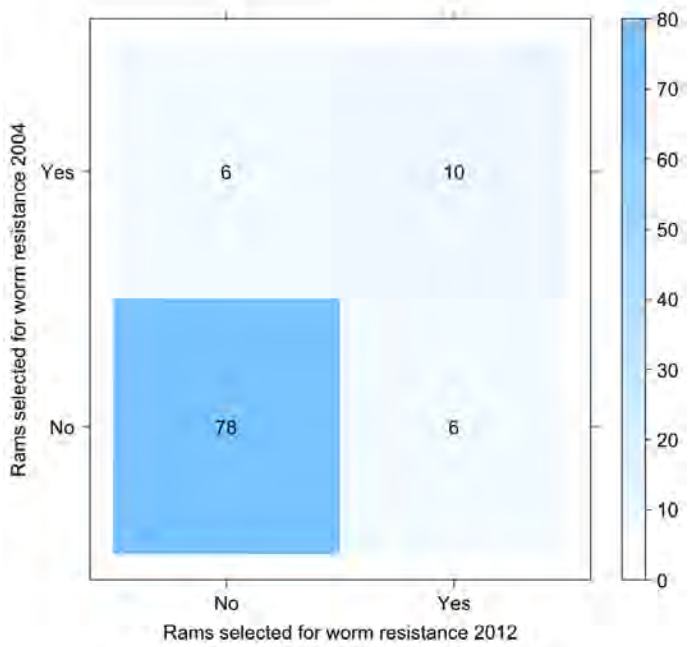


	p value	*n*
NE	*1.0000*	*48*
SE	*0.0129*	*53*
S	*0.6636*	*66*
SW	*1.0000*	*33*

3.6.11.4 Rams selected for resistance to worms

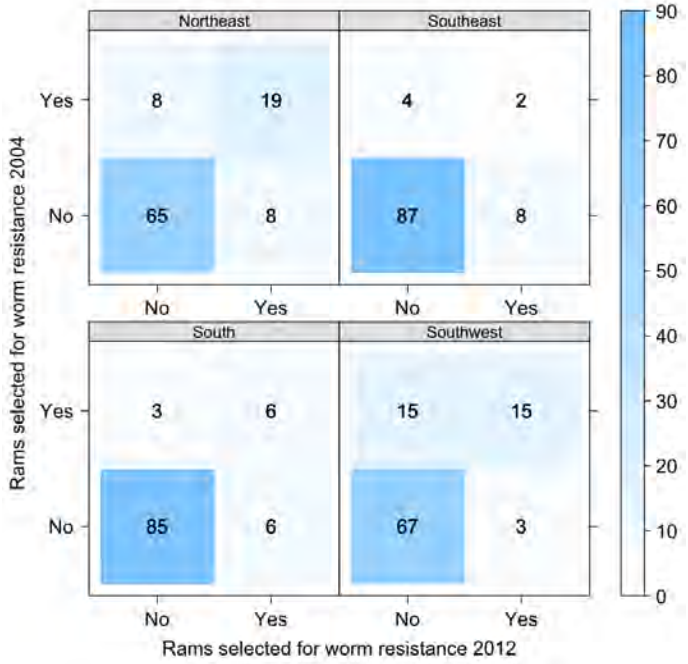
The item wording in 2004 and 2012 was identical: “Use rams selected for resistance to worms”.

National change table	Exact McNemar’s test
% of respondents	*p=1.0000, n=200*



Regional change tables	Exact McNemar’s tests

% of respondents



	p value	*n*
NE	*1.0000*	*48*
SE	*0.6875*	*53*
S	*0.6875*	*66*
SW	*0.2188*	*33*

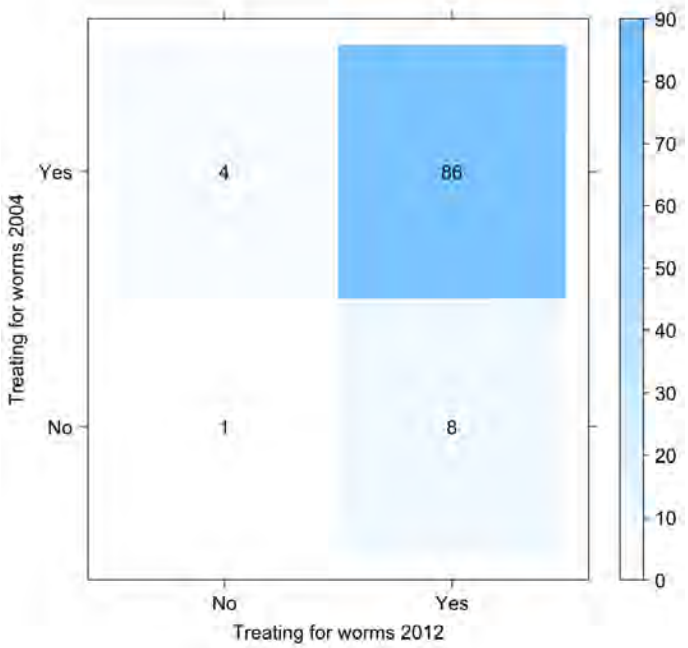
3.6.11.5 Treating for worms

The item wording in 2004 was: “Drenching” and in 2012, “Treating for worms (drenching, injection, capsule)”.

National change table	Exact McNemar’s test

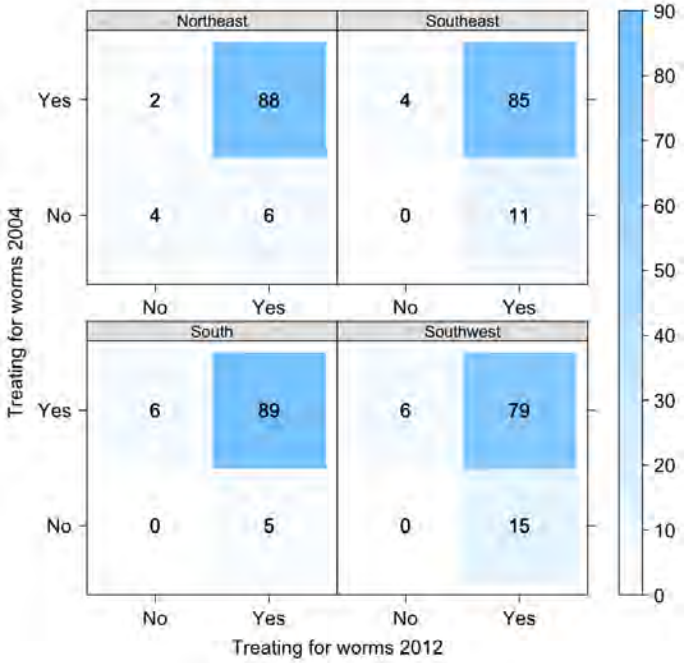
% of respondents

p=0.1686, n=200



Regional change tables	Exact McNemar’s tests

% of respondents



	p value	*n*
NE	*0.6250*	*48*
SE	*0.2891*	*53*
S	*1.0000*	*66*
SW	*0.4531*	*33*

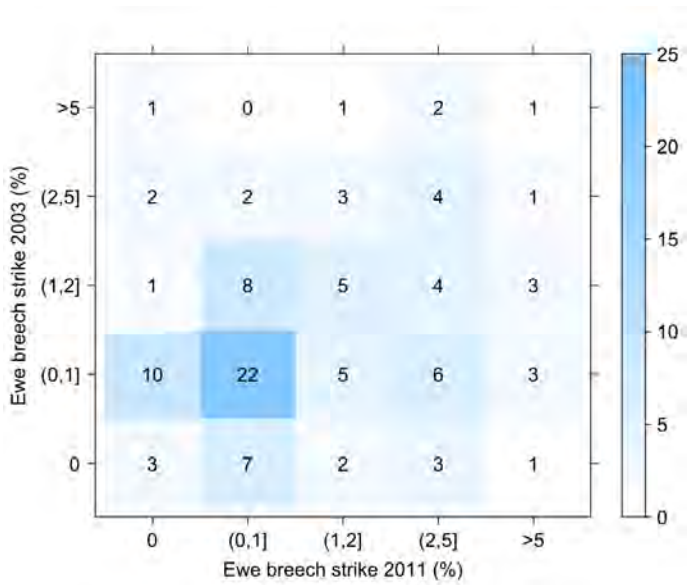
3.7 Blow Fly Management Practices

3.7.1 Incidence of fly strike

Both surveys asked about the incidence of fly strike, although there were some differences in the structure of the question between the two surveys. Comparable items across the two surveys were the percentages of sheep affected in the year prior to the survey by breech and body strike among ewes, wethers and weaners.

3.7.1.1 Breech strike in ewes

National change table



National distributions

% ewes affected	% respondents 2003	2011
0	16	17
>0 & ≤1	45	39
>1 & ≤2	22	16
>2 & ≤5	12	20
>5	4	8

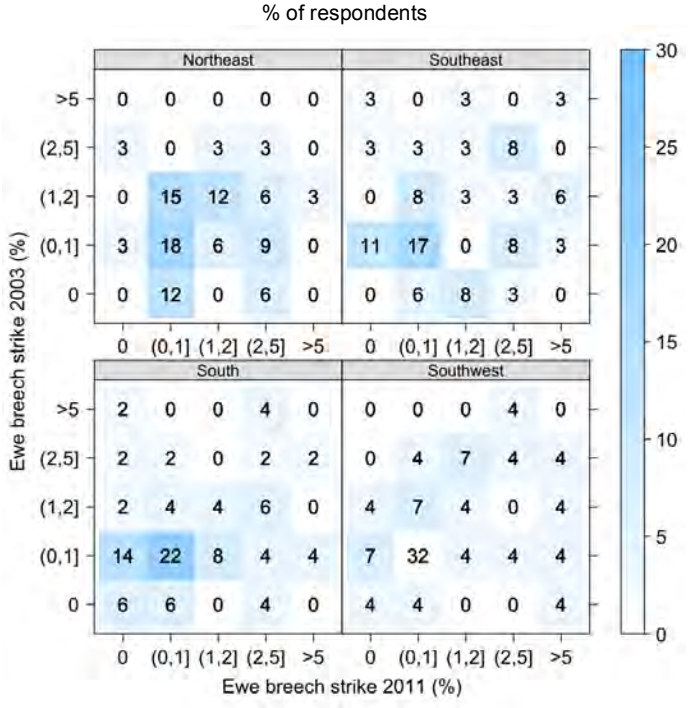
Marginal homogeneity test

χ^2=7.24, p=0.1222, n=146

% of all ewes in survey affected 2003: 3.1

% of all ewes in survey affected 2011: 2.9

Regional change tables



Marginal homogeneity tests

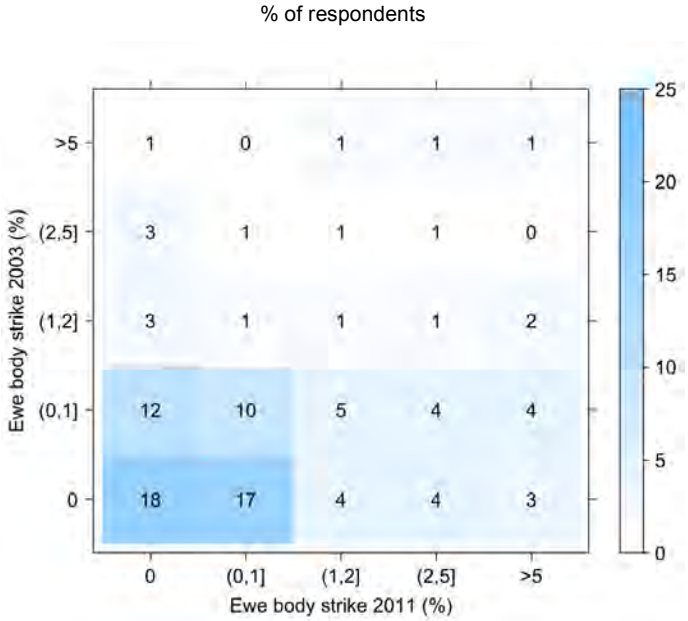
	χ^2	*p value*	*n*
Northeast	*6.03*	*0.1794*	*33*
Southeast	*4.27*	*0.3980*	*36*
South	*10.06*	*0.0319*	*49*
Southwest	*8.09*	*0.0480*	*28*

% of all ewes in survey affected

	2003	2011
Northeast	1.8	2.0
Southeast	3.0	5.4
South	4.6	2.1
Southwest	2.0	2.4

3.7.1.2 Body strike in ewes

National change table



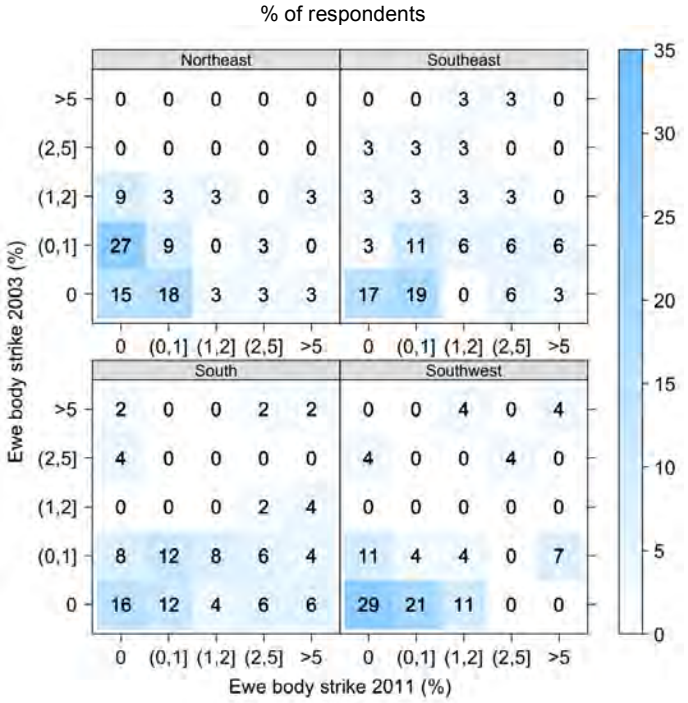
National distributions

% ewes affected	% respondents 2003	2011
0	47	36
>0 & ≤1	34	29
>1 & ≤2	9	12
>2 & ≤5	5	12
>5	5	11

Marginal homogeneity test
χ^2=13.25, p=0.0082, n=146

% of all ewes in survey affected 2003: 1.2
% of all ewes in survey affected 2011: 4.2

Regional change tables



Marginal homogeneity tests

	χ^2	*p value*	*n*
Northeast	*6.03*	*0.1794*	*33*
Southeast	*4.27*	*0.398*	*36*
South	*10.06*	*0.0319*	*49*
Southwest	*8.09*	*0.048*	*28*

% of all ewes in survey affected

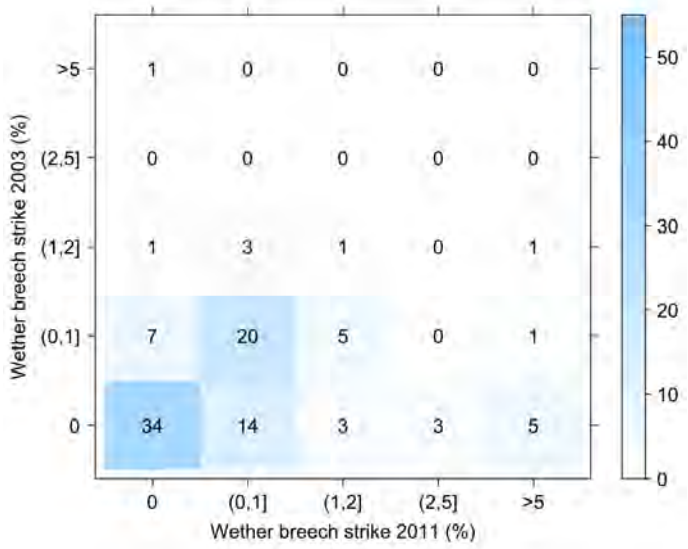
	2003	2011
Northeast	0.4	3.6
Southeast	1.1	1.7
South	1.4	7.6
Southwest	1.8	1.7

Note: The regional change tables and associated marginal homogeneity tests are based on respondents as the unit of analysis and the size of respondents' flocks is not considered. However, the percentage of all sheep in the survey affected by fly strike does take account of flock size and will tend to be dominated by the changes experienced by respondents with large sheep flocks. For this reason, the nature of change between 2003 and 2011 shown in these two different ways of representing the findings need not be in close agreement, particularly if there are systematic differences in the changes experienced in small flocks compared to large flocks.

3.7.1.3 Breech strike in wethers

National change table	National distributions

% of respondents



% respondents

% ewes affected	2003	2011
0	58	43
>0 & ≤1	34	36
>1 & ≤2	7	9
>2 & ≤5	0	3
>5	1	8

Marginal homogeneity test

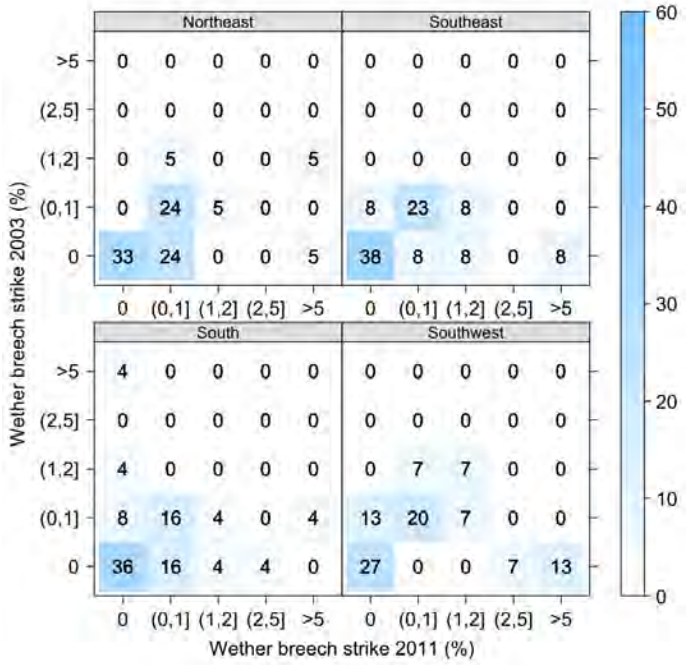
χ^2=7.4, p=0.0994, n=74

% of all wethers in survey affected 2003: 1.2

% of all wethers in survey affected 2011: 1.6

Regional change tables	Marginal homogeneity tests

% of respondents



	χ^2	*p value*	*n*
Northeast	*6.63*	*0.0501*	*21*
Southeast	*3.00*	*0.6239*	*13*
South	*1.35*	*1.0000*	*25*
Southwest	*5.00*	*0.5009*	*15*

% of all wethers in survey affected

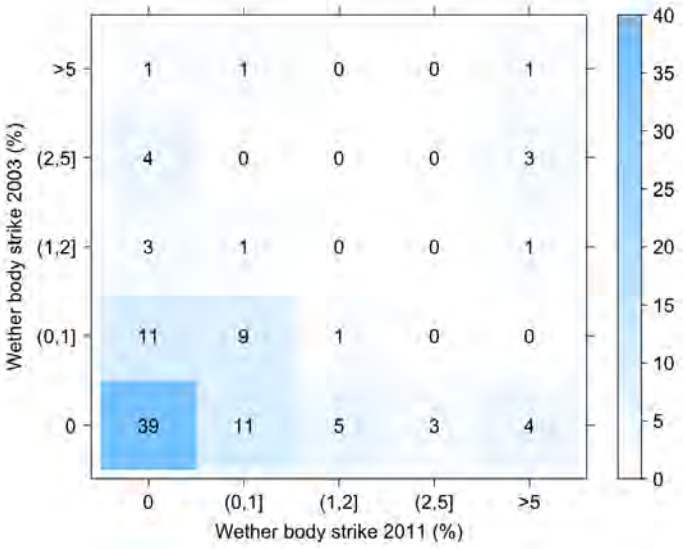
	2003	2011
Northeast	0.4	2.1
Southeast	0.5	2.7
South	2.3	0.6
Southwest	0.3	0.9

Note: The regional change tables and associated marginal homogeneity tests are based on respondents as the unit of analysis and the size of respondents' flocks is not considered. However, the percentage of all sheep in the survey affected by fly strike does take account of flock size and will tend to be dominated by the changes experienced by respondents with large sheep flocks. For this reason, the nature of change between 2003 and 2011 shown in these two different ways of representing the findings need not be in close agreement, particularly if there are systematic differences in the changes experienced in small flocks compared to large flocks.

3.7.1.4 Body strike in wethers

National change table	National distributions

% of respondents



% respondents

% ewes affected	2003	2011
0	62	58
>0 & ≤1	22	23
>1 & ≤2	5	7
>2 & ≤5	7	3
>5	4	9

Marginal homogeneity test

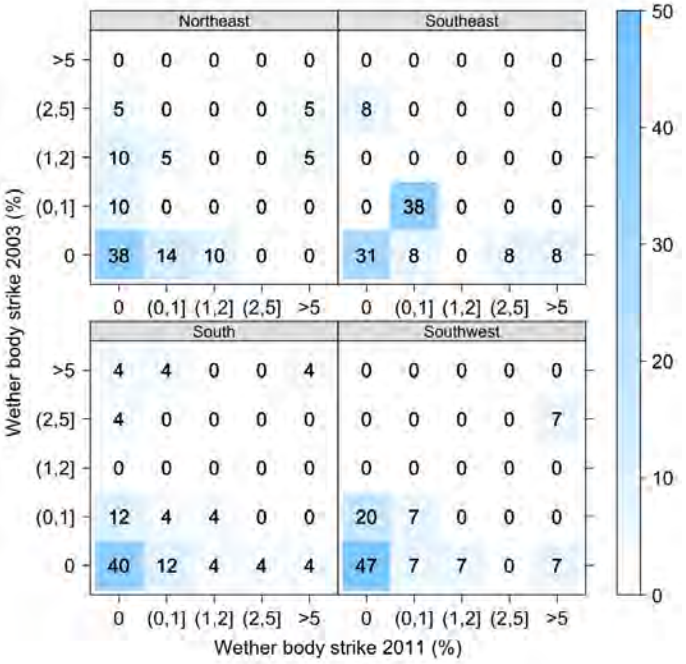
$\chi 2=3.01$, $p=0.5736$, $n=74$

% of all wethers in survey affected 2003: 1.4

% of all wethers in survey affected 2011: 2.6

Regional change tables	Marginal homogeneity tests

% of respondents



	$\chi 2$	*p value*	*n*
Northeast	*3.53*	*0.5857*	*21*
Southeast	*2.00*	*1.0000*	*13*
South	*2.40*	*0.7908*	*25*
Southwest	*4.00*	*0.6251*	*15*

% of all wethers in survey affected

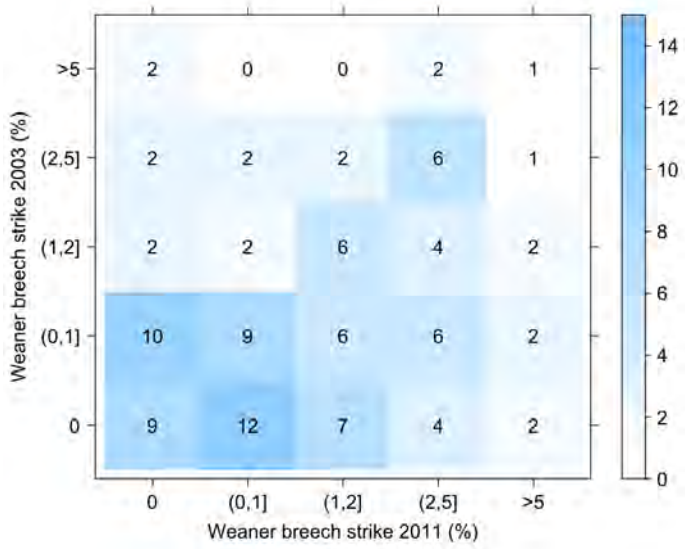
	2003	2011
Northeast	0.8	2.8
Southeast	0.8	5.3
South	2.4	1.4
Southwest	0.3	0.8

Note: The regional change tables and associated marginal homogeneity tests are based on respondents as the unit of analysis and the size of respondents' flocks is not considered. However, the percentage of all sheep in the survey affected by fly strike does take account of flock size and will tend to be dominated by the changes experienced by respondents with large sheep flocks. For this reason, the nature of change between 2003 and 2011 shown in these two different ways of representing the findings need not be in close agreement, particularly if there are systematic differences in the changes experienced in small flocks compared to large flocks.

3.7.1.5 Breech strike in weaners

National change table	National distributions

% of respondents



% respondents

% ewes affected	2003	2011
0	34	26
>0 & ≤1	33	25
>1 & ≤2	15	21
>2 & ≤5	14	22
>5	4	7

Marginal homogeneity test

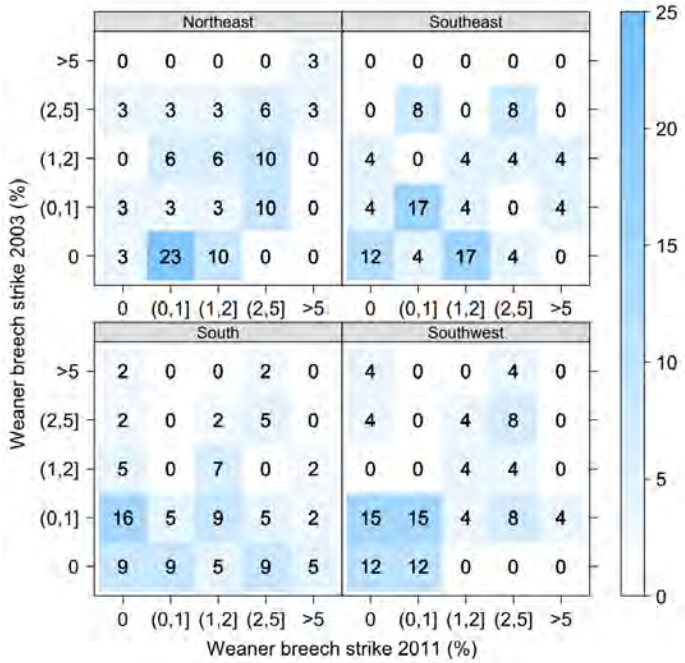
χ^2=8.93, p=0.059, n=125

% of all weaners in survey affected 2003: 1.9

% of all weaners in survey affected 2011: 3.3

Regional change tables	Marginal homogeneity tests

% of respondents



	χ^2	*p value*	*n*
Northeast	*7.05*	*0.1055*	*31*
Southeast	*4.09*	*0.4271*	*24*
South	*8.9*	*0.0537*	*44*
Southwest	*3.31*	*0.617*	*26*

% of all weaners in survey affected

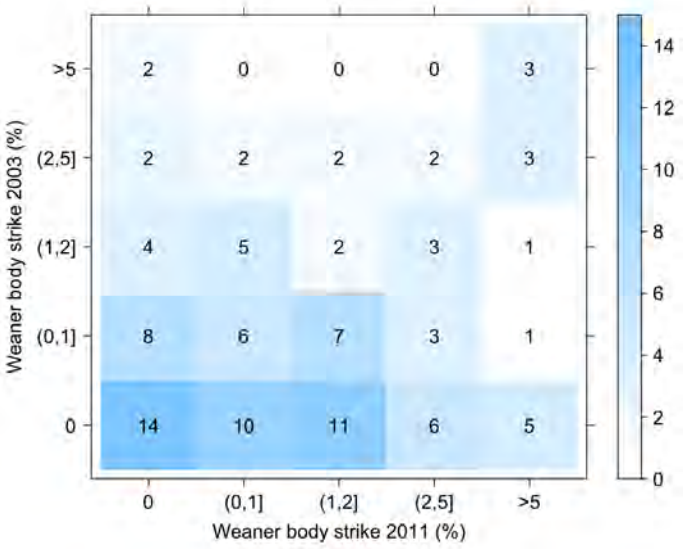
	2003	2011
Northeast	2.4	7.0
Southeast	1.1	2.9
South	2.6	2.3
Southwest	1.4	1.6

Note: The regional change tables and associated marginal homogeneity tests are based on respondents as the unit of analysis and the size of respondents' flocks is not considered. However, the percentage of all sheep in the survey affected by fly strike does take account of flock size and will tend to be dominated by the changes experienced by respondents with large sheep flocks. For this reason, the nature of change between 2003 and 2011 shown in these two different ways of representing the findings need not be in close agreement, particularly if there are systematic differences in the changes experienced in small flocks compared to large flocks.

3.7.1.6 Body strike in weaners

National change table	National distributions

% of respondents



% respondents

% ewes affected	2003	2011
0	46	30
>0 & ≤1	25	22
>1 & ≤2	14	22
>2 & ≤5	10	14
>5	5	13

Marginal homogeneity test

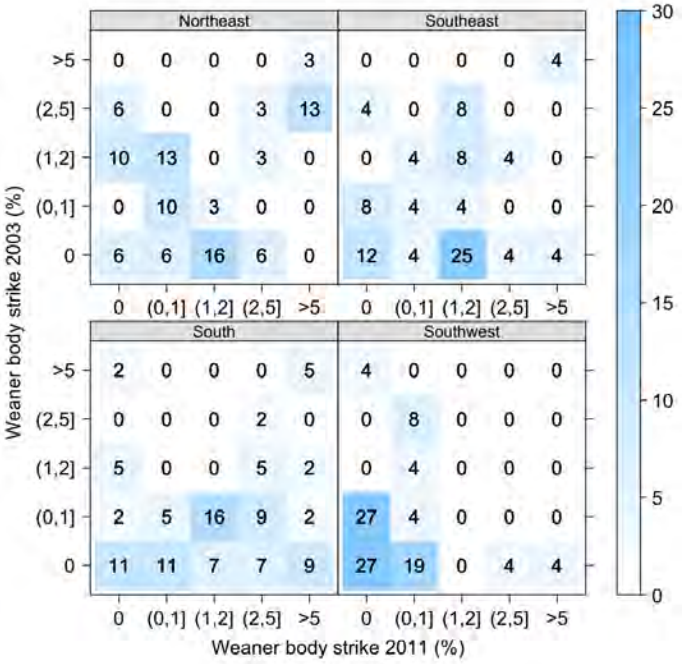
χ^2=12.87, p=0.0103, n=125

% of all weaners in survey affected 2003: 1.4

% of all weaners in survey affected 2011: 4.8

Regional change tables	Marginal homogeneity tests

% of respondents



	χ^2	*p value*	*n*
Northeast	*8.08*	*0.0788*	*31*
Southeast	*5.69*	*0.2207*	*24*
South	*16.79*	*<0.0001*	*44*
Southwest	*1.37*	*1.0000*	*26*

% of all weaners in survey affected

	2003	2011
Northeast	0.8	2.8
Southeast	0.8	5.3
South	2.4	1.4
Southwest	0.3	0.8

Note: The regional change tables and associated marginal homogeneity tests are based on respondents as the unit of analysis and the size of respondents' flocks is not considered. However, the percentage of all sheep in the survey affected by fly strike does take account of flock size and will tend to be dominated by the changes experienced by respondents with large sheep flocks. For this reason, the nature of change between 2003 and 2011 shown in these two different ways of representing the findings need not be in close agreement, particularly if there are systematic differences in the changes experienced in small flocks compared to large flocks.

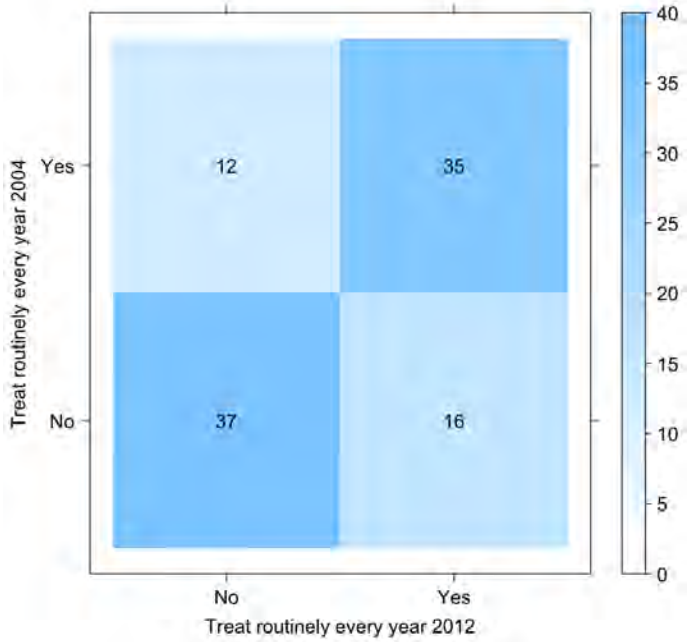
3.7.2 *Typical treatment for blow fly strike*

Respondents in 2004 and 2012 indicated by ticking one or more boxes the typical approach they took in treating for fly strike. The wordings used in each of the four approaches were slightly different between the 2004 and 2012 surveys, and is described for each in the subsections below.

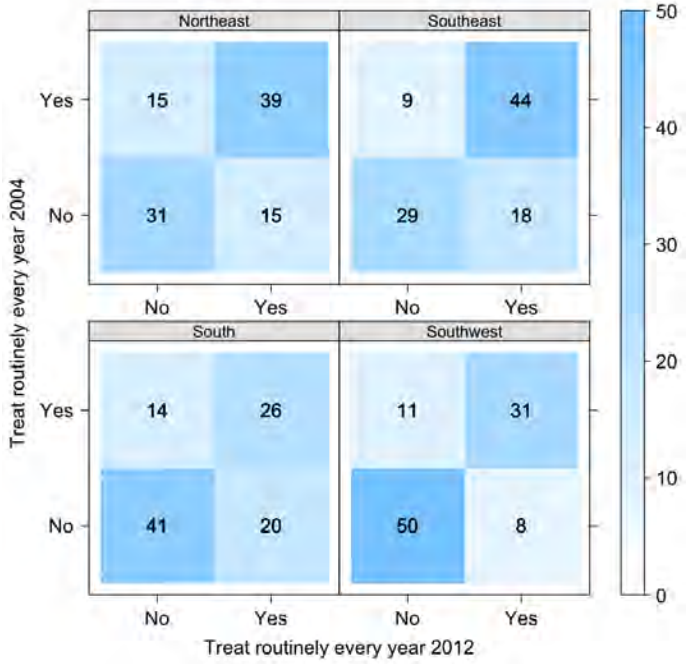
3.7.2.1 Treat routinely each year

Wording in 2004: "Treat routinely for prevention at about the same time each year". Wording in 2012: "Treat your sheep routinely with preventive chemicals for flystrike every year".

National change table	McNemar's test
% of respondents	$\chi^2=0.82$, $df = 1$, $p=0.3662$, $n=211$



Regional change tables	Exact McNemar's tests
% of respondents	

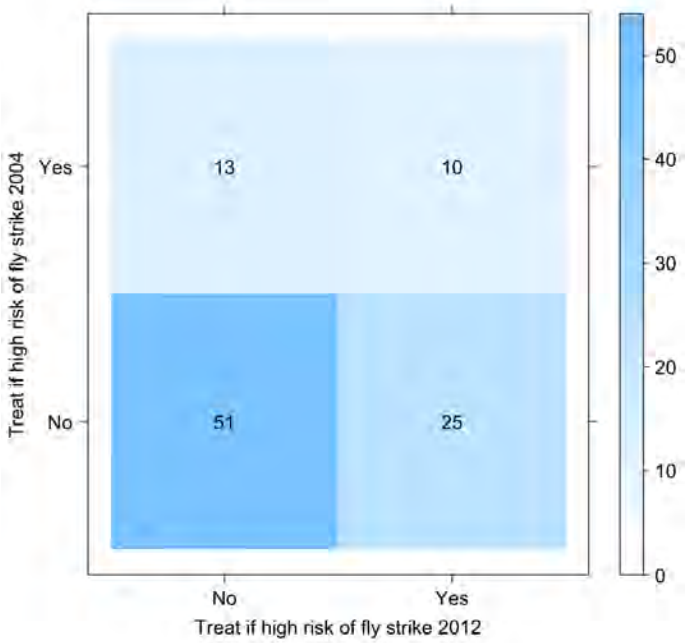


	p value	*n*
NE	*1.0000*	*54*
SE	*0.3018*	*55*
S	*0.5235*	*65*
SW	*1.0000*	*36*

3.7.2.2 Treat when risk of fly strike is high

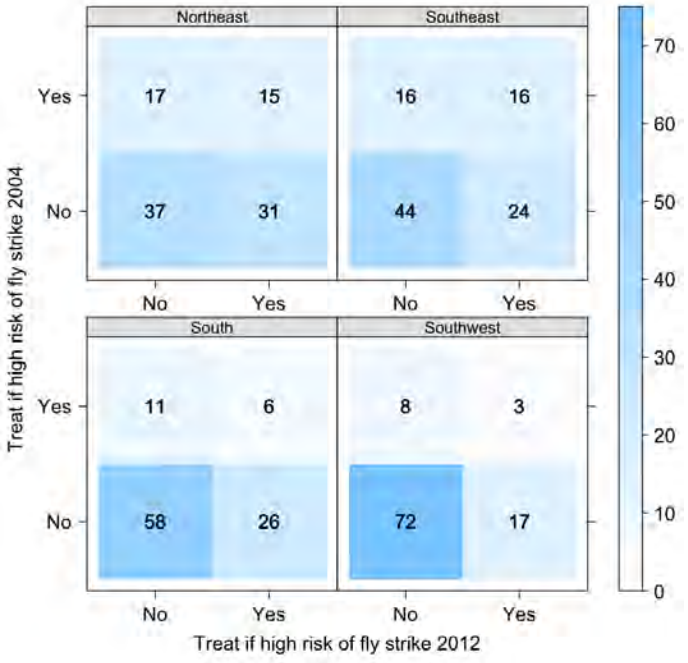
Wording in 2004: "Treat when the weather suggests a flywave might occur". Wording in 2012: "Treat your sheep with preventive chemicals only when the risk of flystrike is high".

National change table	McNemar's test
% of respondents	$\chi 2=7.11$, $df = 1$, $p=0.0077$, $n=211$



Regional change tables	Exact McNemar's tests

% of respondents

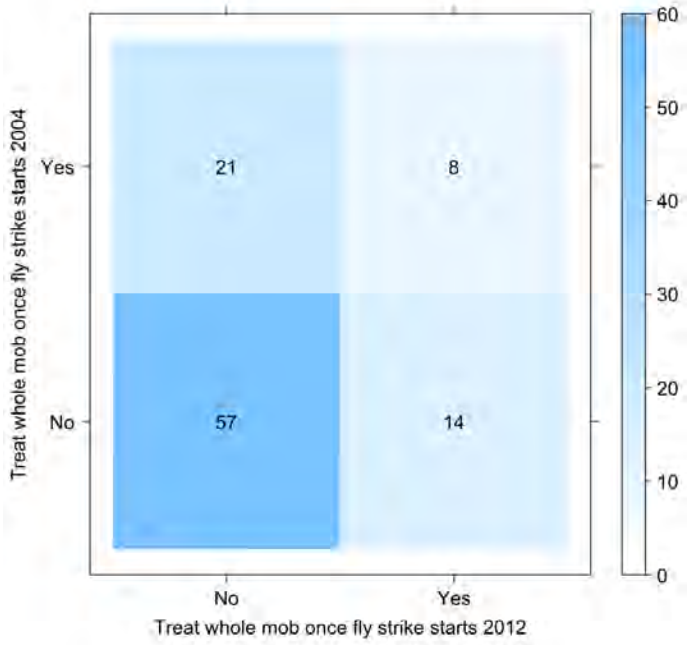


	p value	*n*
NE	*0.1686*	*54*
SE	*0.5235*	*55*
S	*0.0639*	*65*
SW	*0.5078*	*36*

3.7.2.3 Treat whole mob when fly strike detected

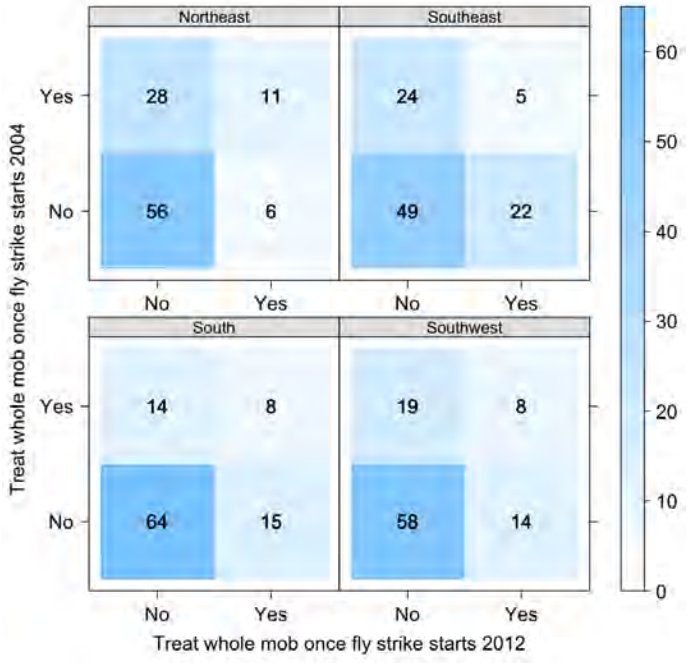
Wording in 2004: "Treat the whole mob once strike starts". Wording in 2012: "Treat the whole mob of sheep once flystrike is detected".

National change table	McNemar's test
% of respondents	$\chi^2=2.28$, $df = 1$, $p=0.1307$, $n=211$



Regional change tables	Exact McNemar's tests

% of respondents



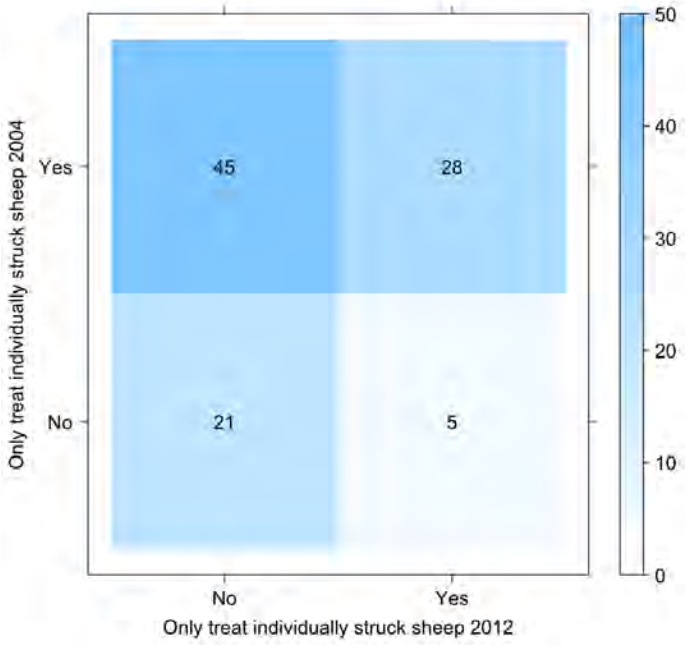
	p value	*n*
NE	*0.0075*	*54*
SE	*1.0000*	*55*
S	*1.0000*	*65*
SW	*0.7744*	*36*

3.7.2.4 Only treat individually struck sheep

Wording in 2004: "Treat individual sheep which become struck". Wording in 2012: "Only treat individually struck sheep".

National change table	McNemar's test

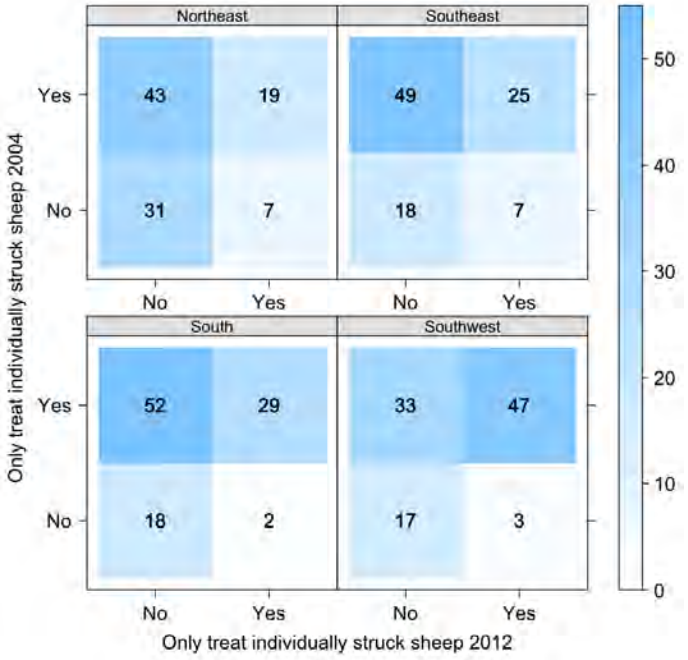
% of respondents



χ2=68.16, df = 1, p<0.00005, n=211

Regional change tables	Exact McNemar's tests

% of respondents

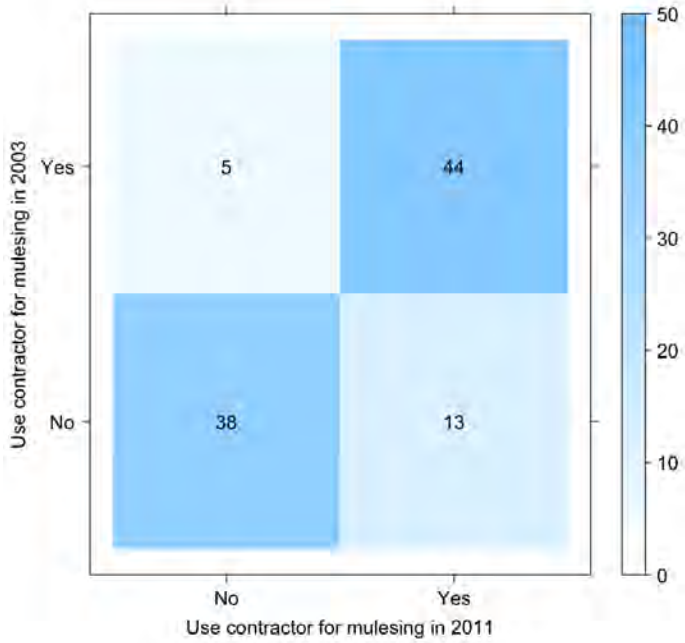


	p value	*n*
NE	*0.0003*	*54*
SE	*<0.00005*	*55*
S	*<0.00005*	*65*
SW	*0.0034*	*36*

3.7.3 *Use of contractors to perform mulesing*

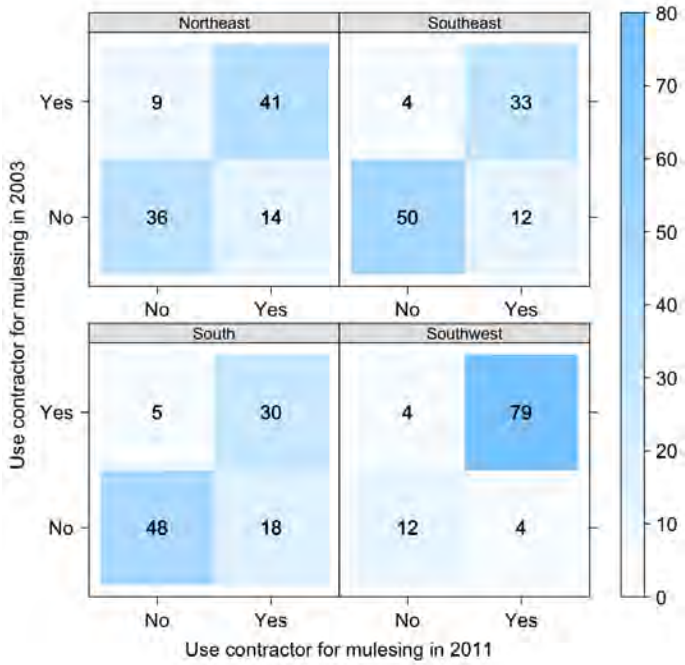
The only item in the question on who performed mulesing of the respondent's sheep, which could be regarded as reasonably comparable between the 2004 and 2012 surveys was the use of contractors. The question was an open question in 2004 and a fixed response question in 2012 with three tick boxes ("Self", "Farm staff", and "Contractor). The only category in the 2004 categorisation of responses to the open question that corresponded with one of the tick boxes in 2012 was "Contractor.

National change table	McNemar's test
% of respondents	$\chi^2=2.45$, $df = 1$, $p=0.1175$, $n=110$



Regional change tables	Exact McNemar's tests

% of respondents



	p value	*n*
NE	*1.0000*	*22*
SE	*0.6250*	*24*
S	*0.1797*	*40*
SW	*1.0000*	*24*

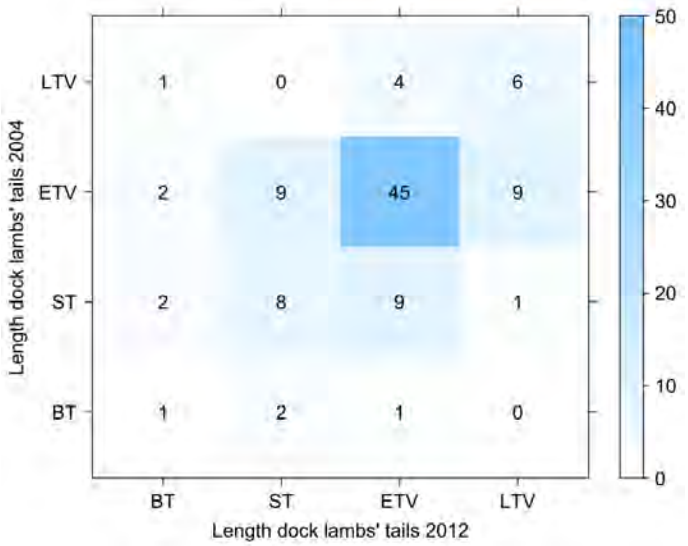
3.7.4 Proportion of sheep mulesed

This question was not asked in 2004, but the 2012 survey asked for this proportion in 2011 and for the respondent's recollection of the corresponding proportion in 2003. Since this does not constitute longitudinal data, and the sample of producers answering this question is different to the longitudinal sample used in the rest of this report, the findings are reported in the accompanying 2012 cross-sectional survey report.

3.7.5 Length at which lambs' tails are docked

This question was identical in 2004 and 2012.

National change table



National distributions

% respondents

Length	2004	2012
BT	*4*	*6*
ST	*20*	*19*
ETV	*65*	*59*
LTV	*11*	*16*

Marginal homogeneity test

χ^2=4.73, p=0.1945, n=196

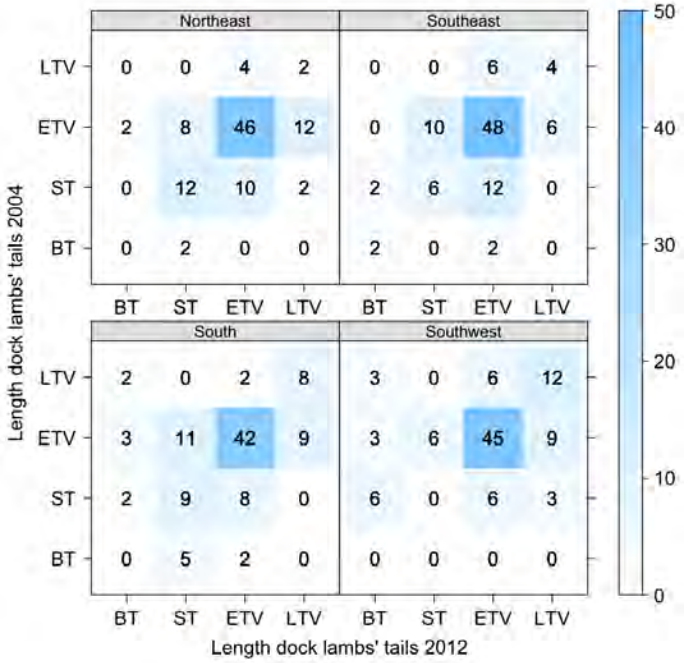
BT=Much shorter than the tip of the vulva in ewes ('butted tail')

ST=Just shorter than the tip of the vulva ('short tail')

ETV=Equal to the tip of the vulva

LTV= Longer than the tip of the vulva

Regional distributions



Marginal homogeneity tests

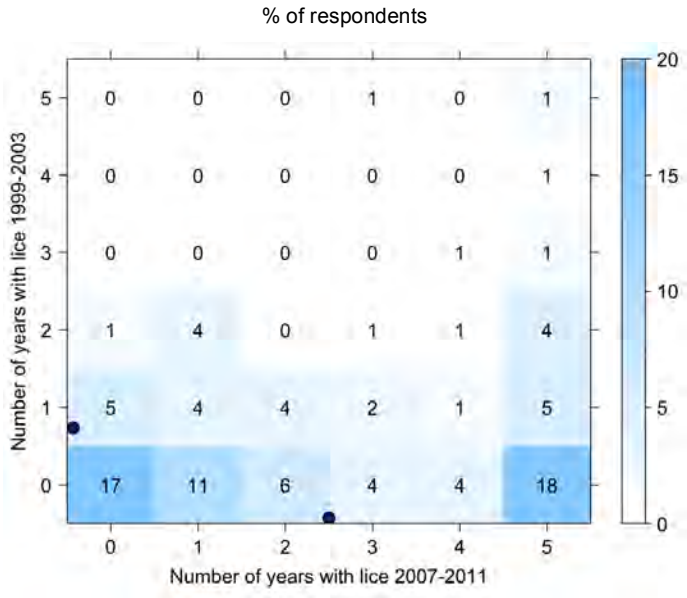
	χ^2	*p value*	*n*
Northeast	*2.8*	*0.4796*	*50*
Southeast	*0.35*	*0.9655*	*48*
South	*3.33*	*0.3308*	*65*
Southwest	*4.65*	*0.2172*	*33*

3.8 Lice Control

3.8.1 *Incidence of lice in last five years*

The 2004 survey asked "How many years in the last five years have your sheep been infested with lice?". The 2012 survey had a more detailed question on the detection and treatment of lice in the previous six year, from which it was possible to derive a figure for the number of years in which lice had been detected and/or treated.

National change table	National distributions and means



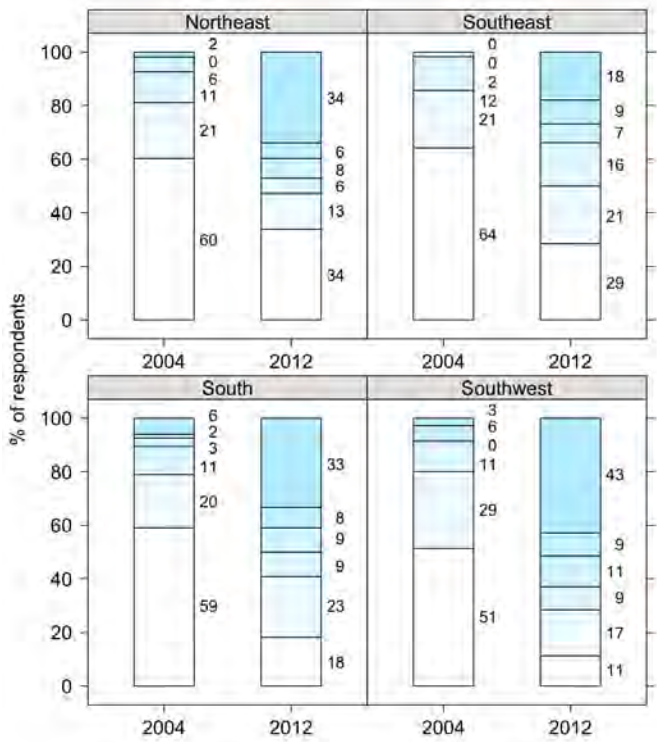
% respondents

Number of years in last five years	1999-2003	2007-2011
0	*60*	*24*
1	*22*	*19*
2	*11*	*10*
3	*3*	*9*
4	*1*	*8*
5	*3*	*31*

Marginal homogeneity test
χ^2*=90.08, p<0.00005, n=210*

Mean number of years 1999-2003: 0.7
Mean number of years 2007-2011: 2.5
T-test: t=12.09, df=209,p<0.00005

Regional change tables	Marginal homogeneity tests, means and t-tests

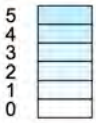


	χ^2	*p value*	*n*
Northeast	*20.98*	*0.0001*	*53*
Southeast	*22.35*	*<0.00005*	*56*
South	*29.85*	*<0.00005*	*66*
Southwest	*20.18*	*0.0001*	*35*

Mean number of years and t-tests

	1999-2003	2007-2011	*p value*	*n*
NE	0.70	2.40	*<0.00005*	*53*
SE	0.52	2.00	*<0.00005*	*56*
S	0.86	2.65	*<0.00005*	*66*
SW	0.89	3.17	*<0.00005*	*35*

Number of years in last five years lice detected and/or treated



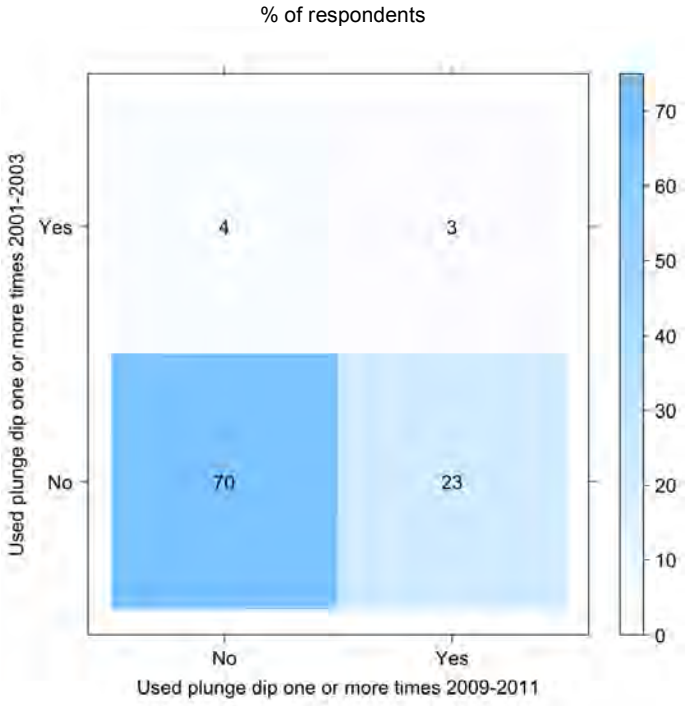
3.8.2 *Use of lice control techniques*

A number of items within the question on use of lice control techniques in 2004 and 2012 had very similar wording in the two surveys. Findings for these items are given below.

3.8.2.1 Off-shears plunge dip

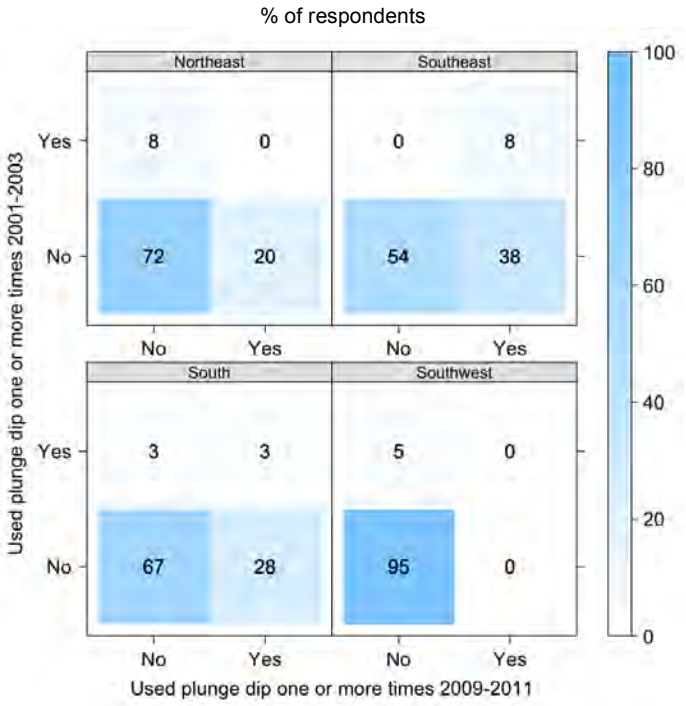
Wording in 2004: "Off-shears plunge dip", in 2012: "Off-shears or short wool plunge dip".

National change table	Exact McNemar's test



p=0.0001, n=108

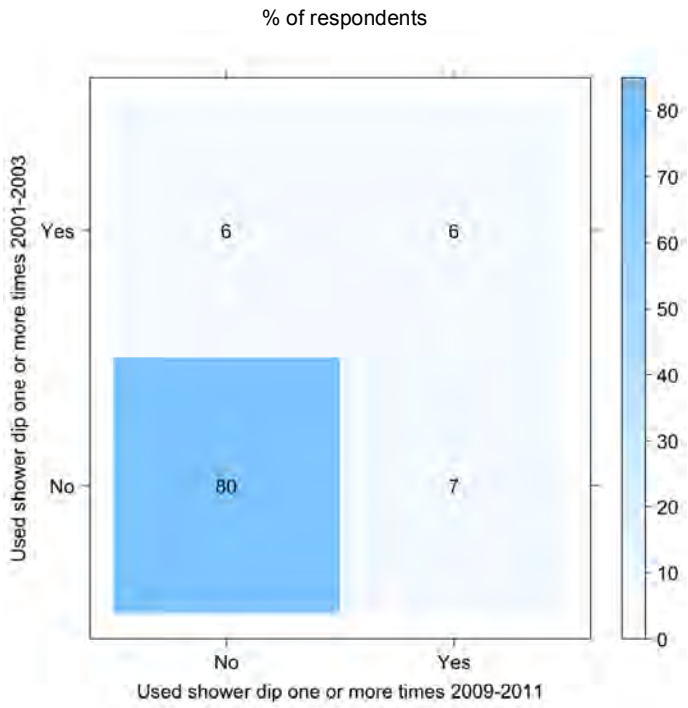
Regional change tables	Exact McNemar's tests

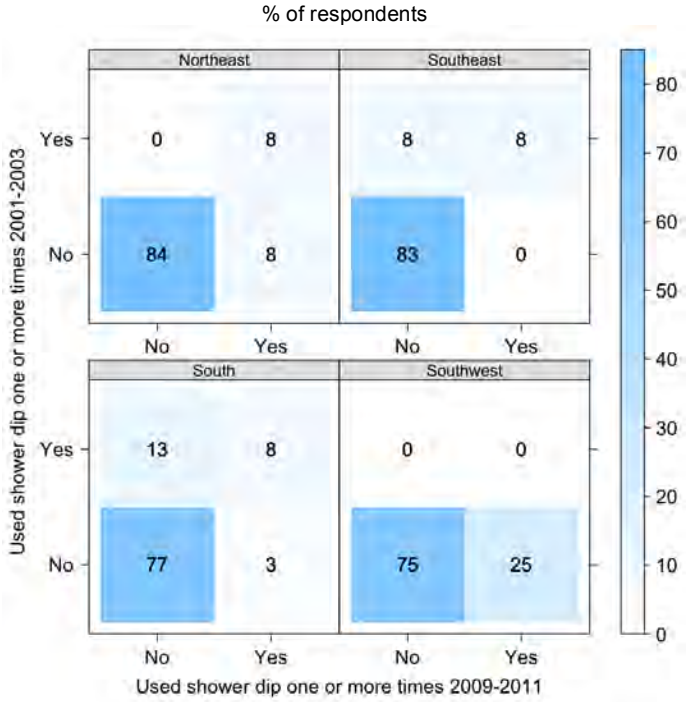


	p value	*n*
NE	*0.4531*	*25*
SE	*0.0039*	*24*
S	*0.0063*	*39*
SW	*1.0000*	*20*

3.8.2.2 Off-shears shower dip

Wording in 2004: “Off-shears shower dip”, in 2012: “Off-shears or short wool shower dip”.

National change table	Exact McNemar’s test
	*p=1.0000, n=108*

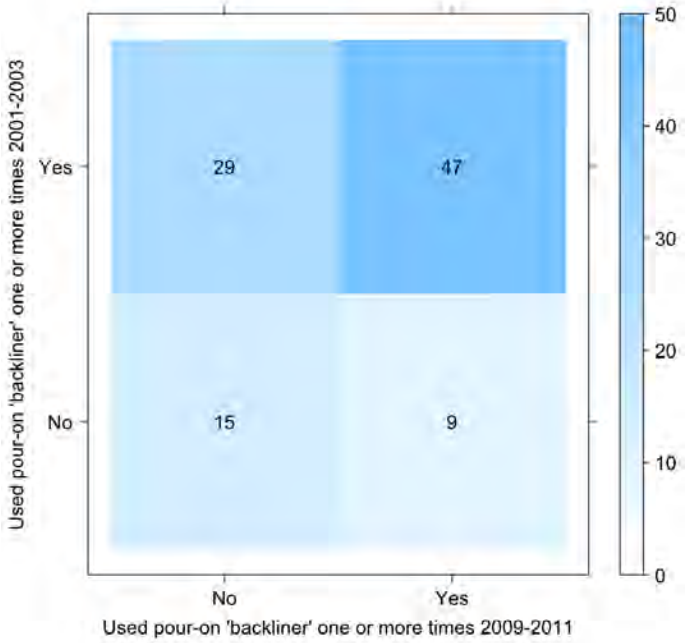
Regional change tables	Exact McNemar’s tests
	

	p value	*n*
NE	*0.5000*	*25*
SE	*0.5000*	*24*
S	*0.2188*	*39*
SW	*0.0625*	*20*

3.8.2.3 Off-shears pour-on 'backliner'

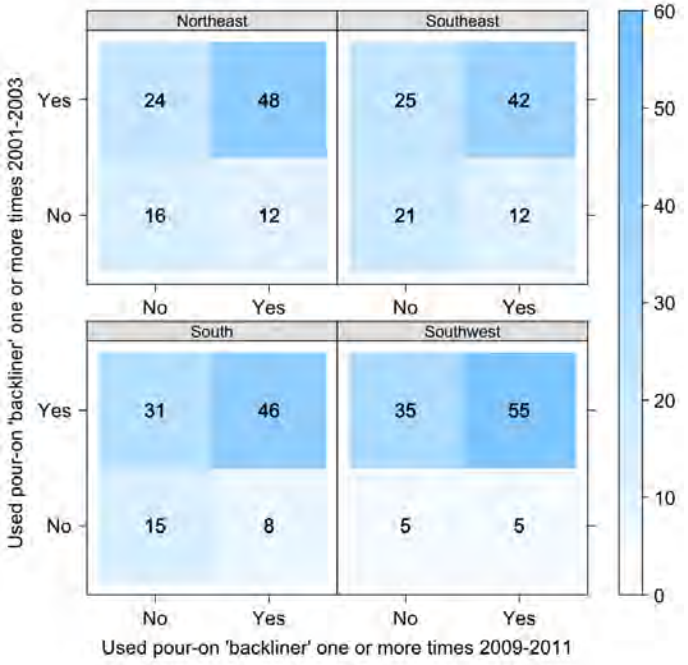
Wording in 2004: "Off-shears pour-on 'backliner'", in 2012: "Off-shears or short wool pour-on 'backliner'".

National change table	Exact McNemar's test
% of respondents	*p=0.0015, n=108*



Regional change tables	Exact McNemar's tests

% of respondents



	p value	*n*
NE	*0.5078*	*25*
SE	*0.5078*	*24*
S	*0.0352*	*39*
SW	*0.0703*	*20*

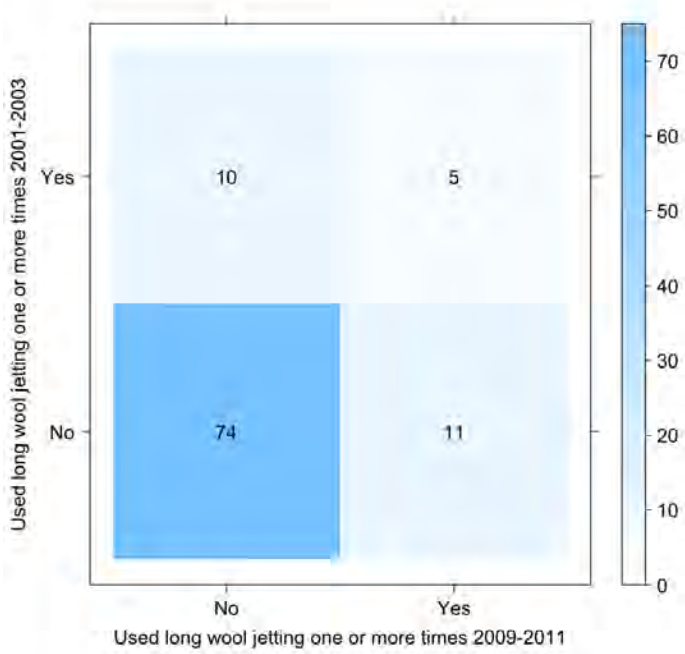
3.8.2.4 Long wool hand jetting

Wording in 2004: "Long wool hand jetting", in 2012: "Long wool jetting". However, the 2012 survey separated quarantine lice treatments from other treatments using hand jetting and pour-on 'backliners'. For comparability with 2004, the responses for quarantine and other treatments have been combined.

National change table	Exact McNemar's test

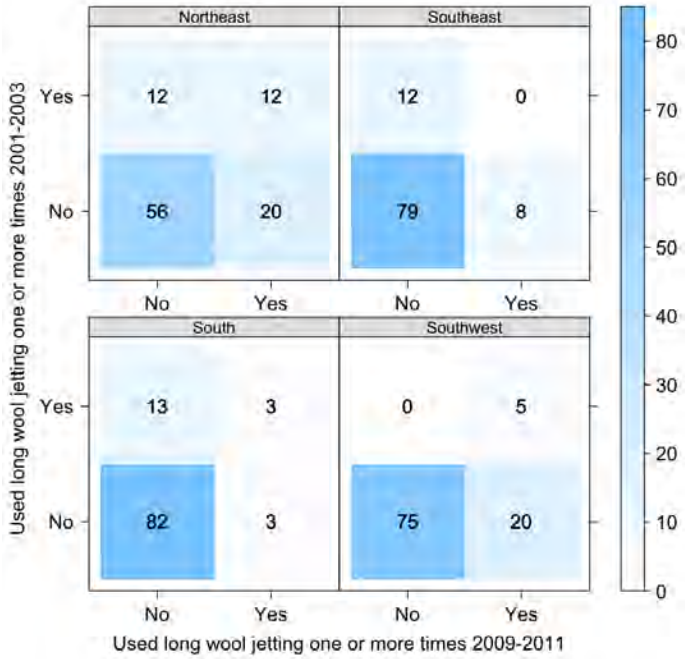
% of respondents

p=1.0000, n=108



Regional change tables	Exact McNemar's tests

% of respondents



	p value	*n*
NE	*0.7266*	*25*
SE	*1.0000*	*24*
S	*0.2188*	*39*
SW	*0.1250*	*20*

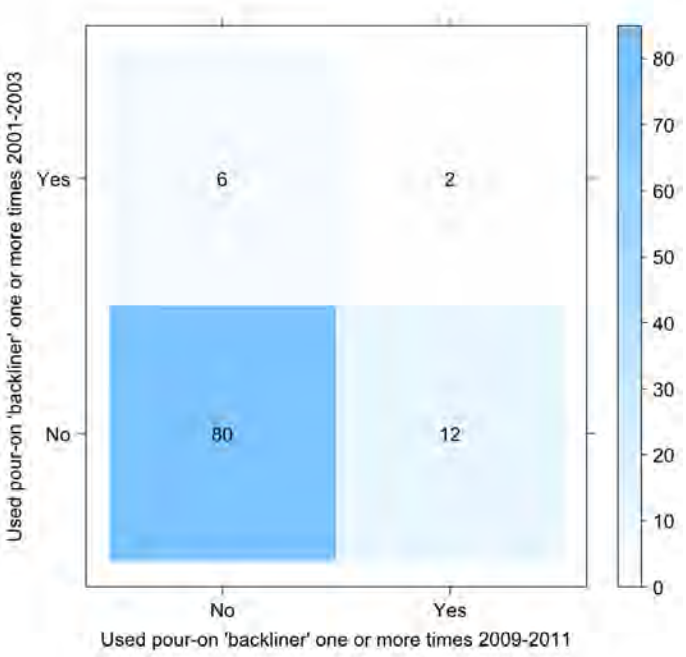
3.8.2.5 Long wool pour-on backliner

Wording in 2004: "Long wool pour-on 'backliner'", in 2012: "Long wool pour-on 'backliner'". However, the 2012 survey separated quarantine lice treatments from other treatments using hand jetting and pour-on 'backliners'. For comparability with 2004, the responses for quarantine and other treatments have been combined.

National change table	Exact McNemar's test

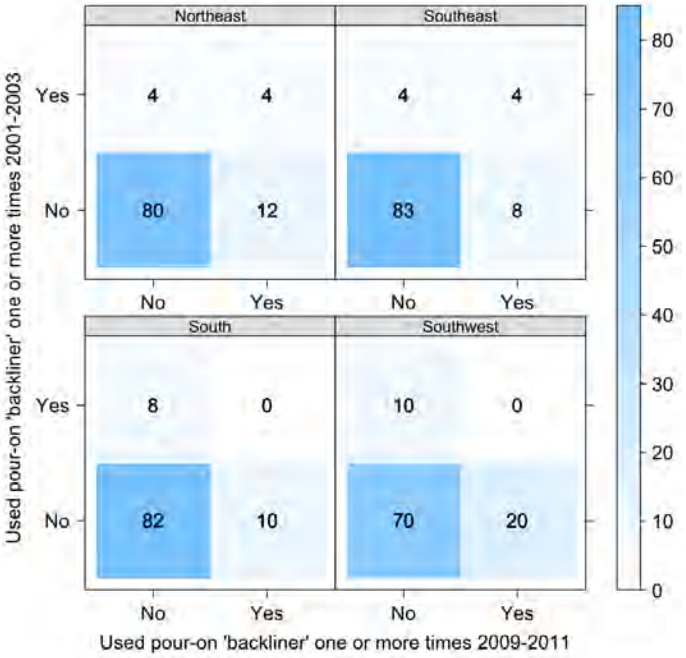
% of respondents

p=0.2632, n=108



Regional change tables	Exact McNemar's tests

% of respondents



	p value	*n*
NE	*0.6250*	*25*
SE	*1.0000*	*24*
S	*1.0000*	*39*
SW	*0.6875*	*20*

3.8.3 *Class of products used in lice treatments in the three years previous to the survey*

A number of items within the question on use of lice control techniques in 2004 and 2012 had very similar wording in the two surveys. Findings for these items are given below. Respondents could name one or more products that were used in one or more years within the three years previous to the survey.

3.8.3.1 Off-shears plunge dip

Wording in 2004: "Off-shears plunge dip", in 2012: "Off-shears or short wool plunge dip".

Product class	Proportion of products used one or more times 2001- 2003 (%)	Proportion of products used one or more times 2009- 2011 (%)
Abrasive	8.3	0.0
Insect development inhibitor	33.3	0.0
Macrocyclic lactone	0.0	2.6
Neonicotinoid	0.0	5.1
Organophosphate	58.3	69.2
Spinosyn	0.0	17.9
Unspecified lice treatment	0.0	5.1

χ^2=21.24, p=0.0281, number of respondents:43, number of products: 51.

3.8.3.2 Off-shears shower dip

Wording in 2004: "Off-shears shower dip", in 2012: "Off-shears or short wool shower dip".

Product class	Proportion of products used one or more times 2001- 2003 (%)	Proportion of products used one or more times 2009- 2011 (%)
Abrasive	8.0	4.2
Insect development inhibitor	36.0	16.7
Macrocyclic lactone	0.0	4.2
Organophosphate	56.0	50.0
Spinosyn	0.0	16.7
Unspecified lice treatment	0.0	8.3

χ^2=10.96, p=0.1958, number of respondents:29, number of products: 49.

3.8.3.3 Off-shears pour-on 'backliner'

Wording in 2004: "Off-shears pour-on 'backliner'", in 2012: "Off-shears or short wool pour-on 'backliner'".

Product class	Proportion of products used one or more times 2001- 2003 (%)	Proportion of products used one or more times 2009- 2011 (%)
Insect development inhibitor	95.1	26.1
Insect growth regulator	0.0	1.1
Macrocyclic lactone	0.0	1.1
Neonicotinoid	0.0	31.8
Organophosphate	0.4	13.6
Other	0.0	1.1
Spinosyn	0.0	19.3
Synthetic pyrethroid	4.5	2.3
Unspecified lice treatment	0.0	3.4

$\chi 2=31.97$, $p=0.00005$, number of respondents:126, number of products: 333.

3.8.3.4 Long wool hand jetting

Wording in 2004: "Long wool hand jetting", in 2012: "Long wool jetting". However, the 2012 survey separated quarantine lice treatments from other treatments using hand jetting and pour-on 'backliners'. For comparability with 2004, the responses for quarantine and other treatments have been combined.

Product class	Proportion of products used one or more times 2001- 2003 (%)	Proportion of products used one or more times 2009- 2011 (%)
Insect development inhibitor	35.6	0.0
Macrocyclic lactone	8.9	52.0
Organophosphate	42.2	4.0
Other	0.0	12.0
Spinosyn	13.3	32.0

$\chi 2=34.05$, $p<0.00005$, number of respondents:33, number of products: 70.

3.8.3.5 Long wool pour-on

Wording in 2004: "Long wool hand pour-on", in 2012: "Long wool pour-on". However, the 2012 survey separated quarantine lice treatments from other treatments using hand jetting and pour-on 'backliners'. For comparability with 2004, the responses for quarantine and other treatments have been combined.

Product class	Proportion of products used one or more times 2001- 2003 (%)	Proportion of products used one or more times 2009- 2011 (%)
Insect development inhibitor	28.6	3.4
Insect growth regulator	0.0	6.9
Organophosphate	7.1	3.4
Spinosyn	0.0	62.1
Synthetic pyrethroid	64.3	20.7
Unspecified lice treatment	0.0	3.4

$\chi 2=33.61$, $p<0.00005$, number of respondents:32, number of products: 43.

3.8.4 Suspected lice resistance

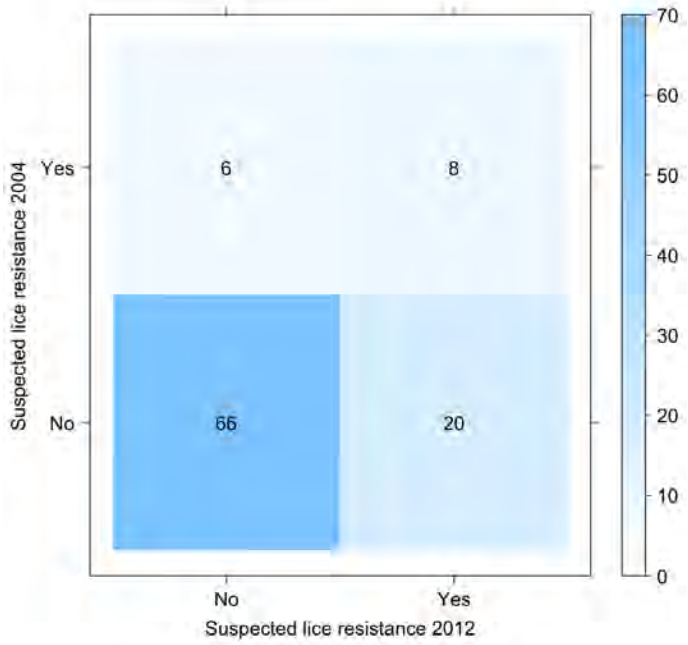
3.8.4.1 Incidence of suspected lice resistance

The question about suspected lice resistance was identical for the 2004 and 2012 surveys: "Have you ever suspected lice resistance to a product on your property?".

National change table	Exact McNemar's test

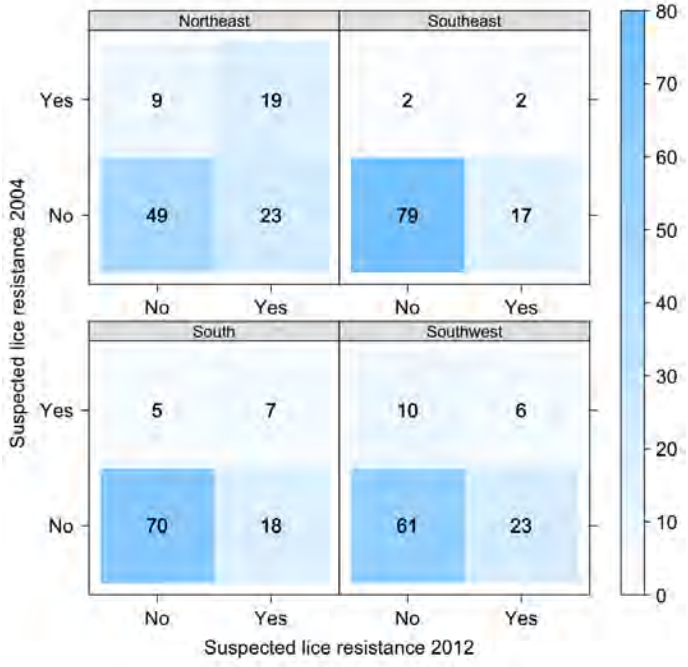
% of respondents

p=0.0003, n=108



Regional change tables	Exact McNemar's tests

% of respondents



	p value	*n*
NE	*0.1796*	*25*
SE	*0.0391*	*24*
S	*0.0574*	*39*
SW	*0.3438*	*20*

3.8.4.2 Products to which lice were suspected to be resistant

In both 2004 and 2012, respondents who answered that they had suspected resistance to a lice product, were ask to list the products.

Product class	Proportion of products used one or more times 2001- 2003 (%)	Proportion of products used one or more times 2009- 2011 (%)
Insect development inhibitor	44.0	68.3
Neonicotinoid	0.0	2.4
Organophosphate	8.0	7.3
Other	0.0	9.8
Spinosyn	0.0	2.4
Synthetic pyrethroid	48.0	2.4
Unspecified lice treatment	0.0	7.3

$\chi 2=19.85$, $p=0.0324$, number of respondents:48, number of products: 66.

APPENDIX A1

A1 METHODS

A1.1 Survey content

The first draft of the benchmark survey questionnaire was based on the 2004 survey and then circulated among researchers involved in the 2004 survey for comment. The second draft was then circulated to a small number of researchers in the field who had not been involved in the 2004 survey, and further adjustments made to the content.

A1.2 Sample frame

The addresses of sheep producers currently in the same postcode districts as used in the 2004 survey were provided by AWI. This address list had larger numbers of sheep producers than the address list supplied in 2004. As a result, samples of producers were drawn for the New England, Queensland and South Australia regions, whereas the whole list of producers in each of these regions was used in 2004.

Random samples were drawn in each region by assigning a random number to each address, sorting the addresses in ascending order by the random number and taking the required number of addresses from the top of the sorted list. The same sized sample of addresses as for the 2004 survey was used in each region.

Of the 6,361 addresses, it was possible to match 240 with addresses of producers in 2004 who had returned a survey at that time. As these 240 would not provide a sufficiently large sample, allowing for the likely response rate, further addresses were obtained from the full 2011 address list that could be matched with addresses of producers in 2004 who had returned a survey. This yielded a further 517 addresses, giving a sample frame for the longitudinal component of 757 addresses (Table A1.0).

Table A1.0 Sample frame details.

Region	No. Mailed Out
New Eng.	116
QLD	56
NSW (rem)	197
VIC	145
SA	114
WA	129
TOTAL	757

The first surveys were sent out from February 2012 over a period of several weeks, with surveys being sent to WA addresses later in the period. Reminders were sent out approximately six weeks after the first mail out. A short one page letter and questionnaire (short survey) developed for the 2004 survey and containing a small number of key questions was mailed to remaining non-responders approximately six weeks after the reminder. This was to encourage non-responders to answer just a few questions from the main questionnaire so that it was possible to analyse the extent to which there was non-response bias in the data from the full questionnaire.

Data from the surveys received up until 13 July 2013 were included in the analysis. Figures for responses received up until this date are shown in Table A1.1.

Table A1.1. Survey response rates. Response rate is calculated as follows: the number of producers with 500+ sheep in the original mailout is estimated using the proportion of returned questionnaires with <500 sheep and 500+ sheep. The response rate is given by the number of completed questionnaires with 500+ sheep as a percentage of the estimated number of producers with 500+ sheep in the original mailout (allowing for questionnaires returned as not deliverable by Australia Post due to the addressee having left the address or not being known at the given address).

Region	No. Mailed Out	Mailed Out Less RTS	Full surveys returned 500+ sheep	Full surveys returned <500 Sheep	Short surveys returned 500+ sheep	Short surveys returned <500 sheep	Estimate of No. in Mail Out with >500 Sheep	Response Rate (full survey) (%)	Response Rate (full and short surveys) (%)
New Eng.	115	112	34	10	11	0	94	36	48
QLD	56	55	21	6	10	0	47	45	66
NSW (rem)	198	190	54	16	21	0	163	33	46
VIC	145	145	35	17	13	2	104	34	46
SA	114	112	39	14	18	0	92	43	62
WA	129	126	36	13	18	2	101	36	53
TOTAL	757	740	219	76	91	4	601	36	52

A1.3 Coding of text answers

The full questionnaire contained 25 questions or parts of questions where the respondent could provide a text answer (rather ticking a box, or providing a numerical answer or numerical rating). In many cases, questions with tick boxes or numerical ratings of a series of items were followed by a space with "Other, please describe". This provided a check that the series of items had not omitted something that was important to respondents. Where a small number of text answers were provided, and it could be inferred from these answers that no important item had been omitted, the text answers were used as a check on the answers to the items preceding the "Other, please describe" space.

A number of questions with text answers required analysis in their own right and coding schemes for each question were developed in close consultation with the project participants.

A1.4 Data quality control

Data was analysed using R (R Development Core Team, 2011). Frequency distributions of all variables in the dataset were examined (the dataset comprised a rectangular array of numbers with a row for each respondent and a column or columns for each question – each row is termed a case, and each column is termed a variable). Where values outside the expected range of values were encountered, the data was checked against the returned questionnaires for misreading or keystroke errors and corrections made where necessary. Where out-of-range values were not due to either misinterpretation of the question by the respondent or an error by the data entry operator, these were noted as possible outliers and given further consideration as to their inclusion or exclusion at the appropriate stage of the analysis.

A number of questions required specific quality control procedures. These are described in the subsections below.

A1.4.1 Sources of income

The percentages of various sources of income were summed and where it appeared that minor errors had been made by the respondent, the income source percentages were proportionally adjusted to sum to 100 per cent. If the failure to sum to 100 per cent was due to a major omission of the percentage for a particular income source, this was treated as missing data.

A1.4.2 Property area and land use

The percentages of the property under various land uses, viz. improved pasture, unimproved pasture , cropped and 'Other' and where it appeared that minor errors had been made by the respondent, the land use percentages were proportionally adjusted to sum to 100 per cent. If the failure to sum to 100 per cent was due to a major omission of the percentage for a particular land use, this was treated as missing data.

A1.4.3 Length lambs' tails docked

Ninety per cent of respondents ticked only one box out the four choices for this question. Of the ten per cent ticking more than one box, eight per cent ticked two adjoining boxes, indicating that they docked to a length between that given by the two adjoining items. The remaining two per cent of respondents appeared to dock lambs' tails to two or more quite different lengths. To maintain comparability with the results from the 2004 survey, one or more ticked items were randomly deleted from the ten per cent of respondents giving multiple answers, until there was just one answer left for each respondent.

A1.5 Cross-sectional and longitudinal sample comparison

Over time, the sample of producers in a longitudinal survey is increasingly likely to have different characteristics to the population, due to new entrants to the industry that are not represented in the longitudinal survey sample. To provide an indication of the representativeness of the longitudinal survey sample, the ensuing sub-sections, below, compare two groups of producers. The first group comprised those producers who were in the random sample of producers from the postcodes of interest in the 2011 shareholder database. These producers were taken as representative of the producer population (the assessment of nonresponse bias described in Appendix 1 of the companion report on the cross-sectional survey concluded that there was minimal nonresponse bias in this sample). The second group relates those producers from the additional 517 addresses who returned questionnaires in 2004 (see section A1.2, above). Of these 517 producers, 196 returned questionnaires in both 2004 and 2011 and these were taken to be representative of the full longitudinal sample (which contained both these producers and those who had been selected as part of the cross-sectional survey – see section A1.2, above). The comparison of the two groups used the subset of key questions that were common to both the full and short surveys.

The questions for which there was a significant ($p<0.01$) difference between the longitudinal and cross-sectional groups are shown in the tables below. The tables are presented in the order in which the questions appeared in the short survey. The numbers of respondents varies from table to table as respondents can miss answering particular questions or parts of questions.

A1.5.1 Cattle numbers

There was no significant difference between the longitudinal and cross-sectional groups in the proportion who had cattle, nor in the mean size of cattle heard among those who did have cattle.

A1.5.2 Sheep numbers

There was no significant difference between the average flock size (number of sheep typically run) of those in the longitudinal group and those in the cross-sectional group. The mean flock size for the former was 3,402 and for the latter, 3,374.

A1.5.3 Lice treatment

There was no significant difference in the frequency of use of off-shears and/or short wool lice treatments between 2009 and 2011 among those in the longitudinal group and those in the cross-sectional group.

A1.5.4 Mulesing and Anti-Flystrike Clips

There was no significant difference in the incidence of various changes in mulesing and skin clip practices between the longitudinal group and those in the cross-sectional group

A1.5.5 Frequency of monitoring worm egg counts in ewes and lambs

There was no significant difference in the average number of times in 2011 ewe and lamb egg counts were monitored, between the longitudinal group and those in the cross-sectional group. Similarly, there was no significant difference in the average number of mobs tested each time.

A1.5.6 Drench resistance test

There was no significant difference between the longitudinal and the cross-sectional group in whether or not they had carried out a drench resistance test in the last five years. There was also no significant difference between the two groups with respect to the proportion who had carried out one or more drench resistance tests in the last five years, of the following types: faecal egg count reduction test, laboratory larval development test, worm egg count conducted before drenching and again within three weeks, and worm egg count conducted only within three weeks after drenching. However, in terms of the actual number of drench resistance tests conducted in the last five years, there was a significant difference in the mean number of tests conducted for the worm egg count conducted only within three weeks after drenching (Table A1.2).

Table A1.2. Difference in use of worm egg counts conducted only within three weeks after drenching, 2007 – 2011. The mean includes those respondents who conducted zero tests.

Respondents in ...	Mean number of worm egg counts conducted only within three weeks after drenching, 2007 – 2011
Longitudinal group	0.34
Cross-sectional group	0.14

Anova, F=4.91, p=0.027, n=1222

Investigation of the data revealed that the mean for the longitudinal group had been inflated by just two respondents, who reported that they had conducted this test 15 and 30 times, respectively. Examination of other data from these respondents suggested that at one was a progressive producer and the 30 tests reported was unlikely to be an error. However, the distribution of the number of tests was highly skewed, with just over 95 per cent of respondents conducting no tests. In these circumstances, a Kruskal-Wallis test is to be preferred and this suggested there was no significant difference between the longitudinal and cross-sectional groups .

A1.5.7 Conclusions

Overall, the findings above show that the longitudinal group of producers, viz. those who responded to both the 2004 and 2011 surveys, does not appear to be systematically different from the random sample of producers in 2011. The changes shown by this group of producers between 2004 and 2011 can therefore be taken as representative of changes more generally among producers in the study area.

A1.6 Choice of Statistics in Tables

Tables presented in the main body of the report aim to present as much detail as possible about the nature of change between 2004 and 2012, consistent with the space available and the need for ready readability. The types of statistics presented varies according to the type of data obtained from survey questions and the type of table.

A1.6.1 Continuous variables

Generally, scatter plots of 2004 values against 2012 values do not readily convey the nature of change between the two surveys. For this reason, the results for continuous variables are mostly presented as box plots with additional information on means and confidence intervals included. However, in some cases, continuous variables only took a small number of values and these were highly skewed, such that the usual descriptive statistics such as medians, means and confidence intervals do not readily convey the nature of change. In these cases, the variable was transformed to an ordinal variable, with the long tail of the skewed distribution lumped into a single category. The variable was then treated as described in section A1.6.2, below. Where the distribution of the continuous variable was reasonably close to a normal distribution, paired t-tests were used to test the significance of the difference between 2004 and 2012 means.

A1.6.2 Ordinal variables from single choice questions

Where questions required the choice of just one item from among a number of possible choices, and there were not a large a number of possible choices, results have been presented as level plots at the national level. Regional level plots were only possible where there was a relatively small number of possible choices. Otherwise regional findings are presented as stacked bar plots. Since in a longitudinal study, the choices made by each respondent in 2004 and 2012 are known, the overall change between surveys is the aggregate of individual changes in the choice made in 2004 and 2012. Those respondents who did not change their choice have no effect on the aggregate change (the level plot cells on the bottom left to top right diagonal). What is of interest is the number of respondents who changed their choice in the direction of an increasing score, versus the number who changed their choice in the opposite direction. The statistical significance of this difference is examined with McNemar's test if there are only two items in the question from which to choose, or with a marginal homogeneity test if there are more than two items. These are asymptotic tests that require sufficient numbers in the off-diagonal cells for the distribution of the test statistic to approximate a chi-square distribution. Where the numbers of respondents in the off-diagonal cells are less than 25, the exact forms of the tests were used.

A1.6.3 Ordinal or nominal variables from multiple choice questions

A number of questions were inherently multiple choice questions, e.g. the months in which lambing took place. The data from these questions is generally not amenable to statistical tests for differences in a longitudinal study, unless tests are performed item by item across the range of question choices, e.g. month by month for the question on months of lambing. In these cases, the 2004 and 2012 distributions have been presented in bar plots and figures for a small number of items in which there were the greatest changes presented.

A1.6.4 Multi-level data

A number of questions in the questionnaire give rise to multi-level data, i.e. data where there are several levels that could be chosen as the unit of analysis. For example, respondents reporting on their lice control practices could nominate one or more practices (such as plunge dip). For each practice they could nominate one or more years between 2001 and 2003 when they undertook the practice. For each year they could nominate one or more products used in that year. Such a data structure can be analysed with respondents as the unit of analysis (and for example, aggregating products across years and practices), or with treatments as the unit of analysis (aggregating products within years or within types of practices), or with products as the unit of analysis. A further complication with this type of data structure is that the same product can be validly named several times (for example, where it is used each year for three years). In this situation, a table of proportions based on counts of respondents may have a cell in which the proportion is greater than 100 per cent. While the figure is quite correct given the structure of the data and the proportion based on counts of respondents, it is cognitively discomforting to comprehend the meaning of a statement that, for example, 125 per cent of respondents used product X. The best that can be inferred from such a statement is that a fair few people must have used product X and quite a lot probably used it several times.

To avoid this type of problem the following guidelines were followed in reporting from multiple choice and multi-level questions. Where the nature of the multiple choice question was such that the same category could not be indicated more than once by the respondent, the percentages in the table reporting on the question were expressed in terms of respondents. In this situation, no single cell can be more than 100 per cent, but the sum of a row of cells may exceed 100 per cent, due to the question allowing multiple choices. Where the latter is a possibility, this is noted in the footnote to the table.

Where the nature of the multiple choice question was such that the same category could be indicated twice (as in the example of the same lice control product used in consecutive years), the percentages in the table were expressed in terms of products, or treatments, or whatever it was for which the respondent could validly name several of the same category.

Multiple choice and multi-level data are generally ill fitted to the assumptions behind the statistical tests used on data from single choice questions. In addition, while the longitudinal study deals with a single group of respondents who provided data in both 2004 and 2012, analysis at a treatment or product level cannot be treated as longitudinal, since single respondents can use more or less treatments or products in 2004 compared to 2012. For these reasons, inferential statistics that can only be presented if data is restructured and treated as repeated cross-sectional data. No statistics are presented in results from multiple choice questions.

A1.6.5 Statistical software

All data transformations and statistical tests were performed with the R statistical package (R Development Core Team, 2012). In addition a number of contributed packages were used for specific tests as follows:

- asymptotic and exact marginal homogeneity tests: coin package (Hothorn et al., 2006, 2008), and
- exact forms of McNemar's test: exact2x2 package (Fay, 2010).

Level plots, bar plots and box plots were produces with the lattice package (Sarkar, 2008).

A1.7 Calculation of DSEs

Where stock numbers have been converted to DSEs, the conversion factors used were taken from McLaren (1997). Attwood provides conversion factors based on daily energy requirements for a number of classes of livestock at two liveweights and, in some case, at different rates of weight gain. As the survey questionnaire did not collect information on liveweight or weight gain, conversion factors in the middle of the range given by Attwood were used. The conversion factors used are shown in the table below.

Livestock type in questionnaire	Factor for conversion to DSEs
Q5 – Cows	12.0
Q5 – Heifers (weaning – 2 years)	7.0
Q5 Steers (weaning – sale)	7.0
Q5 – Bulls	12.0
Q5 – Other	Factor chosen according to description
Q6 – Merino ewes	1.2
Q6 Other ewes	1.2
Q6 – Wethers	1.0
Q6 – Merino weaners	1.3
Q6 – Other weaners	1.3
Q6 – Rams	1.0

A1.8 References

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McLaren, C. 1997. *Dry Sheep Equivalents for Comparing Different Classes of Livestock.* Information Note AG0590. Victorian Department of Primary Industries, Melbourne.

R Development Core Team (2012). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, URL http://www.R-project.org/.

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APPENDIX A2

Benchmarking Australian Sheep Parasite Control
A National Survey

Dear Sheep Producer,

We invite you to participate in a national survey on control of sheep parasites. This survey will evaluate change in parasite control practices between 2003 and 2011 and set a new benchmark of current practices against which to measure future change.

This survey builds on a similar major survey of sheep producers in 2004 (Integrated Parasite Management in Sheep project: Benchmark Survey). The detailed report from that survey is available for download from AWI's website at:http://www.wool.com. Just put IPM-s in the Search box on this page and you will be taken to where the report can be downloaded.

Since that survey there have been a number of major initiatives in parasite control including the Integrated Parasite Management in Sheep project and the development of the WormBoss, FlyBoss and LiceBoss initiatives. This period has also seen consumer pressure on blowfly control options and an increase in drench resistance. It is vital for a profitable sheep industry that we continue to optimize our parasite control methods to reduce production loss, reduce chemical residues in our products and slow the development of resistance to the chemicals used for parasite control.

There is very little writing required to fill in the survey, it is mainly just ticking boxes to indicate your answer. It will take approximately 30 minutes to complete the survey. We hope you will consider being involved. A reply-paid envelope is provided for the return of your questionnaire. The information to be gathered in this survey will, of course, remain confidential, and all respondents will remain anonymous.

More information on the project and the survey is provided on the back of this letter, or you can phone or email either of the UNE staff listed below.

Thank you for your cooperation.

Yours faithfully,

Steve Walkden-Brown (Research team leader)
Animal Science, UNE. (02) 6773 5152 swalkden@une.edu.au

Ian Reeve (Survey team leader)
Institute for Rural Futures, UNE. (02) 6773 5145
ireeve@une.edu.au

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Information Sheet for Participants

About the project

The survey is the second national benchmark survey of sheep producers, following the first survey in 2004. The survey will evaluate change in parasite control practices between 2003 and 2011 and set a new benchmark of current practices. The aim of this survey is to find out what parasite control methods are currently being used for the control of internal and external parasites in sheep to make sure that research meets the needs of sheep producers.

How your address was selected

Your address was provided to us by AWI. The number on the front of the survey is for mailing purposes only – this will ensure that you will not be sent any unnecessary reminders. We will not be using your address for any purposes other than this survey.

Filling in the survey

Your participation is entirely voluntary and you can fill in as little or much of the survey as you can spare time for. We appreciate it is hard for producers to find time to fill in surveys and have made every effort to make the questions as short and easy to answer as possible. It is not necessary to consult your farm records, unless you prefer to. Answering from memory is all that is required. If you mislay the envelope you can return the questionnaire to Reply Paid 61883, University of New England, Armidale, NSW 2351.

Security of your information

Your name is not required on the questionnaire. The information you provide is accessible only to the research team at UNE, and will be held in secure storage at UNE. Your completed questionnaire will be destroyed after five years, while the data will be held on a secure server to be used in future national benchmark surveys. Information on individual farms will not be made available to other organisations or published.

Withdrawing from the study

Posting the completed questionnaire to the University signifies that you have given your consent for the information you have supplied to be used in this study. You are free to withdraw this consent at any time without prejudice. Simply mail a note to this effect to Reply Paid 61883, University of New England, Armidale, NSW 2351, and your completed questionnaire will be destroyed and the data from it will be removed from the study.

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Benchmarking Australian Sheep Parasite Control
A National Survey

Reminder:

If you have already returned the survey, please ignore this letter. Thank you for helping with this project.

Dear Sheep Producer,

We recently sent you a survey form for the national survey on the control of sheep parasites. We have had a good response in some regions of Australia, but in other regions the survey has coincided with a busy time of year.

We just wanted to let you know that if you haven't had a chance to fill in the form, there is still time to do so. If you are able to find the time to complete the form in the next two or three weeks, the information you provide will help give a better picture of sheep parasite control right across Australia. This will enable research and extension to be better focused on the needs of sheep producers in all areas.

There is very little writing required to fill in the survey, it is mainly just ticking boxes to indicate your answer. It will take approximately 30 minutes to complete the survey. We hope you will consider being involved. A reply-paid envelope is provided for the return of your questionnaire. The information to be gathered in this survey will, of course, remain confidential, and all respondents will remain anonymous.

More information on the project and the survey is provided on the back of this letter, or you can phone or email either of the UNE staff listed below.

Thank you for your cooperation.

Yours faithfully,

Steve Walkden-Brown (Research team leader)
Animal Science, UNE. (02) 6773 5152 swalkden@une.edu.au

Ian Reeve (Survey team leader)
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How your address was selected

Your address was provided to us by AWI. The number on the front of the survey is for mailing purposes only – this will ensure that you will not be sent any unnecessary reminders. We will not be using your address for any purposes other than this survey.

Filling in the survey

Your participation is entirely voluntary and you can fill in as little or much of the survey as you can spare time for. We appreciate it is hard for producers to find time to fill in surveys and have made every effort to make the questions as short and easy to answer as possible. It is not necessary to consult your farm records, unless you prefer to. Answering from memory is all that is required. If you mislay the envelope you can return the questionnaire to Reply Paid 61883, University of New England, Armidale, NSW 2351.

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Benchmarking Australian Sheep Parasite Control

A National Survey

Dear Sheep Producer,

A few weeks ago we sent you a survey about what parasite control methods you are using. **If you have already returned this survey, please ignore this letter and take this as our sincere thanks for your help.**

We have had a good response which has been invaluable in providing information about how some sheep producers are controlling parasites in their flocks.

So that we can make sure that this project is of maximum benefit to all sheep producers, we need at least a small amount of information from producers such as yourself.

We appreciate that it can be hard to find the time to respond to the many surveys that primary producers receive. The few questions below will take only two minutes of your time to answer.

Your cooperation in this important project for the sheep industry is greatly appreciated.

Yours faithfully

Steve Walkden-Brown and Ian Reeve, UNE
Ph:02 6773 5152 Ph:02 67735145

Two minutes of your time .... **Helps us develop new and better ways to control parasites that will benefit you and other sheep producers**

1 How many cattle and sheep do you run in a typical year?

_____ cattle

_____ sheep

2 Have you undertaken any of the following lice treatments in the last 3 years? *(please tick any that apply)*

Lice treated off-shears	❒
Lice treated short wool (1 day to 6 weeks)	❒
Lice treated long wool (over 6 weeks)	❒

3 If you used mulesing or Anti-Flystrike Clips in 2011, please give an estimate of the percentage of your replacement sheep treated in 2003 and 2011.

Percentage mulesed 2003	_____%
Percentage mulesed 2011	_____%
Percentage skin clipped 2011	_____%

4 If you monitored worm egg counts in 2011, how many times did you do this?

For ewes _____

For lambs _____

Average number of mobs tested each time?_____

5 Please indicate the number of drench resistance tests used in the last 5 years.

No tests done	❒
FECRT (formal on-farm faecal egg count reduction test)	____
DrenchRite (laboratory larval development test)	____
Worm egg count conducted before drenching and again within 3 weeks after drenching	____
Worm egg count conducted only within 3 weeks after drenching	____

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Steve Walkden-Brown (Research team leader)
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Ian Reeve (Survey team leader)
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PARASITE MANAGEMENT IN THE SHEEP INDUSTRY – 2011

❒ Yes ❒ No

If 'Yes', please continue to fill in the survey. Thank you for your help.

If 'No', please send this blank survey back in the envelope provided, so that you do not receive any unnecessary reminders

Guide and Definitions

1 The best person to fill in the survey is the person who makes the major decisions about the management of livestock on the property.

2 Please fill in the questions for the property on which you reside or spend the most time.

3 If there is insufficient space for your answers to any of the questions, please feel free to put them on a separate sheet of paper and enclose it with the survey form.

4 If a word in the survey is underlined like this, you will find a definition on this page.

WEC	Faecal worm egg count (sometimes called FEC).
Marking %:	(Lambs marked / Ewes joined) x 100
Sheep classes	
Adult ewes	Have lambed previously
Maiden ewes	Ewes being bred for the first time
Lambs or weaners	Milk teeth, less than12 months
Hoggets	2-tooth, 12-18 months)
Intensive rotational grazing	Short graze periods of 1-4 days in summer, up to 8 days in winter.
Smart Grazing	Method of using sheep in the preparation of low worm risk paddocks. Drench sheep with known effective chemical, place in intended low risk paddock for a month or less (ideally less than 3 weeks) then remove sheep. When the pasture has recovered the paddock is low risk.
ASBV	Australian Sheep Breeding Value provided by LAMBPLAN or MERINOSELECT. A measure of the genetic merit of an animal for a range of traits.
Drench group	A drench group indicates a different chemical group, e.g. benzimidazole (BZ), levamisole (LEV), organophosphate (OP) macrocyclic lactone ML, "mectins") or monepantel. Typically resistance to one drench within a group results in side resistance to others in the group, but does not lead to resistance to other groups.

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Section A: Your Farm

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Please provide information from 2011, unless otherwise specified

1. How much rainfall did you receive in 2011?

Rainfall received on your farm - 2011
_____ mm OR _____ inches

2. What was the estimated percentage of income from each enterprise in 2011?

Enterprise type	**Income (%)**
Wool sales	_____
Sheep sales (stores, culls & cast for age, boat wethers)	_____
Sheep sales (First cross ewe sales for breeding)	_____
Sheep sales (1st or 2nd cross prime or store lambs)	_____
Beef cattle	_____
Cropping	_____
Other *(please specify)* _____	_____
	TOTAL: 100%

3. Property size and land uses in 2011.

Total property area	_____ hectares OR _____ acres
Number of paddocks	_____
Percentage improved pasture	_____ %
Percentage unimproved pasture	_____ %
Percentage cropped	_____ %
Other *(please specify)* _____	_____ %
	TOTAL: 100%

4. How many cattle did you have in 2011? Please also indicate the number you typically run (if this is different to the number run in 2011) and the usual month(s) of calving.

No cattle ❒	**Number 2011**	**Number typically run**	**Month(s) of calving**
Cows	_____	_____	_____
Heifers (weaning – first calf)	_____	_____	_____
Steers (weaning – sale)	_____	_____	
Bulls	_____	_____	
Other *(please specify)* _____	_____	_____	_____

5. How many sheep did you have at the main weaning time in 2011, or November 2011 if you have an all wether flock? Indicate the number you typically run if different to the number you had in 2011.

	Breed	**Number 2011**	**Number typically run**
Merino ewes		_____	_____
Other ewes	_____	_____	_____
Wethers	_____	_____	_____
Merino weaners		_____	_____
Other weaners	_____	_____	_____
Rams	_____	_____	_____

6. In which month(s) did you shear and crutch in 2011?

Sheep class	**Month(s) shorn**	**Month(s) crutched**
Ewes (older than 12 months)	_____	_____
Wethers (older than 12 months)	_____	_____
Weaners (less than 12 months)	_____	_____
Rams	_____	_____

7. If you have ewes, please provide details about their breeding programme:

	Merino ewes mated to Merino rams	**Merino ewes mated to Meat-breed rams**	**Cross-bred ewes**	**Other ewes** *(specify)* _____
Month rams put in with ewes in 2011	_____	_____	_____	_____
Time rams left with ewes in 2011	_____	_____	_____	_____
Marking % in 2011 (adults ewes only)	_____	_____	_____	_____
Typical marking % (adult ewes only)	_____	_____	_____	_____
Month lambs weaned in 2011	_____	_____	_____	_____

8. How important to you are each of the following key objectives when determining your overall grazing strategy?
(please rate on a scale of 1 to 5, where 1 = 'very important', and 5 = 'not important')

Objective	**Rating**
Ease of management	_____
Improved pasture productivity	_____
Improved pasture persistence/sustainability/weed control	_____
Improved animal productivity	_____
Parasite control	_____
Utilise crops and stubbles	_____
Other *(please specify)*_____	_____

9. Have you changed your grazing strategy in recent years?

Yes ❒ No ❒

If so, why?

_____

_____

_____

Section B: Worm Control

10. Please show the number and type of chemical worm treatments given to each class of sheep in 2011. If several different classes of sheep were treated in the same month, please use a separate line for each class.

Month of treatment in 2011	**Sheep class**	**Product category**			**Product names** *If two products used at the same time indicate with a "+" between them. If unsure of product name, write "unknown".*
		Drench ❒	**Capsule** ❒	**Injectable** ❒	
_____	_____	❒	❒	❒	_____
_____	_____	❒	❒	❒	_____
_____	_____	❒	❒	❒	_____
_____	_____	❒	❒	❒	_____
_____	_____	❒	❒	❒	_____
_____	_____	❒	❒	❒	_____
_____	_____	❒	❒	❒	_____
_____	_____	❒	❒	❒	_____
_____	_____	❒	❒	❒	_____
_____	_____	❒	❒	❒	_____
_____	_____	❒	❒	❒	_____
_____	_____	❒	❒	❒	_____
_____	_____	❒	❒	❒	_____
_____	_____	❒	❒	❒	_____
_____	_____	❒	❒	❒	_____
_____	_____	❒	❒	❒	_____
_____	_____	❒	❒	❒	_____
_____	_____	❒	❒	❒	_____
_____	_____	❒	❒	❒	_____
_____	_____	❒	❒	❒	_____
_____	_____	❒	❒	❒	_____

11. If you monitored worm egg counts in 2011, please fill in the table below, otherwise skip to question 13.

Month of monitoring in 2011	Sheep class	Number of mobs in class	Numbered of mobs monitored on this date	Monitor type (if known)	
				Individual mob animal WEC	Bulk WEC
_____	_____	_____	_____	❒	❒
_____	_____	_____	_____	❒	❒
_____	_____	_____	_____	❒	❒
_____	_____	_____	_____	❒	❒
_____	_____	_____	_____	❒	❒
_____	_____	_____	_____	❒	❒
_____	_____	_____	_____	❒	❒
_____	_____	_____	_____	❒	❒
_____	_____	_____	_____	❒	❒
_____	_____	_____	_____	❒	❒

12. **Who carried out the worm egg counts you have listed in the table above?**

Self ❒ Govt lab ❒ Private lab ❒ Your vet or consultant ❒ Other _____

13. **Please provide details in the table below of any drench resistance tests you have undertaken between 2006 and 2011.** *(please tick all that apply)*

	2006	2007	2008	2009	2010	2011
No drench resistance tests undertaken	❒	❒	❒	❒	❒	❒
FECRT (on-farm faecal egg count reduction test)	❒	❒	❒	❒	❒	❒
DrenchRite (laboratory larval development test)	❒	❒	❒	❒	❒	❒
Worm egg count conducted before drenching and again within 3 weeks after drenching	❒	❒	❒	❒	❒	❒
Worm egg count conducted only within 3 weeks after drenching	❒	❒	❒	❒	❒	❒
Other *(please specify)*_____	❒	❒	❒	❒	❒	❒

14. **If you did undertake any drench resistance testing, who assisted with the testing?**

Vet or consulant ❒ Govt or LHPA advisor ❒ Drug company rep ❒ Other _____

15. How would you rate the drench resistance status of the following drench groups for the main worm species on your property? Efficacy is measured as % reduction in WEC following treatment and during the claimed efficacy period. Exclude efficacy of capsule preparations.

Drench Group	**Major resistance** (less than 80% reduction in WEC)	**Moderate resistance** (80-95% reduction in WEC)	**No resistance** (over 95% reduction in WEC)	**Don't know**
BZ (white drenches) e.g. Oxfen®, Alben®, Valbazen®, Panacur®, Fenbendazole® Extender capsules®	❒	❒	❒	❒
Levamisole (Clear drench) e.g. Nilverm® Ripercol®, Rycozole®	❒	❒	❒	❒
Organophosphate e.g. Rametin®, Combat®	❒	❒	❒	❒
Ivermectin e.g. Ivomec®, Ausmectin® Imax® Noromectin®, Paramax®, Genesis®	❒	❒	❒	❒
Abamectin e.g. Ovimectin®, Rycomectin®, Virbamec®, Abamax®, Zoomec®, Genesis injection ABamectin® Vetmec®,	❒	❒	❒	❒
Moxidectin e.g. Cydectin®	❒	❒	❒	❒
Closantel e.g. Seponver®, Closamax®, Closicare®, Sustain®	❒	❒	❒	❒
Triclabendazole (for fluke) e.g. Fasinex®, Exifluke®, Flukare®, Trickla®, Tremacide®	❒	❒	❒	❒
Monepantel e.g. Zolvix®	❒	❒	❒	❒
Others *(please specify)* _____ _____	❒	❒	❒	❒

16. **Please rank how important the following factors are when deciding whether to drench ewes and weaners.** *(please tick one per line for ewes (PART A) and weaners (PART B))*

PART A: Ewes

	Very important	Important	Somewhat important	Not important
Results from faecal worm egg count	❒	❒	❒	❒
Condition score of sheep	❒	❒	❒	❒
Time of year	❒	❒	❒	❒
Seasonal weather conditions	❒	❒	❒	❒
Availability of pasture	❒	❒	❒	❒
Quality of pasture	❒	❒	❒	❒
Presence of daggy sheep in mob	❒	❒	❒	❒
Weak sheep when driven (poor exercise tolerance)	❒	❒	❒	❒
Convenience, e.g. when sheep are yarded for other purposes	❒	❒	❒	❒
Appearance of sheep	❒	❒	❒	❒
Other *(please specify)*_____	❒	❒	❒	❒

PART B: Weaners

	Very important	Important	Somewhat important	Not important
Results from faecal worm egg count	❒	❒	❒	❒
Condition score of sheep	❒	❒	❒	❒
Time of year	❒	❒	❒	❒
Seasonal weather conditions	❒	❒	❒	❒
Availability of pasture	❒	❒	❒	❒
Quality of pasture	❒	❒	❒	❒
Presence of daggy sheep in mob	❒	❒	❒	❒
Weak sheep when driven (poor exercise tolerance)	❒	❒	❒	❒
Convenience, e.g. when sheep are yarded for other purposes	❒	❒	❒	❒
Convenience	❒	❒	❒	❒
Appearance of sheep	❒	❒	❒	❒
Other *(please specify)*_____	❒	❒	❒	❒

17. Which of the following treatments or techniques do you use for sheep worm control? *(please tick strategies used)*

		Description/Comment
Treating for worms (drenching, injection, capsule)	❒	_____
Prepare clean pastures by spelling/resting paddock ('long spelling')	❒	_____ _____
Prepare clean pastures by cropping paddock	❒	_____
Prepare clean pastures by cattle/sheep alternation	❒	_____
Prepare clean pastures by intensive rotational grazing	❒	_____
Prepare clean pastures using 'Smart Grazing' techniques	❒	_____
Leave some sheep un-drenched	❒	Show % left un-drenched: _____ %
Feeding strategy	❒	_____
Use rams selected for resistance to worms *(please describe)* _____	❒	With ASBV for WEC? Yes ❒ No ❒
Other *(please specify)* _____	❒	_____

Section C: Blowfly Control

18. **If you had blowfly strike on your property during 2011, please provide details below.**

Type of Strike	Percentage Ewes affected	Percentage Wethers affected	Percentage Weaners affected	Percentage Rams affected
Breech strike	_____ %	_____ %	_____ %	_____ %
Body strike	_____ %	_____ %	_____ %	_____ %
Pizzle strike		_____ %	_____ %	_____ %
Poll strike	_____ %	_____ %	_____ %	_____ %
Wound strike	_____ %	_____ %	_____ %	_____ %
Other *(please specify)*_____	_____ %	_____ %	_____ %	_____ %

19. Please provide details on your chemical treatments for blowfly strike in the table below.

	I usually do this	Month I did this in 2011	Chemical used in 2011
Treat your sheep routinely with preventive chemicals for flystrike every year	❒	_____	_____
Treat your sheep with preventive chemicals only when the risk of flystrike is high	❒	_____	_____
Treat the whole mob of sheep once flystrike is detected	❒	_____	_____
Only treat individually struck sheep	❒	_____	_____
Other *(please specify)*_____	❒	_____	_____

20. **Did you use mulesing or Leader Products Anti-Flystrike Clips to control blowfly strike in 2011?** *(Please tick the ones you used)*

Mulesing ❒

Leader Products Anti-Flystrike Clips ❒ *(if you ticked neither box, please skip to Question 24)*

21. **If you used mulesing or Anti-Flystrike Clips to control breech strike in 2011, who performed the mules operation or breech clipping on your sheep?**

Mulesing				Leader Products Anti-Flystrike Clips
Operator	***Accredited?***			***Operator***
Self ❒	Yes ❒	No ❒	Unsure ❒	Self ❒
Farm staff ❒	Yes ❒	No ❒	Unsure ❒	Farm staff ❒
Contractor ❒	Yes ❒	No ❒	Unsure ❒	Contractor ❒

22. If you used mulesing or Anti-Flystrike Clips in 2011, please provide details in the table below.

	Replacement ewe lambs	**Wethers**	**Other** *(specify)* _____
Age at mulesing/alternative (months)	_____	_____	_____
Percentage of mob treated:			
Mules	_____%	_____%	_____%
Clips	_____%	_____%	_____%
Pain relief provided after mulesing (eg Trisolfen®)	Yes ❒ No ❒	Yes ❒ No ❒	Yes ❒ No ❒
Some wool left on tail	Yes ❒ No ❒	Yes ❒ No ❒	Yes ❒ No ❒

23. **If you used mulesing or Anti-Flystrike Clips in 2011, please give an estimate of the percentage of your replacement sheep treated in 2003 and 2011.**

Proportion mulesed 2003 _____ % Proportion mulesed 2011 _____ %

Proportion skin clipped 2011 _____ %

24. **At what length do you dock lambs' tails?** *(please tick all that apply)*

Tail length		**Type(s) of sheep**
Much shorter than tip of vulva in ewes ('butted tail')	❒	_____
Just shorter than tip of vulva ('short tail')	❒	_____
Equal to the tip of the vulva	❒	_____
Longer than the tip of the vulva	❒	_____
Other *(please specify)*_____	❒	_____

25. **If you used *genetic selection* to assist with blowfly strike control in 2011, please indicate which genetic selection method/s you used.** *(please tick all that apply)*

Method	Ewes		Rams	
	Visual	***ASBV***	***Visual***	***ASBV***
Cull sheep with fleece rot	❒		❒	
Cull sheep with body strike	❒		❒	
Cull sheep with breech strike	❒		❒	
Select for plain bodied sheep	❒		❒	
Select for low breech wrinkle	❒	❒	❒	❒
Select for bare breech area	❒	❒	❒	❒
Select for low CV of fibre diameter	❒	❒	❒	❒
Select for low dag score	❒	❒	❒	❒
Other *(please specify)*_____	❒	❒	❒	❒

26. Did you use any of the following methods to assist with blowfly control in 2011? *(please tick all the methods that you used)*

Method		Details on how method used (if applicable)
Timing of shearing	❒	_____
Timing of crutching	❒	_____
Trapping flies (e.g. Lucitrap)	❒	_____
Destroy maggots from treated sheep clippings	❒	_____
Other method *(please specify)* _____	❒	_____

Section D: Lice Control

27. **Please summarise your lice detection and treatment methods between 2006 and 2011?** *(please tick all that apply)*

	2006	2007	2008	2009	2010	2011
Lice detection						
No evidence of lice seen	❒	❒	❒	❒	❒	❒
Sheep seen rubbing	❒	❒	❒	❒	❒	❒
Live lice seen	❒	❒	❒	❒	❒	❒
Lice detected by ELISA (Lab test)	❒	❒	❒	❒	❒	❒
Lice treatment						
No lice treatment	❒	❒	❒	❒	❒	❒
Lice treated off-shears	❒	❒	❒	❒	❒	❒
Lice treated short wool (1 day to 6 weeks)	❒	❒	❒	❒	❒	❒
Lice treated long wool (over 6 weeks)	❒	❒	❒	❒	❒	❒

28. **Please indicate below which of the following lice control techniques and products you have used in the past three years (2009-2011).**

		Year/s used	Contractor used	Product/s used
Off-shears or short wool	Plunge dip	_____	Yes ❒ No ❒	_____
	Shower dip	_____	Yes ❒ No ❒	_____
	Pour-on 'backliner'	_____	Yes ❒ No ❒	_____
	Other *(please specify)* _____	_____	Yes ❒ No ❒	_____
Long wool	Jetting	_____	Yes ❒ No ❒	_____
	Pour-on 'backliner'	_____	Yes ❒ No ❒	_____
	Other *(please specify)* _____	_____	Yes ❒ No ❒	_____
Quarantine (introduced sheep)	Jetting	_____	Yes ❒ No ❒	_____
	Pour-on 'backliner'	_____	Yes ❒ No ❒	_____
Other *(please specify)*	_____	_____	Yes ❒ No ❒	_____

29. **Have you ever suspected resistance to a lice product on your property?**

No	❒	*Go to question 31, below.*	
Yes	❒	**Product lice resistant to** _____ _____ _____	**Year resistance occurred** _____ _____ _____

30. **If you have a recurring lice problem, how important do you believe the following factors are in causing the problem?**

	Very important	**Important**	**Somewhat important**	**Not important**
Resistance to lice control products	❒	❒	❒	❒
Problems with application	❒	❒	❒	❒
Incomplete mustering	❒	❒	❒	❒
Introduction through fences, or from purchased sheep	❒	❒	❒	❒
Other *(please specify)*_____	❒	❒	❒	❒

Section E: General Parasite Management

31. Did you introduce any sheep to the flock in 2011?

No	❒	*Skip to question 32, below*
Yes	❒	*If yes, please describe below any procedures or treatments on the introduced sheep for worms, lice and flies. If any chemicals were used please specify those used and the method(s) of administration.*
Sheep class	**No of sheep**	**Procedure or treatment**
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

32. **How important are the following sources of information for parasite control on your property?** *(for each parasite category, please rate on a scale of 1 to 5, where 1 = 'very important', and 5 = 'not important')*

	Worms	Flies	Lice
Me or member of my staff	_____	_____	_____
Local vet	_____	_____	_____
Private veterinary consultant	_____	_____	_____
Ag consultant	_____	_____	_____
Ag Department officer	_____	_____	_____
Rural merchandise representative	_____	_____	_____
Drug company representative	_____	_____	_____
Rural newspapers/magazines	_____	_____	_____
WormBoss/FlyBoss/LiceBoss web sites	_____	_____	_____
IPM-sheep web site	_____		
Sheep CRC web site	_____	_____	_____
Other web site *(please specify)*_____	_____	_____	_____
Other source *(please specify)*_____	_____	_____	_____

33. If you have changed your parasite management in the last five years, please describe the change you regard as the most important?

Worms and fluke:_____

Liver fluke:_____

Blowfly:_____

Lice:_____

Finally, we just need a little information about you and your views

34. **What is the post code for your property?**

_____

35. **In what year were you born?** 19 _____

36. **How useful are each of the following web sites to you?**

	Never heard of it	Only heard of it	Actually visited site	Used site to make changes
WormBoss web site	❒	❒	❒	❒
FlyBoss web site	❒	❒	❒	❒
LiceBoss web site	❒	❒	❒	❒
Sheep CRC web site	❒	❒	❒	❒
Other web site *(please specify)* _____	❒	❒	❒	❒

37. **Updated worm control advice is being made available to producers. How useful would each of the following be to you?**

	Very useful	Useful	Somewhat useful	Not useful
Regional worm control plans	❒	❒	❒	❒
Drench Decision Guides to help you tackle your current worm problem	❒	❒	❒	❒
Colour codes on drenches to indicate drench group	❒	❒	❒	❒
Worm control workshops	❒	❒	❒	❒
Other *(please specify)*_____	❒	❒	❒	❒

If you have any additional comments, please write them in the space below, or include a separate piece of paper if you need more room.

THANK YOU FOR YOUR PARTICIPATION

I would like to be contacted about further developments in IPM-s, including workshops or field days. ❒

I would like to be sent a summary of the findings from this survey. ❒