

Scottish Beekeepers' Association
Survey of Members 2006

Report on the Survey

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Abstract

In 2006 the Scottish Beekeepers' Association (SBA) conducted a small survey of about 10% of its membership of around 1000 to investigate current beekeeping practice and experience in Scotland, particularly in the context of the arrival in Scotland of *Varroa destructor* in 1996, and the wide spread of this infestation of honey-bees across the country since then.

There was a gratifyingly high response rate of 77% to this postal survey which approached 100 respondents. Sample selection was not on a random basis.

Forage available for bees was investigated. Sycamore (early), rosebay willow herb (mid-season) and ling heather (late) were those sources most widely stated as available. Heather was significantly more often cited in the North area and rosebay willow herb in the West area.

The typical respondent to this survey is a small-scale beekeeper, with the median number of stocks kept by respondents being 8 or less for the period surveyed. Some larger enterprises were however also included, the largest being one where 325 stocks were kept in 20 apiaries in the West of Scotland area.

Numbers of swarms observed and taken per season were generally low (median 1) though some respondents on lists of beekeepers held by Local Councils or Police dealt with many more (up to 16). Slightly over 50% of respondents used bait hives to try to attract swarms in both 2004 and 2005, the practice being more common in the Aberdeen and North areas. Of those using this technique, 58% were successful in attracting swarms in 2004, and 62% were successful in 2005. It is possible that this may prove a useful measure in future of the impact of *Varroa* in reducing the population of feral honey-bee colonies and hence of the number of stray swarms.

Unexplained losses of colonies were investigated, with an over-all rate of loss per colony kept of just under 5% among those responding to this question for the winter of 2004-05, about 2% during the summer of 2005 and about 7.5% over the winter of 2005-06. Small-scale beekeepers appeared to experience proportionately higher loss rates than large-scale beekeepers.

The sudden collapse of apparently thriving colonies with hives unexpectedly found abandoned was also investigated (the "Marie Celeste" phenomenon). About 45% of reported losses were of this type over the winter of 2004-05, about 81% over the summer of 2005 and about 42% over the winter of 2005-06. The reporting of this phenomenon is also strongly associated among our respondents with the known long establishment of *Varroa* in the respondent's bees (p -value for binary logistic regression of this response on the length of known presence of *Varroa* is 0.003 with an odds ratio estimated at about 1.5 per year's known infestation).

The question on the year in which each respondent first found *Varroa*, revealed that *Varroa* is still not universal throughout Scotland. All respondents in the East area have found it, and most have seen it for at least two years. Only two in the West area have not yet found it, but in the Aberdeen area and in the North area it was still significantly less wide-spread. In fact no-one in the North area had seen it before 2004, and more than half the respondents in that area had not yet found it.

Apistan/Bayvarol are the most commonly used treatments for *Varroa*, with typically about 80% of respondents who are treating for the mite using it. Fewer were using Apiguard, though particularly in the West area its popularity appears to be growing, with 35% of those treating in that area making use of it. Over half the respondents who were treating for *Varroa* were also using drone brood removal as a control measure, except in the East area where fewer than 30% of respondents who were treating used it. A variety of other measures to control *Varroa* were reported, the most frequently being the use of oxalic acid either by sublimation or by the trickle method, with 19 respondents reporting its use in 2004 and 27 in 2005.

An attempt was made to estimate the risks of inbreeding among respondents' bees on the assumption that soon *Varroa* will kill off all feral honey-bee colonies, apart from re-colonisation of

old sites by escaped swarms from beekeepers. Large apiaries with many related queens were supposed to be at particular risk, but due to poor response to questions on these topics it is hard to draw firm conclusions.

An attempt was also made to assess the number of attempts at queen rearing and mating which were made, and the proportion of these which were successful. Large-scale beekeepers made many more attempts and were in general more successful. The success rate was generally over 80%, but there was some suggestion that 2005 was a more difficult year than 2006, though the difference was not significant.

Respondents were invited to report any unusual numbers of supersedures or any deformities among queens being reared, as well as unusual behaviour of bees. High numbers of supersedures were reported by 3 (4%) and queen deformities by 5 (6%). Unusual behaviour was reported by 23 (30%), and were accompanied by useful comments which are included in an Appendix to the report.

1. Introduction: The background, the plan and the response rate

In Spring 2006 the Executive of the Scottish Beekeepers' Association (SBA) decided to explore the feasibility of conducting a survey of their members. The objective was to study some general aspects of present-day beekeeping in Scotland, but particularly in the context of the impact of the arrival of *Varroa destructor* in Scotland upon beekeeping practice and beekeeping success. Particular concerns which have been expressed in England and Wales about the effects of varroasis relate to sudden unexplained colony losses (the "Marie Celeste" phenomenon), to a reported reduction of success in reproduction, reflected in reduced swarming and more frequent failure of queens to mate successfully, and a possible concern about inbreeding due to the loss of many feral honey-bee colonies. After the necessary preliminary feasibility study, it was decided to try to carry this out during the early summer of 2006 as a small-scale postal survey. It was agreed to confine questions to what respondents had experienced during the winter of 2004-05, during the summer of 2005, and during the winter of 2005-06. A questionnaire to cover these topics was designed, and is printed as Appendix 3 to this report, which is the final definitive report on that survey.

When the survey was being planned, the initial decision was to sample approximately proportionately from the four SBA areas covered by the Area Representatives. At the time when the SBA membership register was compiled in 2005, which is the data source we used in making our plans, the numbers of members in these areas were:-

Aberdeen	78
East	488
North	219
West	239
Elsewhere in Scotland	21
Furth of Scotland	66

Table 1.1: SBA membership figures for 2005 by SBA area

Thus the recorded membership at that time of members resident in areas of Scotland covered by a Local Association was 1024. There were in addition recorded on the register 66 full members of the SBA resident outside Scotland, and a further 21 members resident in areas of Scotland without a Local Association. It was a deliberate policy decision that we should not attempt to sample those members living outside Scotland, since we were aiming to discover more about what was happening in Scotland. However it was with regret that we also had to leave out of the survey those living in areas with no Local Association. These members are resident in the Hebrides and in Orkney and Shetland, and their beekeeping in these remote island groups will undoubtedly be different from what most of the rest of us experience. The only reason for omitting them was that we wished to use Local Association Secretaries in selecting our sample.

After seeing these figures, our final decision was to approach 10 members in the Aberdeen area, and 30 in each of the three other areas, so that we should be sampling 100 members altogether, representing about 10% of the available membership of the SBA. In fact, this seriously under-represents the East area if we are attempting to sample on a proportional basis. But the less numerous West and North areas are of importance to us, so we felt this scheme was not

unreasonable.

In order not to breach the confidentiality undertaking given when the membership register was compiled however, we then had to ask the four Area Representatives to approach members who either consented to the Area Representative in person, or whose consent was gained through their Local Association Secretary to be asked to participate in this survey. This sampling technique unfortunately cannot be guaranteed to give a representative sample of the whole membership of the SBA, but was the best we could achieve in the circumstances, and did in fact succeed in getting us a satisfyingly high response rate as follows:-

Sample selection details

<i>Area</i>	<i>Number approached</i>	<i>Number responding</i>	<i>Percentage of sample</i>	<i>Percentage of those approached</i>
Aberdeen	10	7	9%	70%
East	30	23	30%	77%
North	30	24	31%	80%
West	30	23	30%	77%
Total	100	77	100%	77%

Table 1.2: Detail of sample selection

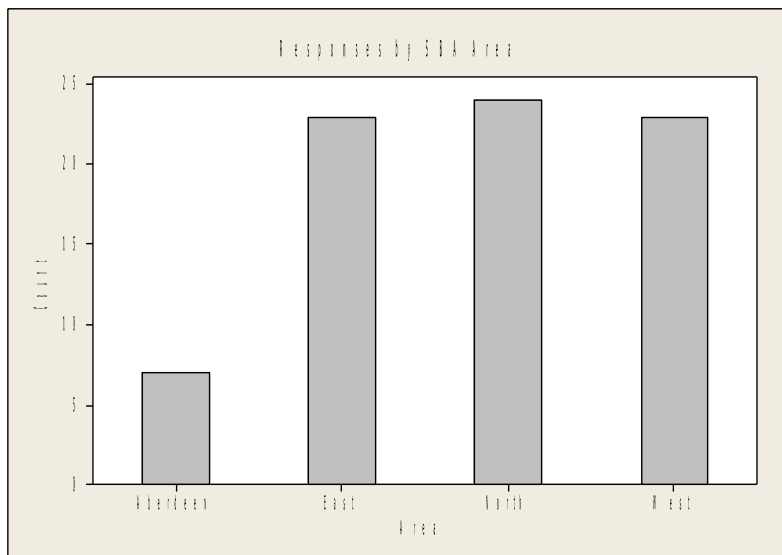


Figure 1.1: Numbers of responses by SBA area

The table and bar-chart above show the numbers of responses to the survey by SBA Area. The areas were very similar in their response rates. Although the response rate from Aberdeen looks a lot lower, in fact if just one more response had been received from there, it too would have been up at 80%. The overall response rate was 77%, which is excellent for a postal survey.

Responses by Local Association

Since we were using Local Associations to make up our samples, it is interesting to see how evenly they were represented in the final responses. There is of course much more variation here, from a low of 2% of the available SBA membership for the East of Scotland Association, to a high of 27% for the Lochaber Association. Undoubtedly this reflects an effort by the Area Representatives to ensure that even the relatively remote and sparsely populated parts of Scotland were adequately represented.

<i>Local Association</i>	<i>SBA Membership 2005**</i>	<i>Number in Survey</i>	<i>Percentage of Survey Responses</i>	<i>Percentage of Local SBA membership in Survey</i>
Aberdeen	77	7	9	9
Ayr	23	1	1	4
Border	17	2	3	12
Caddonfoot	41	2	3	5
Cowal	6	1	1	17
Dingwall	15	3	4	20
Dunblane & Stirling	45	3	4	7
Dunfermline & West Fife	41	2	3	5
East Lothian	24	3	4	12
East of Scotland	50	1	1	2
Easter Ross	24	1	1	4
Eastwood	20	1	1	5
Edinburgh & Midlothian	81	2	3	2
Fife	26	2	3	8
Fortingall	31	1	1	3
Freuchie	11	0	0	0
Glasgow & District	20	3	4	15
Helensburgh	14	2	3	14
Inverness-shire	45	2	3	4
Kelvin Valley	21	2	3	10
Kilbarchan & District	19	1	1	5
Kilmarnock & District	20	1	1	5
Kirriemuir	17	0	0	0
Largs & District	20	2	3	10
Lochaber	11	3	4	27
Moray	31	4	5	13
Mull	3	0	0	0
Nairn & District	20	2	3	10
Oban	14	2	3	14
Olig	15	3	4	20
Peebles-shire	18	2	3	11
Perthshire	31	1	1	3
Skye & Lochalsh	12	3	4	25
South of Scotland	32	4	5	12
Sutherland	18	2	3	11
West Linton & District	41	2	3	5
Western Galloway	33	2	3	6
Other*	-	2	-	-

* Two respondents to the survey entered no Local Association.

** NB This number is the number of *SBA members resident in that Association's area*, not the number of members the Local Association has, which is a purely local matter.

Table 1.3: Local Association representation in the survey

2. Analysing the Responses

2.1 Willingness of respondents to be contacted for follow-up

Everyone participating in the survey was assured that their details would not be published in any analysis of the survey, but they were asked to provide contact details if they were willing to do so, in case any of the responses they gave indicated that more could be gained by further follow-up by the survey organisers. Most were happy to be contacted in that way, and helpfully provided contact details as part of their responses. The numerical details of how many people were willing to be contacted later are as follows:-

<i>Area</i>	<i>Unwilling to be contacted</i>	<i>Willing to be contacted</i>
Aberdeen	2 29%	5 71%
East	3 13%	20 87%
North	5 21%	19 79%
West	2 9%	21 91%
Over all	12 16%	65 84%

Table 2.1: Willingness to be contacted

Over-all, just over 84% of respondents were prepared to disclose their contact details.

2.2 Reported Nectar and Pollen sources in different parts of Scotland

After an initial pilot study, the survey organisers decided that the most commonly reported sources of nectar and pollen in Scotland were the following:-

<i>Season</i>	<i>Sources</i>
Early	Autumn-sown oil seed rape
	Broom
	Gorse
	Horse chestnut
	Hawthorn
	Sycamore
	Willow
Mid-season	Bell heather
	Bramble
	Clover
	Lime
	Raspberry
	Rosebay Willow Herb
	Spring-sown oil seed rape
Late	Balsam
	Ivy
	Ling heather

Table 2.2: Agreed important nectar and pollen sources

Respondents were invited to state which of these sources were used as forage by their bees, as well as what additional sources they were aware of in their areas, or if that was their situation, that they didn't know what sources their bees were using.

Very few respondents stated that they didn't know what sources their bees were using.

	<i>Number not knowing sources</i>	<i>Percentage not knowing sources</i>
Early season	1	1.3%
Mid season	0	0
Late season	5	6.5%

Table 2.3: Respondents' knowledge of foraging sources

The way in which the chosen early sources were claimed to be available in the four SBA districts is shown below. The upper row shows the actual number of respondents claiming their bees use that source, and the lower line what percentage that is of respondents in that area (rounded to the nearest whole percentage point). Those cases in which a statistical chi-squared test show that the differences between SBA areas are sufficiently marked as to be statistically significant at the 5% level have been marked with a # mark. Although all sources show some differences between areas, the other cases may well be just chance fluctuations: the significant ones are more likely to be due to real differences in the flora between the different areas.

<i>Source</i>	<i>Aberdeen</i>	<i>East</i>	<i>North</i>	<i>West</i>	<i>Over all</i>
Autumn sown OSR#	6 86%	14 61%	7 29%	5 22%	32 42%
Broom#	7 100%	11 48%	15 63%	15 65%	48 62%
Gorse#	6 86%	15 65%	24 100%	18 78%	63 82%
Horse Chestnut	4 57%	10 43%	9 38%	15 65%	38 49%
Hawthorn	5 71%	17 74%	13 54%	19 83%	54 70%
Sycamore	6 86%	19 83%	19 79%	23 100%	67 87%
Willow	5 71%	16 70%	15 62%	19 83%	55 71%

Table 2.4A: Early sources

Below are given two similar tables for the mid-season and the late sources.

<i>Source</i>	<i>Aberdeen</i>	<i>East</i>	<i>North</i>	<i>West</i>	<i>Over all</i>
Bell heather#	4 57%	4 17%	14 58%	5 22%	27 35%
Bramble	4 57%	11 48%	14 58%	17 74%	46 60%
Clover	5 71%	18 78%	19 79%	15 65%	57 74%
Lime#	3 43%	15 65%	7* 30%	18 78%	43 57%
Raspberry	1 14%	9 39%	13* 57%	6 26%	29 38%
Rose-bay willow herb#	5 71%	20 87%	15* 65%	22 96%	62 82%
Spring sown OSR	3 43%	9 39%	3* 13%	3 13%	18 24%

* One respondent in the North Area failed to respond to this question.

Table 2.4B: Mid-season sources

<i>Source</i>	<i>Aberdeen</i>	<i>East</i>	<i>North</i>	<i>West</i>	<i>Over all</i>
Balsam#	0 0%	2 9%	4 17%	10 43%	16 21%
Ivy#	2 29%	7 30%	6 25%	15 65%	30 39%
Ling heather#	6 86%	17 74%	23 96%	12 52%	58 75%

Table 2.4C: Late sources

Over all of the main sources, the most widely reported available sources were sycamore in the early season, rose-bay willow herb in the mid season and ling heather in the late season.

As well as being asked about these pre-decided nectar and pollen sources, respondents were invited to name up to two other early sources, two other mid-season sources and two other late sources being used by their bees. Some in fact named more than this. It is not easy to report such responses systematically, but the table below states how frequently such sources were mentioned.

Other Nectar and Pollen sources

	Aberdeen	East	North	West	Over all
Early					
Aconite	0	1	1	0	2
Alder	0	1	0	0	1
Apple/pear	1	1	3	1	6
Bean	0	1	0	0	1
Blackberry	0	0	1	0	1
Blackthorn	0	1	1	1	3
Bluebell	0	1	0	0	1
Box	0	1	0	0	1
Butterburr	1	1	1	0	3
Cotoneaster	0	1	0	0	1
Crocus	0	1	2	0	3
Dandelion	0	0	1	2	3
Elm	0	0	2	0	2
"Garden flowers"	0	0	3	1	4
Gean/wild cherry	1	0	2	1	4
Hazel	0	1	0	0	1
Holly	0	0	1	0	1
Honeysuckle	0	1	0	0	1
Maple	0	0	1	1	2
Mexican orange	0	1	0	0	1
Raspberry	0	0	1	0	1
Rhododendron	0	0	0	2	2
Snowdrop	0	1	2	0	3
Soft fruit	0	0	2	0	2
Mid Season					
Apples/pears	0	1	0	0	1
Balsam	0	0	0	1	1
Comfrey	0	0	0	1	1
Cotoneaster	0	0	1	0	1
Crinodendron	0	0	0	1	1
"Garden flowers"	0	3	3	1	7
Field bean	0	1	0	0	1
Hogweed	0	0	1	0	1
Laurel	0	0	1	0	1
Meadowsweet	0	0	0	1	1
Mustard	1	0	0	0	1

Table 2.5: Other nectar and pollen sources

colonies being kept can in fact be misleading, since the few large-scale beekeepers exert an undue influence in the calculation of the average. For this reason, statisticians in these circumstances usually quote the *median* number, that is to say the number such that half the beekeepers have no more than that number, and half have no less. These numbers are given in the table below, as well as the minimum and maximum numbers reported so that some idea of the range of sizes of operation can also be seen.

<i>Area</i>	<i>Median</i>	<i>Minimum</i>	<i>Maximum</i>
Aberdeen	1	1	6
East	1	1	12
North	1	1	3
West	2	1	20

Table 2.6: Summary of numbers of apiaries being managed by each respondent by area

<i>Area</i>	<i>Median</i>	<i>Minimum</i>	<i>Maximum</i>
Aberdeen	12	1	31
East	7	1	183
North	6	1	14
West	8	1	325

Table 2.7: Summary of numbers of colonies being managed in March 2006 by area

Some effort was also made to try to determine how the numbers of colonies being managed by those sampled has been changing in the recent past. Rather than split this information up by areas, what is reported below is the median number for the whole of our sample as reported for October 2004, March 2005, October 2005 and finally, as before, for March 2006. Of course some decline in figures between the October report and the following March report is to be expected in many cases, because of inevitable winter losses, with no chance between those dates to make any increase in colony numbers, unless by buying stock in. For the same reason we may expect increases in numbers of stocks to occur between March and October when there is an opportunity to make increase.

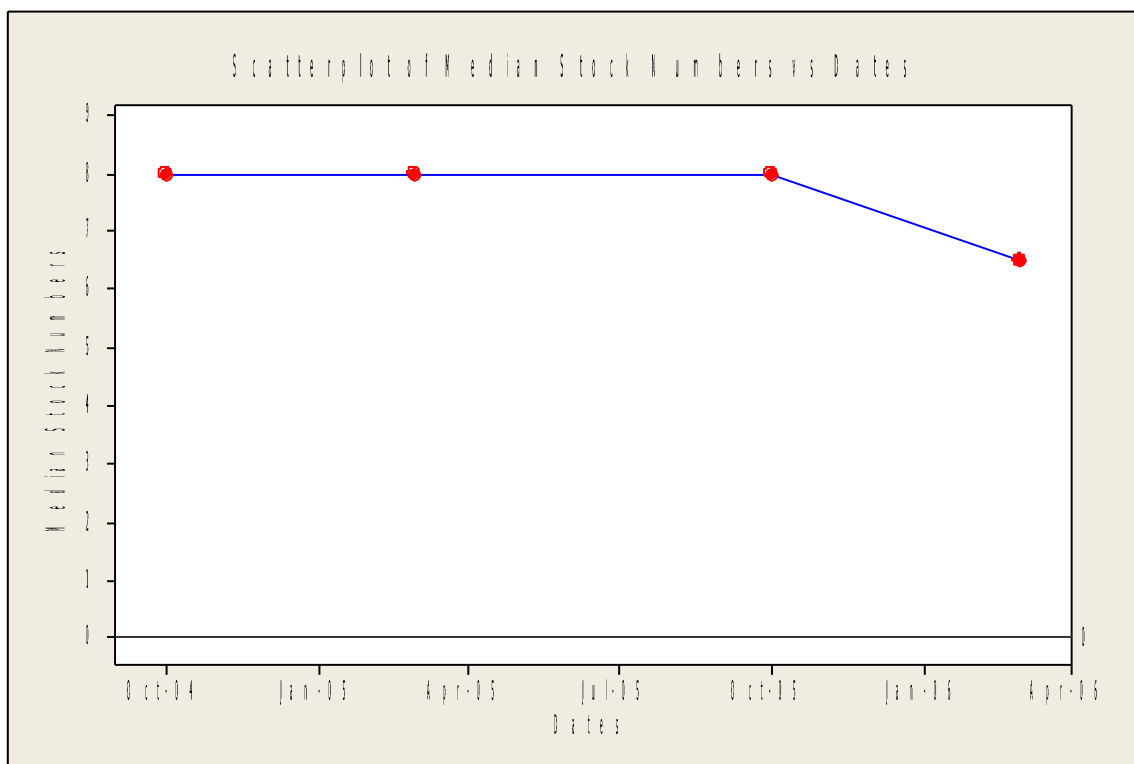


Figure 2.2: Median numbers of stocks being managed by respondents

The median number kept remains constant at 8 until the last reporting time when it falls to 6.5. This probably does not reflect any systematic change, so that within our sample, there is good evidence of a fairly stable situation.

A word of caution is needed here however, about taking our sample as being representative of beekeeping in Scotland. As stated initially, our sample was selected by the personal choices of the Area Representatives and the Local Association Secretaries. Such samples are notorious for being biased, and the suspicion of the investigators is that the sample we have is over-representative of the serious and well-organised beekeepers in the SBA. We believe that a typical member of the SBA probably keeps bees on a smaller scale, and in a less well-organised way than is suggested by this report.

2.4 Observations on Swarming in 2004 and 2005

A: Numbers of swarms observed and taken

Two groups of questions were asked about swarming. The first group simply asked respondents to say for each of the years 2004 and 2005 how many swarms they had observed originating from outside their own apiaries, and of these how many they had captured. Quite a high proportion of respondents (about 1 in 7) failed to answer these questions, and this may well be because some were unsure where some of the swarms they had observed had come from: of course this is not always easy to determine. Those who did respond in general reported observing a fairly small number - the median number over-all was 1 swarm observed - but there were a few respondents who reported observing many more than this, in one case as many as 16. However all those who had reported observing high numbers of swarms not from their own apiaries also stated that they were on some official list held of people willing to deal with swarms. Sometimes the list

was held by the police, sometimes by the local Council, and in one case by a pest control firm. Clearly being on such a list for an organisation actively dealing with stray swarms in the summer puts one in a completely different league from those beekeepers not on such a list as far as number of swarms dealt with is concerned. The numbers involved are shown in the histograms for each area in both years of the survey.

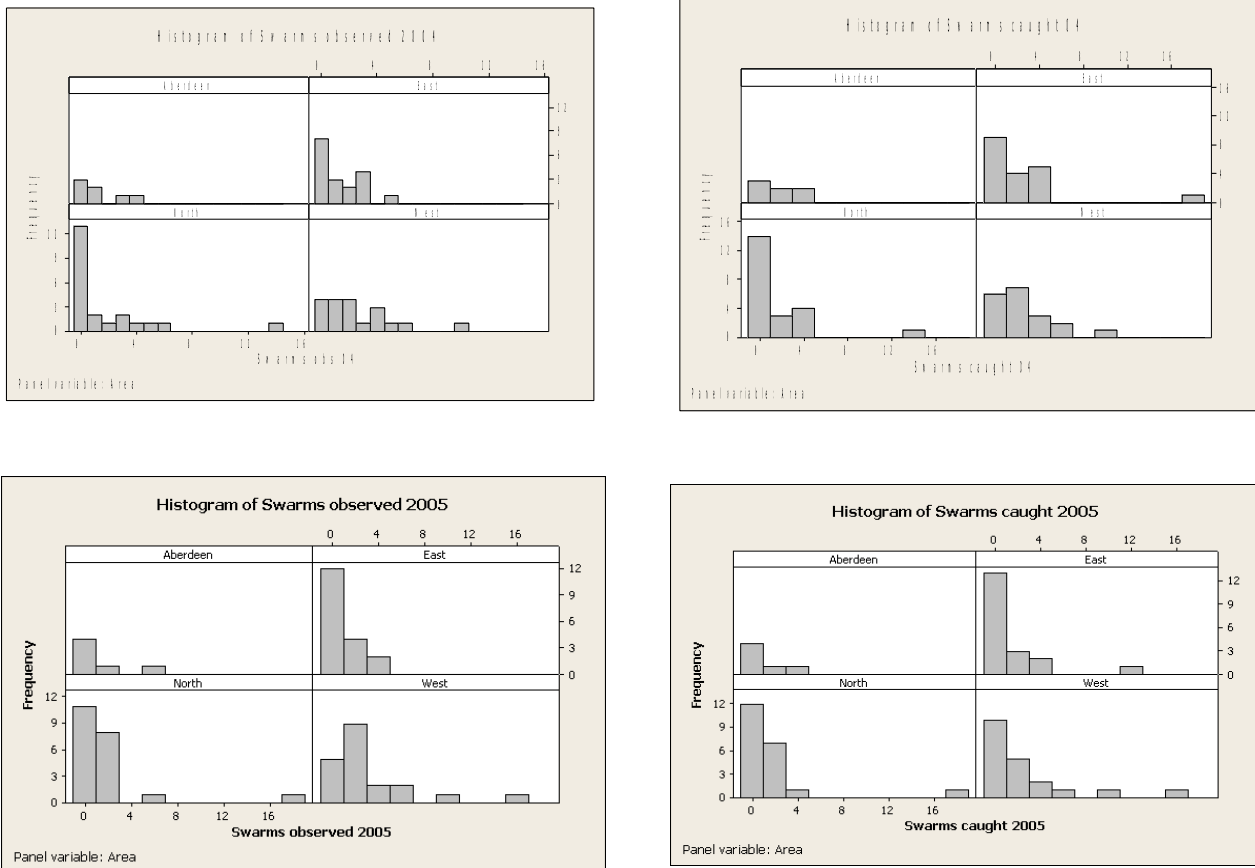


Figure 2.3: Numbers of swarms observed and taken 2004/2005

Of the swarms dealt with in these circumstances, a high proportion was captured in both 2004 and 2005. The mean was 84% caught in 2004 and 73% caught in 2005, with a fairly high number reporting capturing all the swarms they had observed in each year. Those on lists, so that they were dealing with high numbers of swarms, were clearly very competent at their job, as they had captured virtually all the swarms they had had to deal with.

These findings are illustrated by the graphs below.

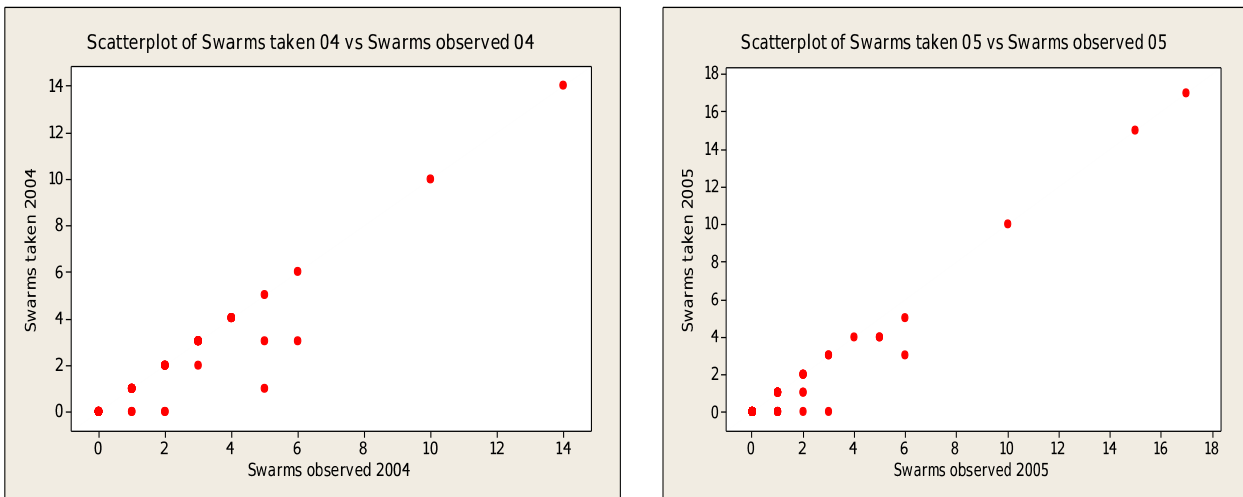


Figure 2.4 Swarms taken compared with swarms observed in 2004 and 2005

B: The use of bait hives to attract swarms

The second group of questions asked respondents about putting out bait hives to attract swarms. They were asked whether they usually did this and whether they were usually successful, and also whether they had done so, and with what success, in each of 2004 and 2005. The tables below summarise the findings.

Tabulated statistics: Area, Usually bait?					
Area		No	Yes	Missing	All
Aberdeen	Count	2	5	0	7
	Percent	28.57	71.43	*	100.00
East	Count	17	6	0	23
	Percent	73.91	26.09	*	100.00
North	Count	8	15	1	23
	Percent	34.78	65.22	*	100.00
West	Count	11	12	0	23
	Percent	47.83	52.17	*	100.00
All	Count	38	38	1	76
	Percent	50.00	50.00	*	100.00

Table 2.8: Practice of using bait hives regularly

Over-all 50% of the respondents to the survey claim to use bait hives regularly, but the practice does not appear to be uniform across Scotland. The differences between the areas are significant (*p*-value for Pearson's chi-squared test is 0.033, which is less than 0.05). Whether the high proportion of respondents regularly practising this in the Aberdeen area compared with the low proportion in the East area is a genuine regional difference, or whether it is just because of some bias introduced in the sample selection technique of our survey must be a matter of speculation, but

the observation is interesting nonetheless.

The next table shows the proportion of regular users of bait hives who claim to be "usually" successful, again by SBA Area.

Proportion of Respondents claiming to be "usually successful" with bait hives					
Area		Yes	No	Missing	Total
Aberdeen	Count	4	1	2	5
	Percent	80.00	20.00	*	100.00
East	Count	4	2	17	6
	Percent	66.67	33.33	*	100.00
North	Count	7	8	9	15
	Percent	46.67	53.33	*	100.00
West	Count	4	7	12	11
	Percent	36.36	63.64	*	100.00
All	Count	19	18	*	37
	Percent	51.35	48.65	*	100.00

Table 2.9: Proportion of respondents who bait who are "usually" successful

About half of those who regularly use bait hives claim to be regularly successful. Although once again there are differences between the different SBA areas, the differences this time are not statistically significant (p -value for Pearson's chi-squared test is 0.324).

Below are summaries of what the respondents claimed to have happened in this context in the summers of 2004 and 2005.

Tabulated statistics: Area, Baited 2004					
Area		No	Yes	Missing	All
Aberdeen	Count	2	5	0	7
	Percent	28.57	71.43	*	100.00
East	Count	15	8	0	23
	Percent	65.22	34.78	*	100.00
North	Count	6	15	3	21
	Percent	28.57	71.43	*	100.00
West	Count	10	12	1	22
	Percent	45.45	54.55	*	100.00
All	Count	33	40	*	73
	Percent	45.21	54.79	*	100.00

Table 2.10: Numbers and percentages of those using bait hives in 2004 by SBA area

Tabulated statistics: Area, Baited 2005					
Area		No	Yes	Missing	All
Aberdeen	Count	2	5	0	7
	Percent	28.57	71.43	*	100.00
East	Count	16	7	0	23
	Percent	69.57	30.43	*	100.00
North	Count	6	15	1	21
	Percent	28.57	71.43	*	100.00
West	Count	10	12	1	22
	Percent	45.45	54.55	*	100.00
All	Count	34	39	*	73
	Percent	46.58	53.42	*	100.00

Table 2.11: Numbers and percentages of those using bait hives in 2005 by SBA area

The patterns reported in 2004 and 2005 match fairly closely what the respondents claimed the "usually" do. A slightly more even distribution in 2004 across the areas means that the area differences in that year just fail to achieve statistical significance at the 5% level (p -value for Pearson's chi-squared test is 0.077), but the differences are significant again for the 2005 figures (p -value is 0.033).

The final pair of tables below show what proportion of respondents putting baited hives out reported success in attracting swarms. This is perhaps the most useful of the pieces of information from this section. It is not unreasonable to think that in the past at least, a fairly high proportion of stray swarms will have originated from unmanaged feral honey-bee colonies. If this is so, then the loss of feral colonies now taking place due to *Varroa* infestation can be expected to lead to a long-

term decline in the number of stray swarms available to be attracted to bait hives. Any future surveys carried out can perhaps use the proportions of successes reported here as a bench-mark against which to test rates of success in attracting swarms to bait hives in the future, to determine whether there is a real decline over the years in the number of stray swarms in each of the SBA areas. The sample in each area is of course a small one, but there is less chance here in our view that our sample selection method will have had a direct biasing effect in making the rates reported unduly high or unduly low.

Proportion of Respondents claiming to be successful in 2004 with bait hives					
Area		Yes	No	Missing	Total
Aberdeen	Count	2	3	2	5
	Percent	40.00	60.00	*	100.00
East	Count	6	2	15	8
	Percent	75.00	25.00	*	100.00
North	Count	9	6	9	15
	Percent	60.00	40.00	*	100.00
West	Count	6	6	11	12
	Percent	50.00	50.00	*	100.00
All	Count	23	17	*	40
	Percent	57.50	42.50	*	100.00

Table 2.12: Success rates with bait hives in 2004 by SBA area

Proportion of Respondents claiming to be successful in 2005 with bait hives					
Area		Yes	No	Missing	Total
Aberdeen	Count	3	2	2	5
	Percent	60.00	40.00	*	100.00
East	Count	6	1	16	7
	Percent	85.71	14.29	*	100.00
North	Count	9	6	9	15
	Percent	60.00	40.00	*	100.00
West	Count	6	6	11	12
	Percent	50.00	50.00	*	100.00
All	Count	24	15	*	39
	Percent	61.54	38.46	*	100.00

Table 2.13: Success rates with bait hives in 2005 by SBA area

In neither year is the rate of success significantly different across the different SBA areas (p -value for Pearson's chi-squared in excess of 0.5 in 2004 and in excess of 0.4 in 2005), so it seems best simply to concentrate on the reported success rate over-all in each year. This is reported as 57.5% in 2004 and 61.5% in 2005. Clearly the rate fluctuates in different seasons, no doubt due to such variables as the summer weather conditions, and the precise locations where the bait hives are placed. However two seasons in succession with over-all success of attracting swarms to bait hives in excess of 50% is a useful starting figure to record.

2.5 Questions relating to the impact of *Varroasis* on beekeeping in Scotland

2.5.1 Unusual losses of colonies

Apart from the expected occasional losses of stocks during the winter, some beekeepers in England and Wales have in recent years been reporting the sudden disappearance of bees from apparently thriving hives, where a hive is suddenly found to have been completely abandoned. Within the last two years, there have been reports of occasional similar occurrences in Scotland. Those responding to the survey were asked to report on their recent losses, and on whether any of them fitted this "Marie Celeste" ("MC") pattern.

In summary for the Aberdeen area, only 1 of the 7 respondents reported any unexplained losses in winter 2004-05. That respondent lost 4 colonies and all losses were of "Marie Celeste" ("MC") type. In the summer of 2005, again only 1 respondent reported any losses, with the loss of 2 colonies, both with "MC" type loss. In the winter of 2005-06, only 1 respondent reported a single unexplained colony loss, and that was not of "MC" type.

The picture for the East area is more complicated. In brief, in the winter of 2004-05, a total of 23 unexplained colony losses were reported by 6 of the 21 respondents who answered this question. Of these losses 11 were reported as being of "MC" type. In the summer of 2005 a total of 17 unexplained colony losses were reported by 5 of the 21 respondents, of which 9 were of "MC" type. In the winter of 2005-06 a total of 46 unexplained colony losses were reported by 11 of the 21 respondents, of which 19 were of "MC" type.

Summarising similarly for the North area, in the winter of 2004-05, 7 respondents of the 22 answering this question reported a total of 12 unexplained colony losses, of which 7 were of "MC" type. In the summer of 2005, 1 of the 22 respondents reported a total of 2 unexplained losses, of which both were of "MC" type. In the winter of 2005-06, 5 of the 20 respondents reported a total of 30 unexplained colony losses, of which 14 were of "MC" type. All but one of the "MC" losses in this last winter were reported by one respondent.

Finally for the West area, in the winter of 2004-05, 4 of the 20 respondents answering the question reported a total of 18 unexplained colony losses, of which 8 were reported to be of type "MC". In the summer of 2005, 4 of the 21 respondents answering the question reported a total of 6 unexplained colony losses, of which 5 were reported to be of type "MC", and in the winter of 2005-06, 10 of the 20 respondents answering this question reported a total of 32 unexplained colony losses, of which 14 were reported to be of type "MC".

The findings for the whole of this section are summarised in the table below.

		<i>Aberdeen</i>	<i>East</i>	<i>North</i>	<i>West</i>	<i>Over all</i>
<i>Winter 2004-05</i>	Number responding	7	21	22	20	70
	Number with losses	1	6	7	4	18
	Total losses	4	32	12	18	66
	MC losses	4	11	7	8	30
<i>Summer 2005</i>	Number responding	7	21	21	21	70
	Number with losses	1	5	5	4	15
	Total losses	2	17	2	10	31
	MC losses	2	9	9	5	25
<i>Winter 2005-06</i>	Number responding	7	21	20	20	68
	Number with losses	1	11	5	11	28
	Total losses	2	48	31	32	113
	MC losses	0	19	14	14	47

Table 2.14: Summary of pattern of unexplained colony losses over two years

Some summary statistics from this are the following. Over the winter of 2004-2005 the rate of loss per colony kept among those who responded to this question was just under 5%, during the summer of 2005 it was about 2% and during the winter of 2005-2006 it was about 7.5%. The small-scale beekeepers among our respondents suffered proportionately higher losses in general, so that the mean loss percentages per respondent over these same periods were respectively 7.2%, 2.8% and 10.7%.

In order to see the implications of these figures, some graphical displays are helpful, as shown below. These will be backed up by reporting the results of a few relevant statistical tests for the significance of the differences observed between the different seasons. It is convenient to split these into two parts, the first looking for significant differences in the rates of colony losses reported, and the second looking for differences in the rates of "Marie-Celeste" type losses over the two winter seasons and one summer season covered by the survey.

1. Rates of unexplained colony losses

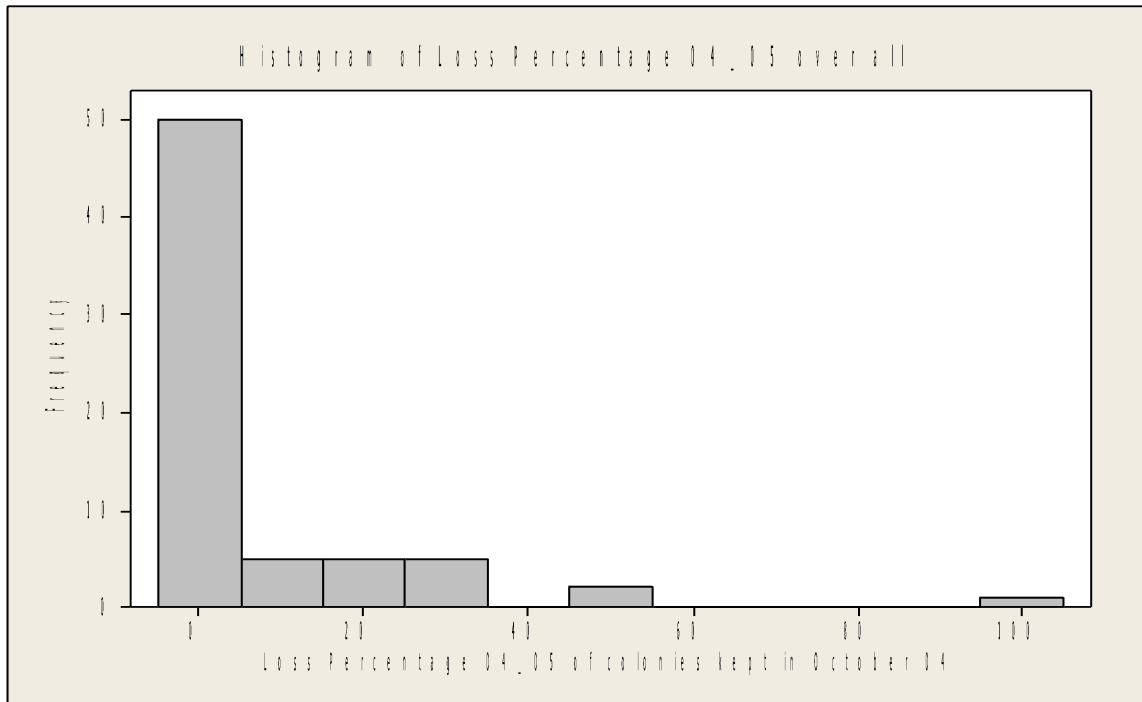


Figure 2.5: Over-all unexplained loss percentages, winter 04-05

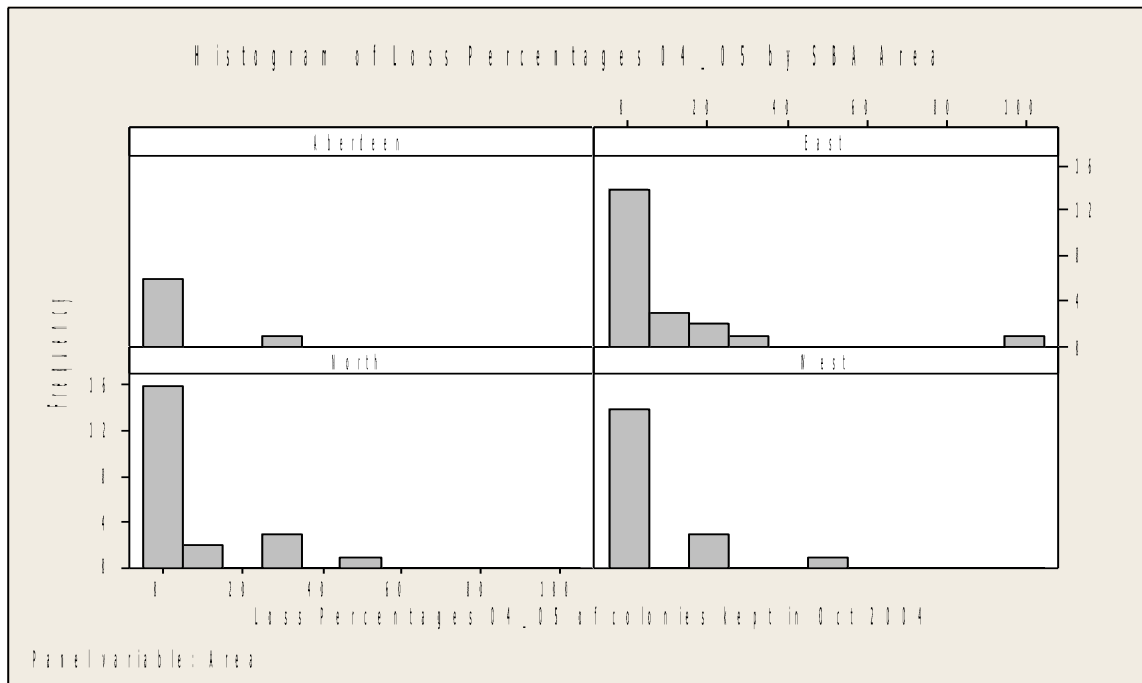


Figure 2.6: Unexplained loss percentages by SBA area, winter 04-05

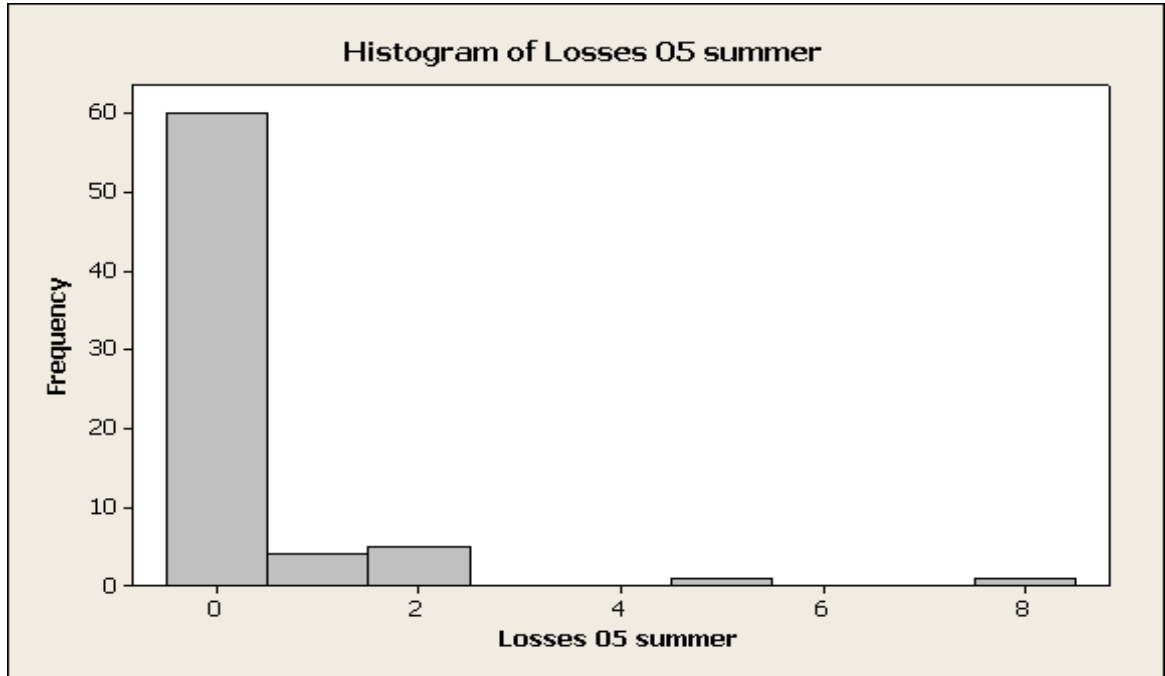


Figure 2.7: Over-all unexplained loss percentages, summer 2005

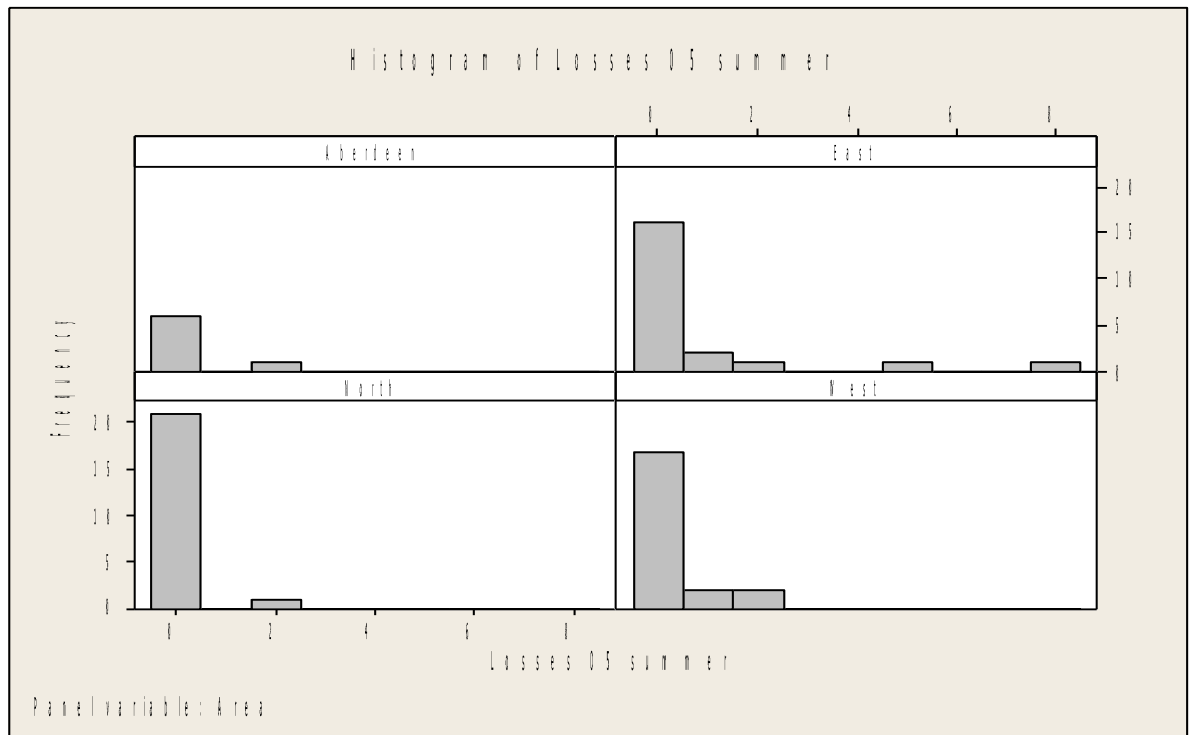


Figure 2.8: Unexplained loss percentage by SBA area, summer 2005

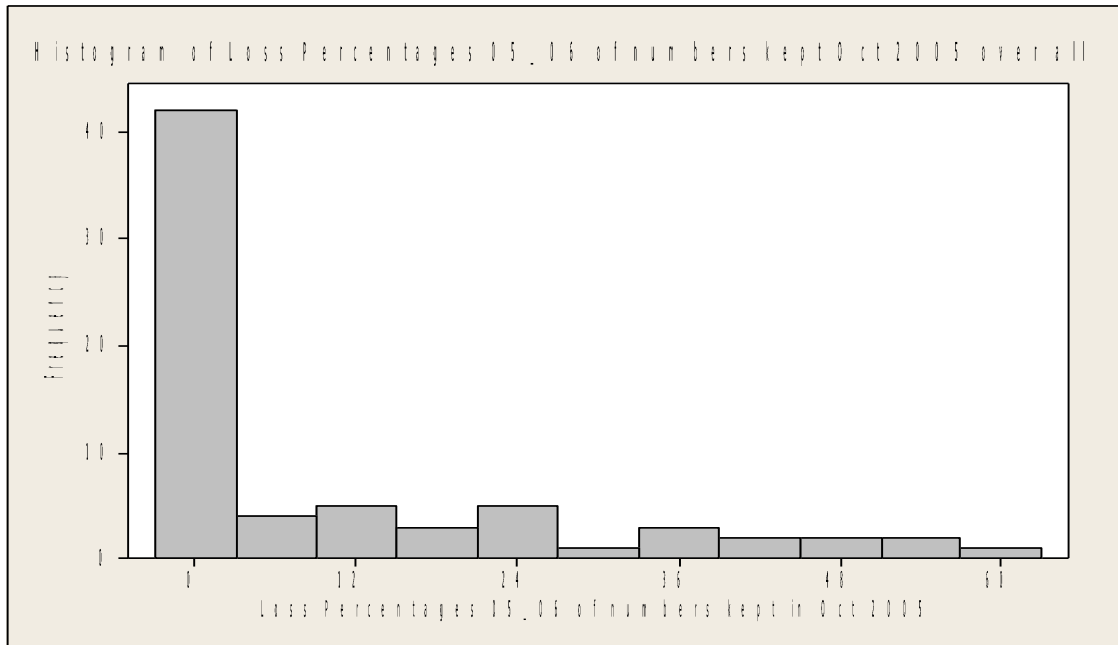


Figure 2.9: Over-all unexplained loss percentages, winter 05-06

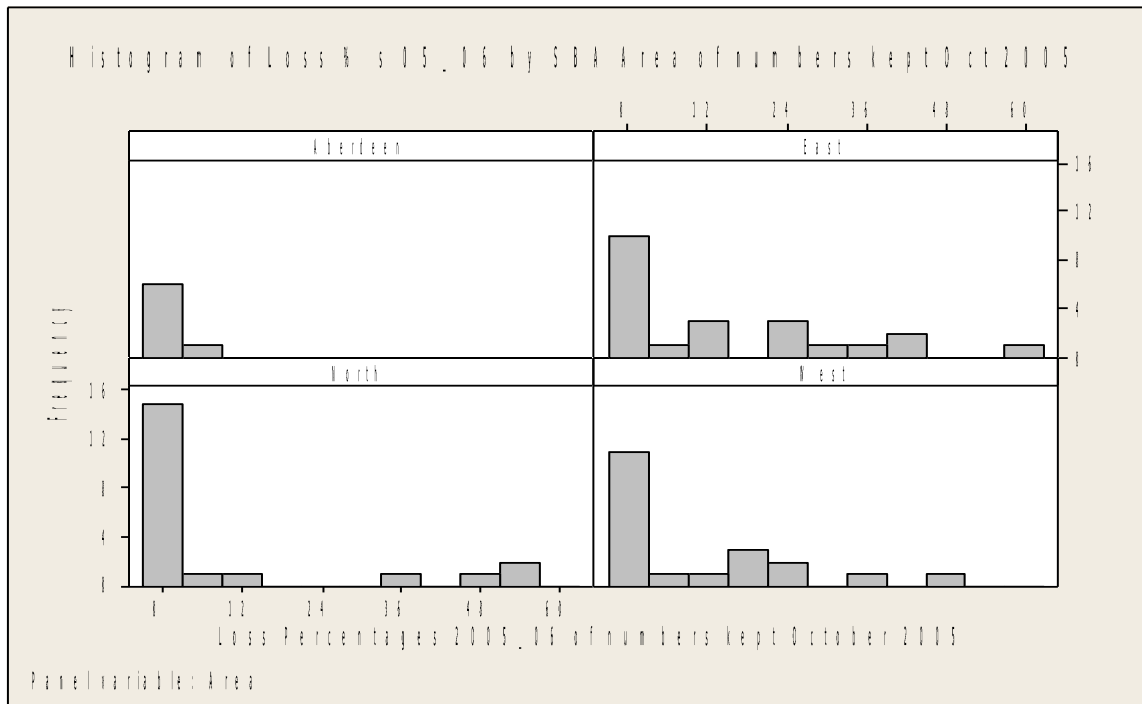


Figure 2.10: Unexplained loss percentages by SBA area, winter 05-06

The six graphs above show the losses over the three roughly six-month periods covered by the survey as percentages of the initial numbers of colonies being kept by each beekeeper. Further analysis of these results shows that, unsurprisingly, the percentage losses reported during the summer of 2005 are significantly lower than the mean of the percentage losses reported for the two winters covered by the survey (p -value less than 0.5×10^{-4} for a two-tailed sign test of the median observed difference, with a 95% confidence interval for the median difference running from 4.7 to 8.1). However the differences between the two winter seasons covered are not significant (p -value for a two-tailed sign test of the median difference of percentage losses between the two seasons of is 0.22).

Hence as far as the data collected here are concerned, the only significant difference in the rates of loss reported is the expected one, i.e., that significantly fewer losses occur during the summer than during the winter.

2. Rates of "Marie-Celeste" losses as a percentage of all losses

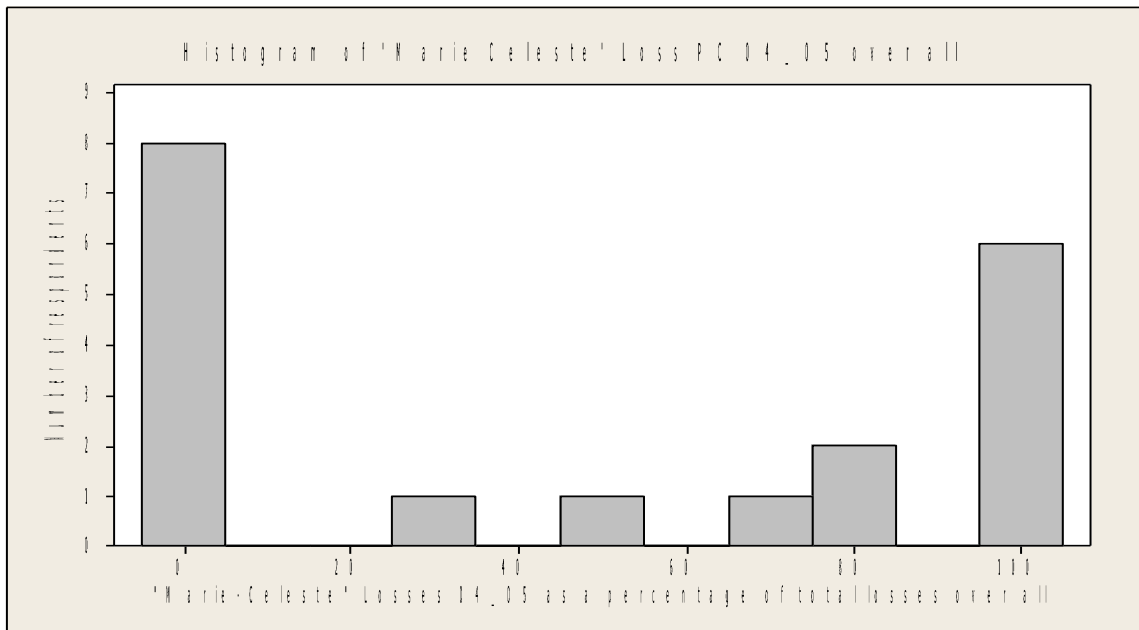


Figure 2.11: "Marie Celeste" losses as a percentage of over-all unexplained losses 04-05

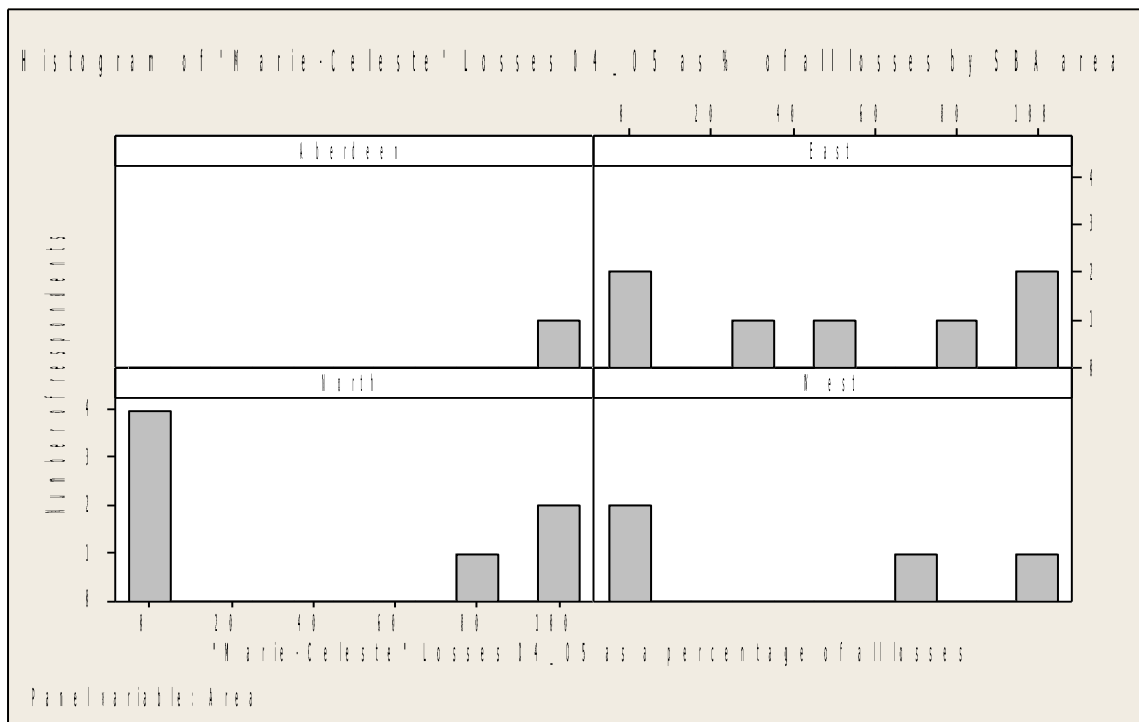


Figure 2.12: "Marie Celeste" losses as a percentage of unexplained losses by SBA area 04-05

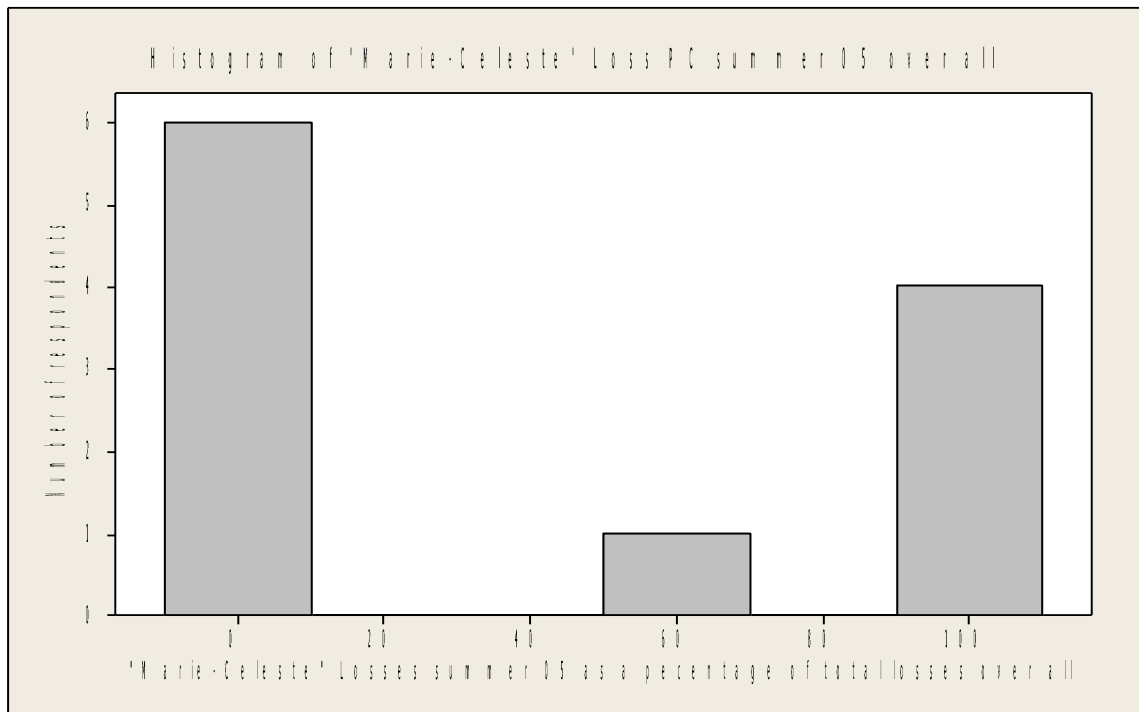


Figure 2.13: "Marie Celeste" losses as a percentage of over-all unexplained losses, summer 05

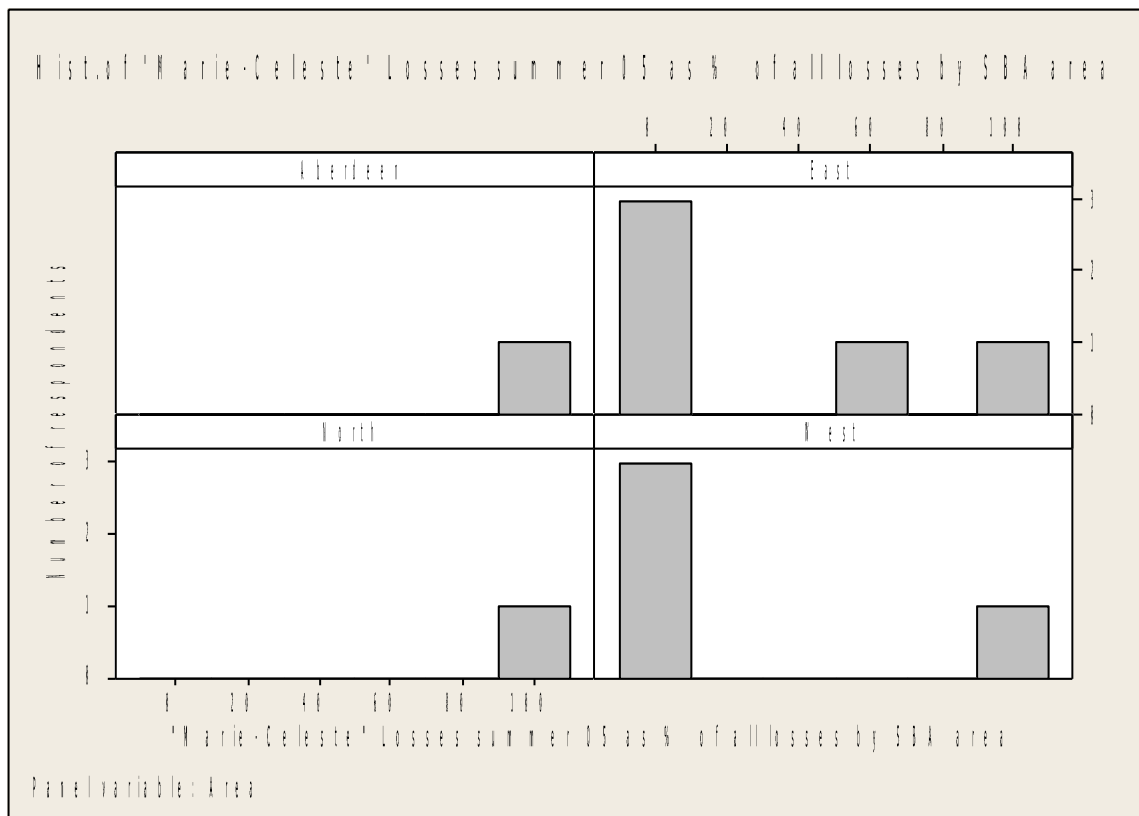


Figure 2.14: "Marie Celeste" losses as a percentage of unexplained losses by area, summer 05

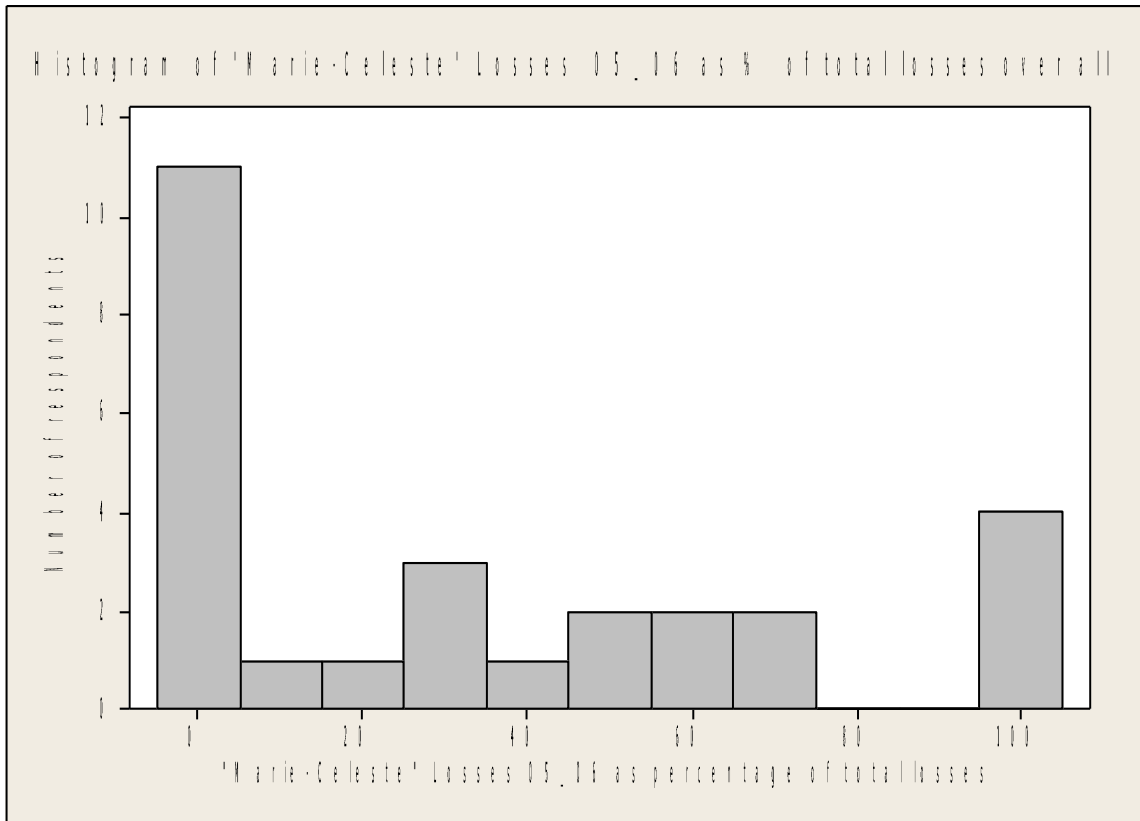


Figure 2.15: "Marie Celeste" losses as a percentage of over-all unexplained losses 05-06

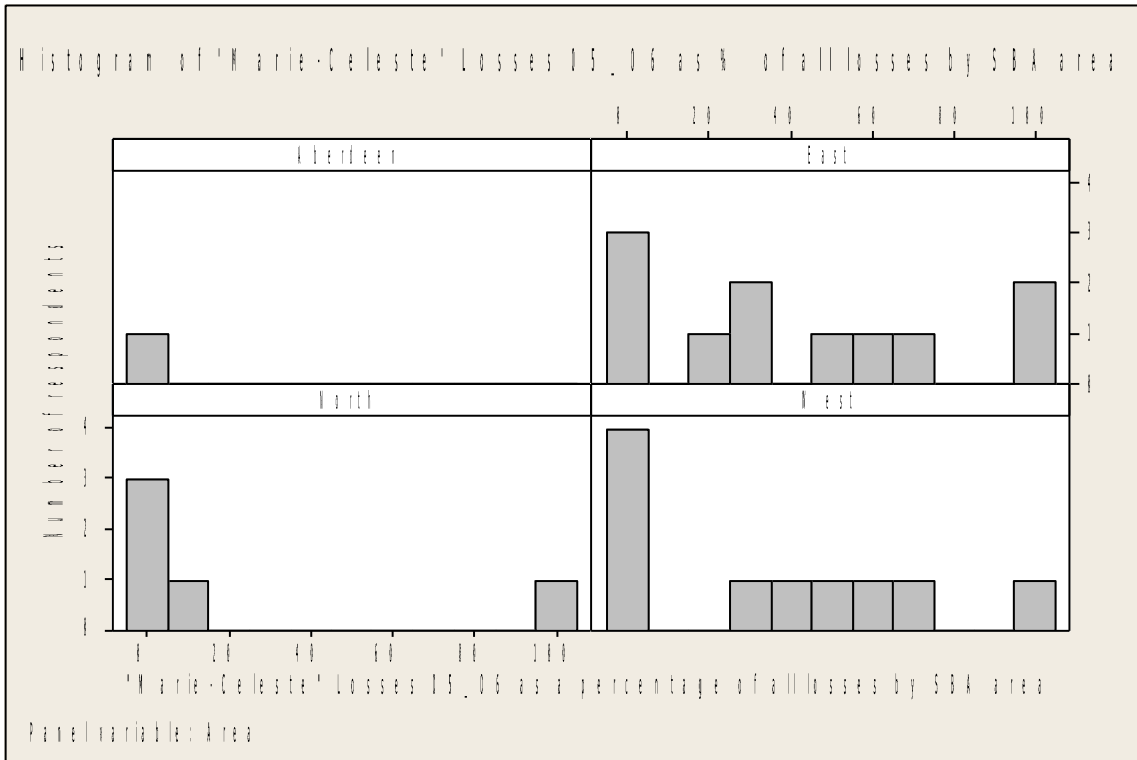


Figure 2.16: "Marie Celeste" losses as a percentage of unexplained losses by SBA area 05-06

The numbers of reports here are of course far fewer, so that the only statistical test which can meaningfully be carried out is to see whether the proportion of losses over-all which were reported as "Marie-Celeste" type has changed between the three seasons involved. The numbers are as follows:-

	<i>Total losses</i>	<i>Of which "MC" type</i>
Winter 04-05	66	30
Summer 05	31	25
Winter 05-06	113	47

Table 2.15: Numbers of unexplained losses and "MC" losses for three seasons

The over-all proportion of losses which were reported to be of MC type was about 45% for the first of the two winter seasons and about 42% for the second winter season. For the summer of 2005 this proportion was about 81%.

Carrying out the standard test for the significance of the difference between two proportions on the figures for the two winter seasons yields a p -value of 0.275, so that there is no significant difference in the rates of "Marie-Celeste" losses reported as a proportion of all losses between the two winter seasons covered by the survey. However the proportion of reported summer losses which were of MC type as a proportion of all reported summer losses is very significantly higher than the mean of that for the two winter seasons.

Analysing the "Marie Celeste" (MC) losses further, one other interesting fact emerges. There is evidence of a strong association between whether or not a respondent has experienced any such losses, and the year in which that respondent first noted the presence of *Varroa*. Using binary logistic regression of the binary response variable indicating whether that respondent had experienced any "Marie Celeste" type losses throughout the period of the survey or not against the year in which the respondent noted the presence of *Varroa*, the p -value is 0.003, so that this phenomenon is strongly associated among our respondents with the reported long established presence of this parasite. The estimated odds ratio is about 1.5 per year of known presence of *Varroa* for the increased risk of having this occur. Only ten of our respondents failed to give data relevant to this enquiry, so that this result is fairly robust within this survey. Those who had not yet reported the presence of *Varroa* were recorded for this purpose as having it first present in 2007.

2.5.2 Spread of *Varroa* across Scotland

Most beekeepers know that *Varroa destructor* first appeared in the UK in 1992, and since then has been spreading inexorably across the country. It has in general spread steadily from South to North, although Fife had a surprisingly early outbreak ahead of other places further south in Scotland.

This general pattern is reflected in what those responding to our survey said about when they first found *Varroa* in their bees, as shown in the bar charts below which give the picture for each area separately.

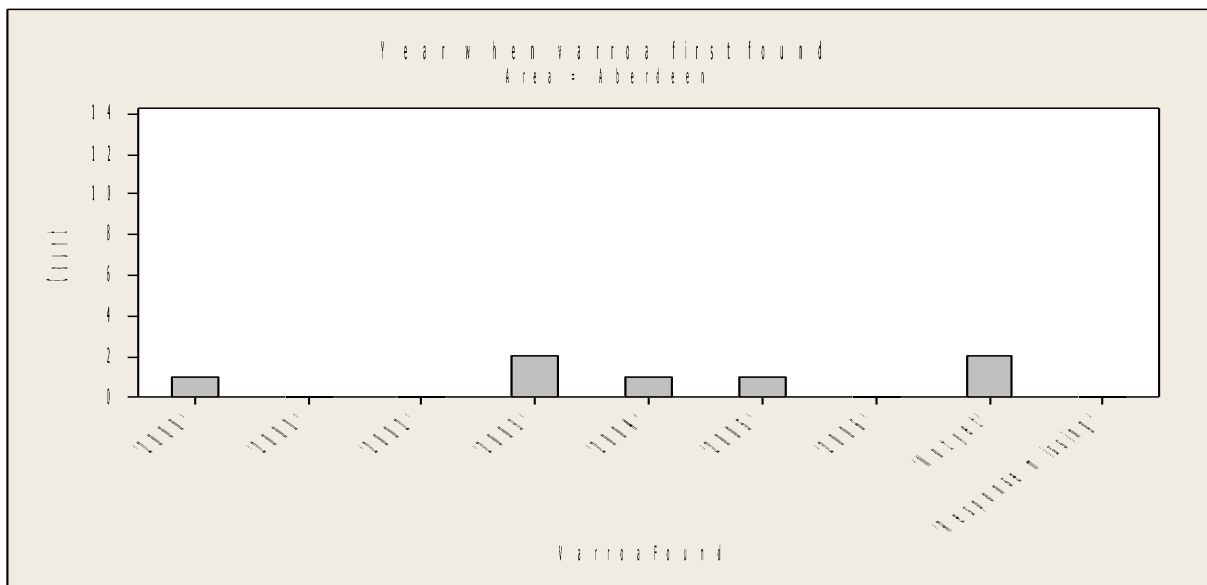


Fig 2.17A: Spread of *Varroa* - Aberdeen area

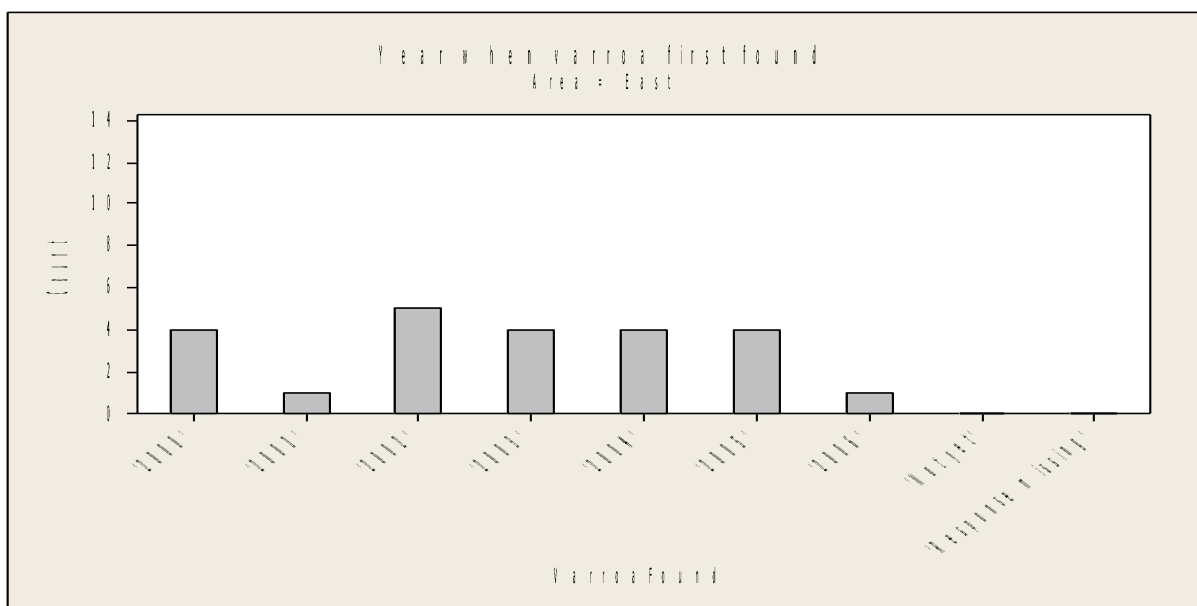


Figure 2.17B: Spread of *Varroa* - East area

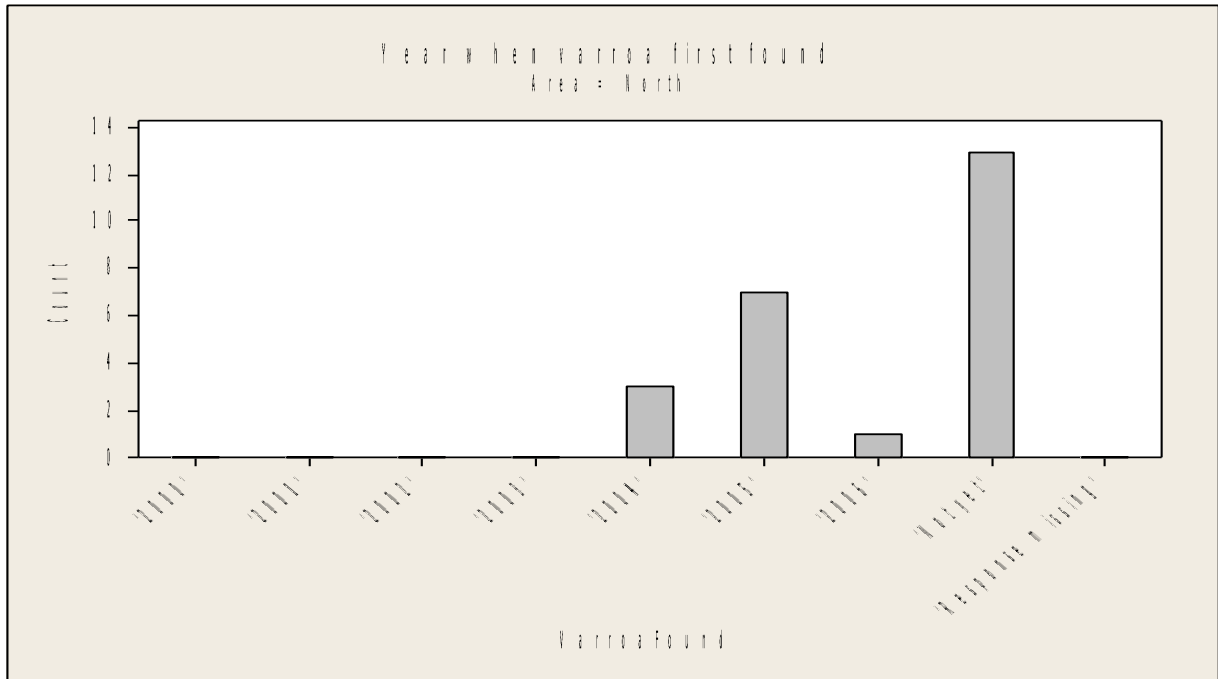


Figure 2.17C: Spread of *Varroa* - North area

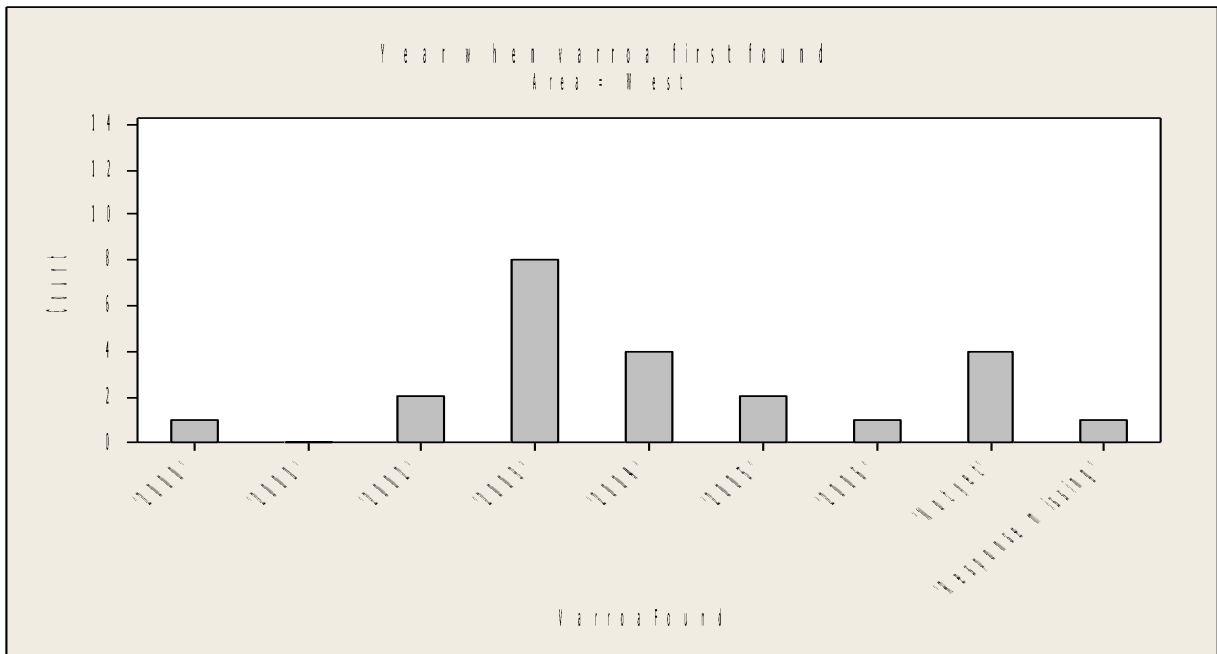


Figure 2.17D: Spread of *Varroa* - West area

In the East Area everyone responding to our survey reported having found *Varroa* in their bees, quite a few as early as the year 2000 or before. The situation in the West Area is similar, though four people claim not yet to have found it. Perhaps this reflects the greater isolation of some parts of the West Area, or possibly the effect of the early Fife outbreak. In the Aberdeen Area, two out of the seven respondents claim not yet to have found it, and in the North Area, 13 respondents - about half our sample - claim they have not yet found *Varroa* in their bees. Moreover in the North, no-one claims to have found *Varroa* earlier than the year 2004.

One odd feature of our sample, is that only one person in the whole sample - a respondent in the East Area - claims to have made the first discovery of *Varroa* in the year 2001. Of course many of the claims labelled as '2000' may have indicated an earlier discovery, so perhaps this simply reflects the fact that it was subsequent to 2001 that the impact of this pest first began to be widely felt.

2.5.3 The frequency with which the different treatments for *Varroa* have been applied

Obviously only those who believe their bees have *Varroa* will feel the need to use time and money in treating their bees for it. This section reports on the frequency with which those whose bees are known to be infested have been using the different methods of treatment, and how the relative popularity of the different treatments has been changing over the last two years, at least among those who responded to our survey.

In this survey no distinction has been made between Apistan and Bayvarol. The two treatments make use of very similar chemicals, and if mites develop resistance to one, they will almost certainly at the same time develop resistance to the other.

Only three different kinds of treatment were asked for by name

- (1) Apistan-Bayvarol (either spring or autumn application in 04 or 05);
- (2) Apiguard (whether used in either year or not);
- (3) Removal of Drone Brood (whether used in either year or not).

The affirmative responses received are summarised in the tables below. The first entry in each cell is the number of affirmative respondents to the question and the second number expresses that number as a percentage of those in that area who answered the question. The others presumably did not treat at all as they believed they were *Varroa*-free.

	<i>Aberdeen Area</i>	<i>East Area</i>	<i>North Area</i>	<i>West Area</i>
Spring 2004	1 (20%)	3 (20%)	0 (0%)	2 (13%)
Autumn 2004	3 (60%)	16 (89%)	4 (40%)	13 (81%)
Twice 2004	0 (0%)	3 (20%)	0 (0%)	1 (7%)
Spring 2005	0 (0%)	5 (23%)	2 (18%)	2 (12%)
Autumn 2005	4 (80%)	16 (73%)	6 (55%)	13 (76%)
Twice 2005	0 (0%)	4 (22%)	0 (0%)	1 (7%)

Table 2.16: Use of Apistan or Bayvarol as *Varroa* treatment 2004-05

Treatment with Apistan or Bayvarol is widespread among those treating, and, as is recommended practice, most of those using it choose to do so in the autumn. Of those treating in the spring, most also treat in the autumn, so that those treating in spring are for the most part using that treatment as part of a twice yearly treatment plan.

	<i>Aberdeen Area</i>	<i>East Area</i>	<i>North Area</i>	<i>West Area</i>
2004	1 (20%)	3 (17%)	1 (10%)	2 (12%)
2005	1 (20%)	2 (9%)	1 (9%)	6 (35%)

Table 2.17: Use of Apiguard as *Varroa* treatment 2004-05

Apiguard has until now been a less popular treatment than Apistan/Bayvarol, but there has been a growth of interest in it over the last two years.

The removal of Drone Brood in order to try to keep the number of mites in check is a different type of treatment than the use of chemicals to kill the mites.

	<i>Aberdeen Area</i>	<i>East Area</i>	<i>North Area</i>	<i>West Area</i>
2004	1 (20%)	5 (28%)	3 (30%)	8 (50%)
2005	3 (60%)	5 (23%)	6 (55%)	9 (53%)

Table 2.18: Use of Drone Brood removal as a control measure for *Varroa*

The numbers and percentages (of those in our sample who say they are treating for *Varroa*) using this method are shown in the table above for the two years 2004 and 2005. It is quite a popular supplement to other treatments, and its use appears to be growing.

Other measures for the control of *Varroa*

Respondents were also asked to indicate any other treatments they had used for the control of *Varroa*. Below is a summary of what methods were reported:-

	<i>Aberdeen</i>	<i>East</i>	<i>North</i>	<i>West</i>	<i>Total</i>
2004					
Exomite	0	0	0	0	0
Exorcept	0	1	0	0	1
Icing Sugar	1	0	0	0	1
Integrated Pest Manmt	0	0	0	1	1
Open Mesh Floors	0	1	1	1	3
Oxalic acid sublimation	1	2	0	0	3
Oxalic acid trickle	0	4	1	2	7
Oxalic acid unspecified	0	2	1	6	9
Thymol crystals	0	0	0	0	0
2005					
Exomite	0	1	0	0	1
Exorcept	0	0	0	0	0
Icing Sugar	1	0	0	0	1
Integrated Pest Manmt	0	0	0	1	1
Open Mesh Floors	0	2	1	1	4
Oxalic acid sublimation	0	3	0	1	4
Oxalic acid trickle	0	5	2	2	9
Oxalic acid unspecified	0	5	3	6	14
Thymol crystals	1	0	0	0	1

Table 2.19: Other procedures against *Varroa*

Of the alternative treatments mentioned, oxalic acid in one form or another is by far the most widely reported, with the trickle method being more often reported than the sublimation method among those who state the form in which they use it. Moreover it appears to be growing in popularity. Interestingly only one respondent claimed to be using "Integrated Pest Management", though perhaps that is because others did not feel this should be mentioned as an answer to this question. No attempt has been made here to represent these numbers as percentages, as it is not at all clear what would be the appropriate denominator to use in calculating the percentage.

2.6 Possible problems of inbreeding arising as the result of the impact of *Varroa*

There has been some reporting from England of problems with queen rearing that have been attributed to the inbreeding that may have resulted from the loss of most of the feral colonies of honey-bees to *Varroa*. It is generally believed that once *Varroa* becomes established in an area, almost all the feral colonies of honey-bees die out within about three years since they are untreated. It is believed that the only drones available for queens to mate with in these circumstances are often almost all from the virgin queen's home apiary, and that they may well be the offspring of closely related queens if the beekeeper habitually raises all his new queens from his own stock. If so, the loss of genetic diversity in the breeding population might account for some of the problems reported.

Questions were included in the survey to try to elucidate how severe a problem this might be for Scottish beekeepers. This was the hardest area for our respondents to deal with, and it is almost equally hard to analyse the responses. However an attempt is made below.

Each respondent was asked how many apiaries he or she managed and in which the colonies kept were entirely under the respondent's own control. For each such apiary, the respondent was asked three questions to be answered with respect to both the year 2004 and the year 2005. The three questions were

- How many stocks headed by a laying queen were in the apiary?
- To how many distinct *Family Groups* did these queens belong? Two queens were to be reckoned as in the same Family Group if they were mother and daughter or were sisters. This was undoubtedly the question that gave most difficulty in the whole survey.
- How many other apiaries are there known to the respondent within five miles of the one being reported on?

The numbers of apiaries reported on by each respondent varied from none up to eight, the details of this reporting by SBA Area being shown in the table below.

<i>No of apiaries</i>	<i>Aberdeen</i>	<i>East</i>	<i>North</i>	<i>West</i>	<i>Total</i>
0	2	6	4	2	14
1	4	11	13	9	37
2	0	2	3	3	8
3	1	3	4	1	9
4	0	0	0	2	2
5	0	1	0	4	5
6	0	0	0	0	0
7	0	0	0	1	1
8	0	0	0	1	1
Totals	7	23	24	23	77

Table 2.20: Numbers of respondents reporting different numbers of apiaries

The total number of apiaries reported on was therefore 128, distributed as shown in the table below across the different areas.

	<i>Aberdeen</i>	<i>East</i>	<i>North</i>	<i>West</i>	<i>Total</i>
Nos of apiaries	7 (5%)	29 (23%)	31 (24%)	61 (48%)	128 (100%)

Table 2.21: Distribution of apiaries by SBA areas

It is notable that the respondents sampled in the West Area included a far higher proportion of large-scale beekeepers than those selected from any other area, so that there are many more apiaries reported on from there, and the information gathered in this part of the questionnaire will therefore necessarily be quite heavily biased towards what is happening in the West of Scotland.

A first useful thing to consider about these apiaries is their size, as indicated by the number of colonies with mated laying queens which they contain. The tables and dotplots below give an indication of that for the two years 2004 and 2005, grouped into SBA Areas.

	<i>Aberdeen</i>	<i>East</i>	<i>North</i>	<i>West</i>
Median apiary sizes 2004	5	8.5	4	7
Median apiary sizes 2005	8	9	5	7

Table 2.22: Median apiary sizes as defined by number of queenright colonies

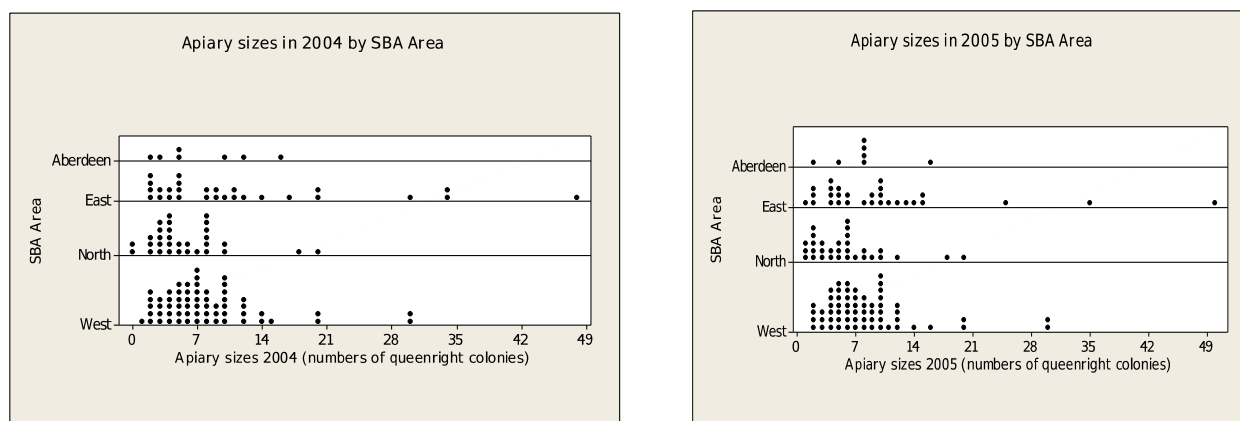


Figure 2.18

Dotplots of apiary sizes defined by number of queenright colonies by SBA Area in 2004 and 2005

The next stage in the analysis was to consider how the information provided might give an indication of how closely inbred locally raised queens and their progeny are likely to be. The problems of inbreeding are likely to arise if most of the available drones for mating virgin queens are closely related drones from the apiary that raised the queen, and there are few drones from other sites within flying range. These were the two points on which respondents were asked to provide

information. One possible crude scoring system that can easily be derived from this information is the sum of the number of family groups in the apiary and the number of adjacent apiaries. First of all, however, it is important to realise that the record returned of the number of family groups in each apiary is the variable for which many respondents found it impossible to make an accurate response, and so left this response blank, as indicated below.

	<i>Apiaries with a response</i>	<i>Apiaries with no response</i>	<i>Total</i>
Year 2004	91 (71%)	37 (29%)	128
Year 2005	92 (72%)	36 (28%)	128

Table 2.23: Response rates for "Family Groups" question

When the numbers reported here are added to those reported for the numbers of adjacent apiaries, the situation becomes even worse, since there are cases where although the respondent has been able to provide information about the number of Family Groups of queens in the apiary, he or she did not know anything about the number of adjacent apiaries lying within 5 miles. The situation is as shown in the table below.

	<i>Apiaries with a value available</i>	<i>Apiaries with no value available</i>	<i>Total</i>
Year 2004	86 (67%)	42 (33%)	128
Year 2005	87 (68%)	41 (32%)	128

Table 2.24: Outbreeding scores

Two pairs of graphs are therefore displayed below: the first pair are dotplots showing each of the apiaries placed as a dot on the graph, where the horizontal axis shows the number of queenright colonies in that apiary, and the vertical axis shows its "Outbreeding Score" calculated as the sum of the number of "Family Groups" in that apiary and the number of adjacent apiaries within 5 miles. The second pair does the same thing but for the "Family Groups" response only.

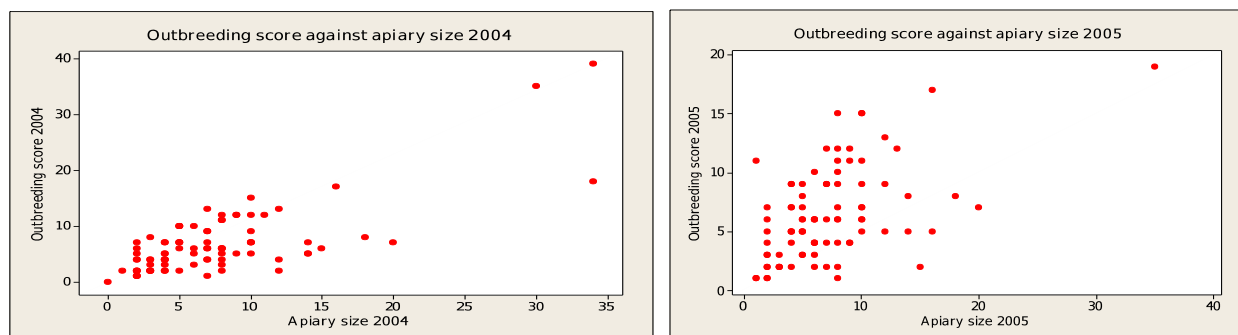


Figure 2.19: Outbreeding scores against apiary sizes 2004 and 2005

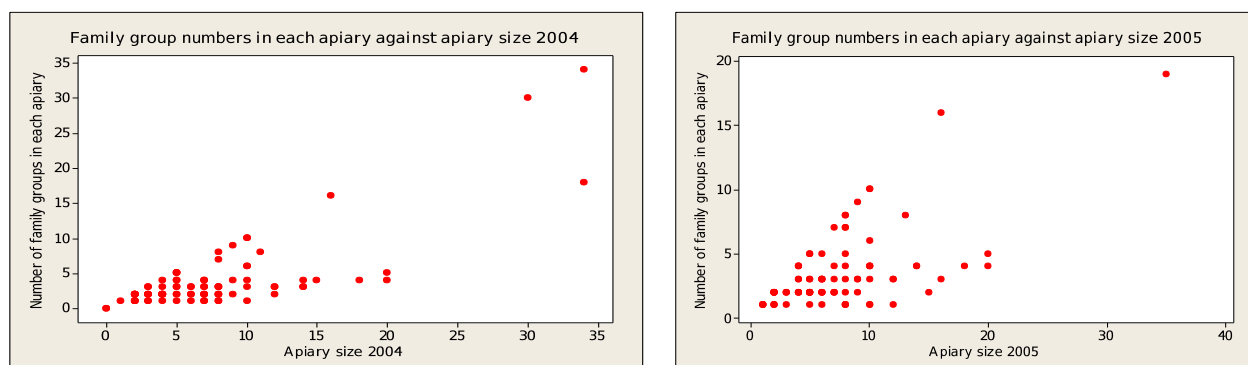


Figure 2.20: "Family Group" numbers against apiary sizes 2004 and 2005

From the point of view of avoiding excessive inbreeding, an apiary is best placed, the higher it appears on whichever graph is being viewed. From the point of view of its importance to the general genetic diversity of the local honey-bee population, the further to the right it is on the graph the more important it is. Clearly therefore from this perspective, large apiaries (on the right) with a large number of unrelated queens (high on the graph) are desirable. Of course, from other points of view - the depletion of local forage, and the spread of disease, say - such large apiaries are less desirable. However there is a case for suggesting that large apiaries where colonies are headed by queens all closely related to one another should perhaps be avoided in future. There is little doubt that the admixture of genetic diversity provided by feral colonies which Scottish beekeepers have had available to them in the past is soon not going to be there.

2.7 Queen rearing success rates

There have been some reports lately about declining success rates with attempts at queen rearing. The suggestion has even been made that the application of drone brood removal as a control measure against *Varroa* build-up may have resulted in a general shortage of drones for the mating of virgin queens. To address this question, and even just to establish a base-line against which future experience may be measured, respondents were asked to report on how many attempts they had made to rear and mate virgin queens during the summers of both 2004 and 2005, and what success rates they had experienced. Below are summaries of what was reported.

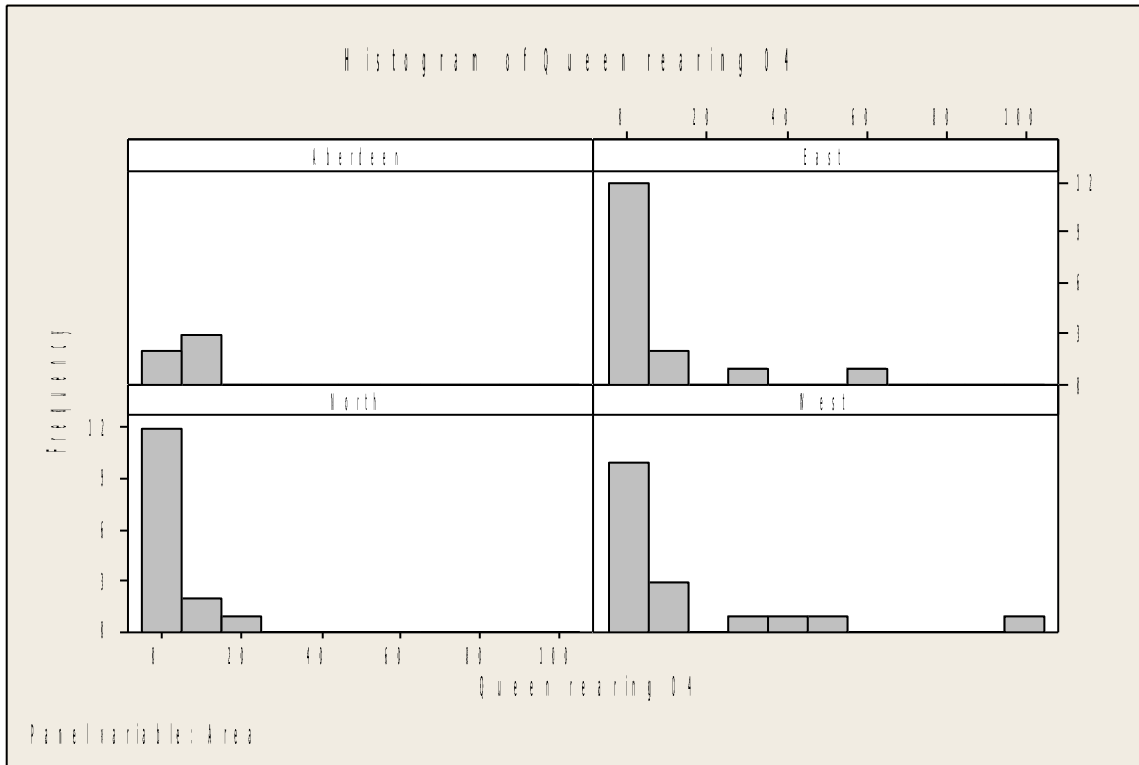


Figure 2.21: Queen rearing attempts 2004

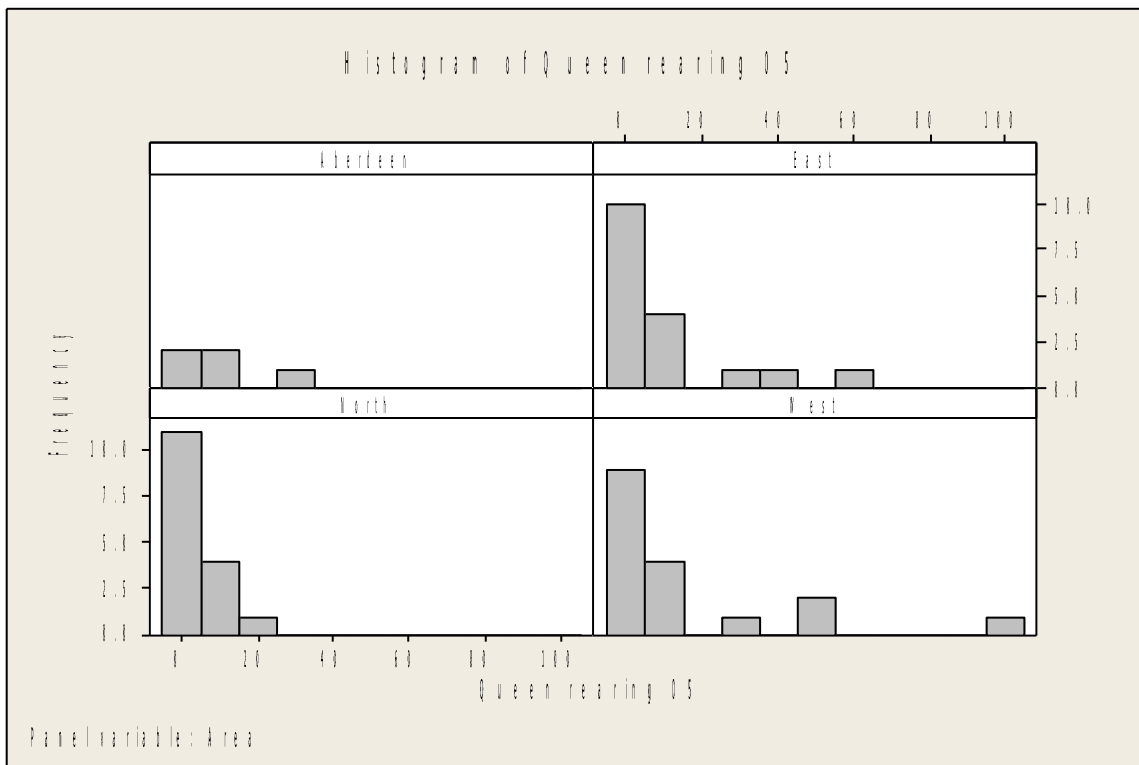


Figure 2.22: Queen rearing attempts 2005

Not all respondents answered these questions: 24 respondents did not do so for 2004, and 22 for 2005. The numbers of attempts made by those who did respond are given in the histograms above for each of the two years.

In order to give a picture of how these enterprises fared, four graphs are shown below. The first two show the distribution of the proportions of attempts which were successful over-all during the two years 2004 and 2005. The second pair show plots of the number of attempts made against the number of successes attained. In the second pair of graphs, any points below the diagonal line show a respondent whose attempts at queen rearing included some failures. The lower the point lies, the less successful was the endeavour.

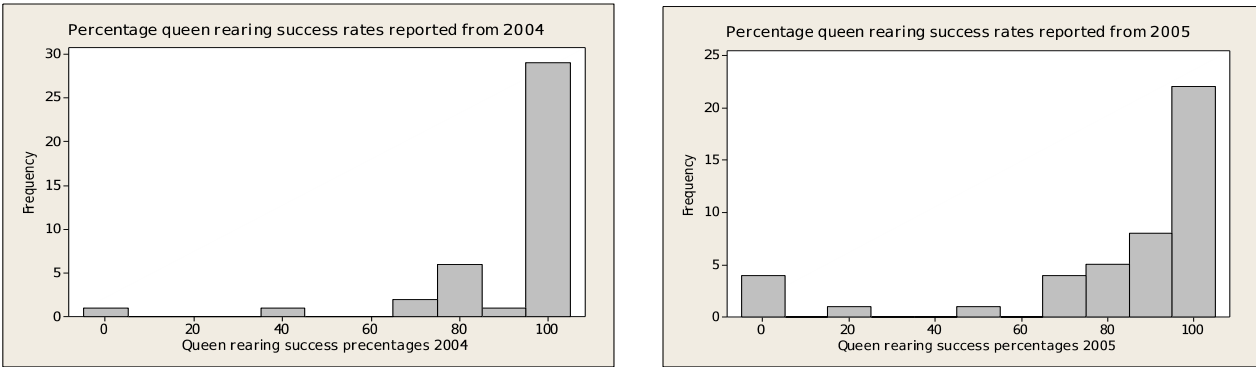


Figure 2.23: Over-all proportion of successes at Queen rearing 2004 and 2005

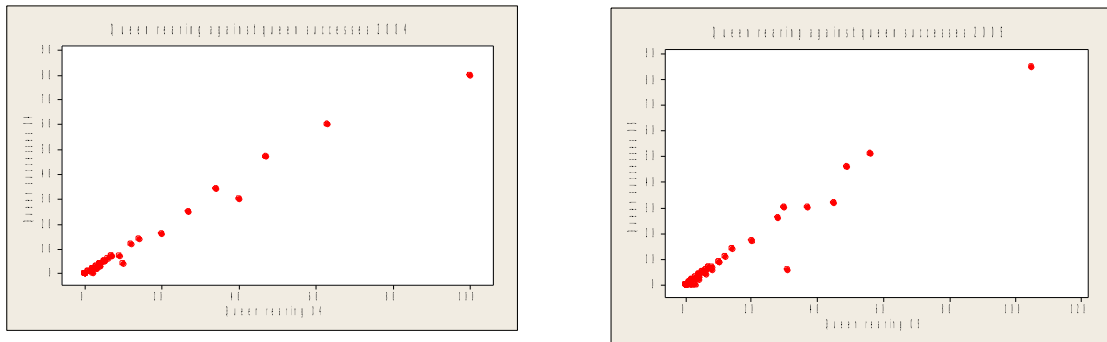


Figure 2.24: Rearing attempts made vs successes achieved 2004 and 2005

In both pairs of graphs there is perhaps a suggestion that 2005 was a slightly less successful year than 2004. It is more likely that these figures will be useful in establishing some sort of base-line for future work than that they can be used to deduce any sort of pattern developing between these two years.

2.8 Unusual observations about bees in 2004 and 2005

Respondents were asked whether they had observed unusual numbers of supersedures, unusual numbers of deformed queens or other unusual behaviour of bees recently. The numbers responding positively to these questions were as follows:-

<i>Supersedures</i>	<i>Queen deformities</i>	<i>Behaviour</i>
3 (4%)	5 (6%)	23 (30%)

Table 2.25: Types of unusual behaviour reported

The large proportion of respondents claiming to have observed unusual behaviour each gave written detail of what they had seen, as requested. These and other unrelated useful comments are printed in the Appendix which follows.

3 Conclusion

This is the full report on the findings of this survey. It is the first time that the SBA has attempted an exercise of this kind, and we hope that it is useful. Some further analysis of the data may reveal further useful information, but we believe that this report contains the principal findings that have emerged.

We are hoping to conduct a repeat survey some time not too far in the future, so any comments we receive about what are perceived as the most useful areas of enquiry included, and suggestions for other topics we might consider including, will be very welcome.

Appendices

Rather than attempting to summarise the many varied and useful comments made by respondents, they are all reported in Appendices 1 and 2 below. Finally Appendix 3 gives in full the questionnaire that was used in conducting the survey.

Appendix 1: Comments about unusual behaviour observed

1. Slow spring build-up in two colonies (one still owned, the other sold).
2. Winter 05/06 heavy defecation but no trace of nosema. Very strong colonies in autumn became tiny clusters by spring and expire from isolation starvation surrounded by honey and with fondant above in cold March. Thirteen colonies lost this way. In 21 years of beekeeping I have never lost more than 3 colonies over winter before. Certainly several due to failing queens - no brood - presumably all bees too old. 1 hybrid drone layer. Others laid small patches of brood in February and died out in March. All colonies have plenty of stores plus fondant.
3. Unusually high colony losses (3).
4. Bees hanging in clusters at hive entrance or occupying void space in WBC hives.
5. At one recent demonstration the “noise” or “sound” were not usual bee sounds & the bees tended to cluster on the observers. The brood patterns were not compact with one colony having many dead brood on the point of hatching.
6. As a beekeeper for many years, I have observed an increase in the number of colonies emerging queenless in spring over the last three years. The number of colonies surviving winter but appearing in a weakened state in spring has also increased over this period of time. In every case the colonies went into winter in good shape, were treated for *Varroa* and had an abundance of stores in spring.
7. In a colleague's apiary 100 m from mine numerous crawling bees last autumn. Also high losses of bees in late winter, early spring OUTSIDE the hives. My losses occurred in winter not in summer.
8. 2006 May 9 very early swarm. Might have been congestion but not weather as other three hives showed signs of swarming.
9. On a warm sunny day in March 2005 almost all bees crawled out of the hive. Thousands of them crawled into the grass and up plant stems. All were normal size and shape but many had uncoupled wings and were trembling. They showed text book symptoms of Chronic Paralysis Virus. Only the queen and about 100 bees were left in the hive and these were dead in a few days. There was no brood but there was still food. Combs were clean, not soiled. The bees all died in the grass and in a few days all trace had disappeared. If we hadn't been there then we wouldn't have known what happened. I suspected a problem because I'd seen very little activity round the hive but it had been too cold to investigate earlier. The bees first got *Varroa* during the summer of 2004 and were treated in September. I think that stress was a factor as we put our two colonies together in mid-September, didn't sort out the frames very expertly when we tried to put the two brood boxes together and didn't remove the supers and feed until near the end of the month. We've learned a lot since then.
10. One hive this year odd - fine at first inspection <in 2006> , large areas of brood and eggs and larvae, but 2 weeks later no larvae or eggs, and empty brood cells filled with nectar. Have twice inserted a frame with eggs, first attempt failed, second hasn't been checked yet. Only hive where I haven't marked the queen - haven't found her yet, if she's still there! Why would she stop laying?

11. Very long time in getting queens mated and laying. Loss of virgin queens.
12. Unmated queens absconding with nucleus.
13. A few bees in 2006 spring look slightly deformed.
14. Winter 2005/6 one colony “starved” directly below a FULL deep with no visible obstruction.
15. Strongest colony with a laying Q in autumn 2005 went queenless in winter. Queens were raised from the split stocks of artificial swarms whilst treating with Apiguard. Wondering if this interfered with queen development.
16. Bee health and hygiene much improved since dosing for Varroa mite: never been so good in last twenty years of keeping bees!
17. Hives very slow to build up to summer strength.
18. Artificial swarm in May 2005 - i.e. into two boxes. The original parent hive swarmed in mid-August. The old queen was clipped and so was lost.
19. Removed lots of larvae on two colonies mid summer, after winter oxalic acid treatment. I recovered about 400 dead mites from floor sample tray. Apistan in spring (4 days) showed no mite drop. Colony strong in 2005/06. Assume 99% kill of mites: very low mite count in 2006 (Spring) (second oxalic acid treatment).
20. Slow spring build-up. Drone rearing late in 05-06.
21. Three virgin queens mated and laying normally at the end of June 2005 superseded in mid-July. Supersedure subsequently successful.

Appendix 2: General Comments

1. Reports an outbreak of *Varroa* found 2006 May 19 at Helmsdale.
2. Practises mobile beekeeping from a purpose-built trailer.
3. I have been rearing queens and requeening colonies.
4. Lost 13 hives due to shoving on open *Varroa* floors. The other 12 hives did not have an open floor.
5. Queens are taken off to the local “drone zone” for mating which can be visited by drones from as far as **10 miles**.
6. Though no “bait hives” were put out, bees visited two empty hives that had not been put out but were *in situ*. Bees visited for a few days but swarms did not follow.
7. Re Marie Celeste losses: there were a few dead bees and plenty of stores. In one case a tiny number of bees and a poor-looking queen wandering on combs alone. Low mite count on hive floors on spring check (samples sent to SASA).
8. Re Marie Celeste losses: another one experienced in July 2004, where bees appeared to abandon hive - may have been due to lack of forage as no dead bees were found. It is possible that spray damage occurred but I've never experienced this before this time (about 30 years in THIS APIARY). Both above losses at an out apiary at ***** in a small plantation of trees. I've had good surpluses most years from here but between summer 2004 and March 2005 lost both hives. These were not starvation deaths: the bees seemed to abscond.
9. Re loss of all five colonies: Contacted Alan Teale and Graeme Sharpe. AT attributed loss to excess treatment with oxalic acid by the trickle method (3.5% at 30 ml per hive). Treatments were given at the end of September on return from heather and also in mid-December. At the mid-December treatment one colony with plenty of stores was already dead, the bees few in number and clustered tightly on a bare patch of comb. Exactly similar features were found when all the other four hives were opened in March, although one colony had a lot of dead brood on the floor. Mr Sharpe of Auchincruive suggested the possibility of systemic insecticide pollution from oil seed rape. The fact of one colony already dead in December rather suggests that oxalic acid excess might not have caused the deaths. The fact that the bees did not die until the spring might suggest that systemic insecticides might not have been the cause because the bees would have been in contact with poisoned pollen since at least September. My hunch is that the *Varroa* or another agent spread a lethal virus. In late autumn one colony had a yellowish dysentery at the entrance. Test by 1000X magnification and nigrosin did not reveal presence of nosema in pulverised bees. Feral colony in roof also died out which would perhaps support my supposition that a virus was responsible. A locally purchased colony is thriving on some of the combs - again suggesting virus. Any further ideas?
10. Notes forwarded by Marion Lang: At his ***** apiary hives have been very slow in building up this year, although they are doing better now. He has also noted that unmated queens swarmed late into the season last year and this spring that queens which were mated late last year are now being superseded. ***** has about 200 hives and has not experienced this sort of thing before.

He will be happy to discuss it with you.

11. Perhaps some losses following oxalic acid trickle treatment, but might be just wintering difficulties following failure to build up adequately from swarms.

12. "Bait" hives only used for hiving own swarms captured within apiary. Queens reared in own apiary are marked with year colour.

13. Slow start in 2006 but otherwise all is as normal.

14. Is on Council list for swarm removal, hence high number dealt with.

15. Possible Marie Celeste loss of a newly arrived swarm in early 2006.

16. Re Bait hives: Without scientific verification, it is difficult to know the origin of swarms which take over bait hives, but in the main I am fairly sure that, more often than not, the swarms are off my own hives.

17. Re inbreeding: all 2004 queens reared from a total of 40 colonies; all 2005 queens reared from a total of 30 colonies. Inbreeding highly probable!

18. Re unexplained losses: 1 Marie-Celeste loss in 2006 April. Re swarm numbers: pest control company was notifying me of swarms during 2005, hence high numbers dealt with.

19. Re Varroa treatment: alternate between Apistan and Apiguard year about.

20. Re Varroa infestation: Although there is no evidence of *Varroa* in my home area, all the beekeepers here carry out the following anti-Varroa measures as a routine:

Spring: test using Apistan and send to SASA

Summer: drone brood forking

Autumn: Test using Apistan

Winter: Oxalic acid.

21. Re Varroa treatment and absconding bees: I do not like Apiguard and will not be using it again. I think bees dislike it and did not remove it. Think this may have been part of the absconding problem.

22. Re apiaries: In addition to 20 permanent apiary sites, I have 10 heather sites.

23. Re nectar and pollen sources: please note we are in a 10 acre west coast garden.

Appendix 3

The questionnaire used in conducting the survey

SBA 2006 Beekeeping survey

Dear Scottish Beekeeper,

Some English beekeepers have reported unusually high numbers of queen failures in recent years. The Scottish Beekeepers' Association wishes to learn whether there is any evidence for this in Scotland. At the same time we would like to get an indication of the broader picture of beekeeping in Scotland to serve as a basis for future surveys of the "health and wellbeing" of our craft. Both of these objectives, if met, will help us to respond better to emerging problems.

We are therefore approaching a carefully selected subset of our members in order to gain a picture of how things went last year in this country. The selection of members for the survey was made to provide us with as representative a picture as possible. You are one of those selected.

We would greatly appreciate it if you could take the time to complete this questionnaire as accurately as possible, and return your completed form to your area contact person who is:-

In order that we can report on the results of this survey by the end of the summer, we would ask that you please return this form in the stamped addressed envelope provided

by Friday May 26th please.

Finally, we wish to stress that any and all answers to the questions that you can provide will be valuable, no matter how few. If you cannot answer a question please indicate this as directed in the question, or with "Not known" or something equally applicable.

With many thanks in advance for giving your time.

The SBA executive.

Contact details or anonymous response

Unless you indicate that you are willing to be contacted for possible follow-up, your responses will remain anonymous and we will not trouble you further after receiving your completed survey form. But if you would be willing to be contacted by the SBA to follow-up your answers, please give your contact details here:-

Name.....

Address.....

.....

Phone..... email.....

OR

I wish my response to this questionnaire to remain anonymous (Tick Box)

Questionnaire

Topic: In which AREA do you keep your bees?

In 2005 there were 38 Local Beekeeping Associations affiliated to the SBA. A list of these is at the end of this questionnaire, and each has been given a code number for you to insert here. If you keep your bees in the home area of one of these Associations, then please insert its code number below. If not, then respond in writing to the second part.

SBA Local Association Code No.

OR

None of these areas applies to me and the location(s) of my apiaries is/are best described as follows:

.....

.....

.....

.....

.....

.....

.....

.....

Topic: What forage is available for your bees?

Which of the following are the principal nectar/pollen sources available to you? *(Please tick those that apply, and/or add others at the end. If you don't know, just tick "Not known".)*

Early

- Autumn-sown oil-seed rape
- Broom
- Gorse
- Horse chestnut
- Hawthorn
- Sycamore
- Willow
- Other 1 (specify).....
- Other 2 (specify).....
- Not known

Mid-season

- Bell heather
- Bramble
- Clover
- Lime
- Raspberry
- Rosebay willowherb
- Spring-sown oil-seed rape
- Other 1 (specify).....
- Other 2 (specify).....
- Not known

Late

- Balsam
- Ivy
- Ling heather
- Other 1 (specify)
- Other 2 (specify)
- Not known ✓

**Topics: How many colonies do you keep?
How many have you inexplicably lost recently?**

How many separate apiaries do you manage?.....

In total how many queenright colonies had you in:

October 2004?	
March 2005?	
October 2005?	
March 2006?	

How many colonies did you lose to unknown causes during the following periods? Several beekeepers have recently described colony losses as exhibiting the *Marie-Celeste* phenomenon, when a hive previously apparently thriving is one day unexpectedly found completely abandoned. How many of your total recent losses would you say were of this type? If you are unsure of the answers to any of these questions, then simply respond “unsure”.

	How many total unexplained losses?	How many of these were <i>Marie-Celeste</i> ?
October 2004 - March 2005.		
April 2005- September 2005.		
October 2005 - March 2006.		

Topic: Swarms and swarming

How many swarms originating OUTSIDE your own apiary(ies) did you observe in 2004 and 2005? Of these, how many did you capture? Was the number higher or lower than you usually expect (or are you unsure whether this is higher or lower than usual)?

	<i>Observed</i>	<i>Captured</i>	<i>High/Low/unsure</i>
Summer 2004			
Summer 2005			

Has it been your custom to put out an empty hive or hives for swarm capture? If so, did you do so in 2004 or 2005, and if so was it/were they naturally colonised by bees **originating outwith your own apiary**? Does this match your previous experience?

- (a) (i) Usually put a hive/hives out?
Yes/No (*Ring the appropriate one.*)
- (ii) Some hive(s) is/are usually colonised from outside the apiary?
Yes/No (*Ring the appropriate one.*)
- (b) (i) Put hive(s) out in 2004?
Yes/No (*Ring the appropriate one*)
- (ii) Some hive(s) was/were naturally colonised from outside the apiary?
Yes/No (*Ring the appropriate one.*)
- (c) (i) Put hive(s) out in 2005?
Yes/No (*Ring the appropriate one.*)
- (ii) Some hive(s) was/were naturally colonised from outside the apiary?
Yes/No (*Ring the appropriate one.*)

Topic: Managing *Varroa*

In which year did you first find any of your colonies of bees infested with *Varroa*? (Please tick the appropriate box in the table below.)

Before 2001	
In 2001	
In 2002	
In 2003	
In 2004	
In 2005	
In 2006	
Not yet known to be infested	

(If the answer is “Not yet known to be infested” please go straight to Q 10.)

What treatments have you used against *Varroa* in the last two years?

	<i>Apistan/Bayvarol</i>		<i>Apiguard</i>	<i>Drone brood removal</i>	<i>Other (specify)</i>
2004	Spring	Autumn	Yes/No	Yes/No	
2005	Spring	Autumn	Yes/No	Yes/No	

(Please ring the appropriate entries or fill in the last column. If you have not administered any treatment, then enter “None” in the last column of the table.)

Topic: In-breeding dangers associated with *Varroa* infestation

One potential source of the difficulties being experienced in England is that *Varroa* has by this time wiped out most of the wild colonies of honey-bees, so that there is an increasing tendency for managed bees to become in-bred from queens mating with drones which are closely related to them. The questions that follow are an attempt to gain information about how genetically diverse are the drones available for queens mating from a typical Scottish beekeeper's apiary. Some of these questions may be hard for you to answer, but please do your best.

We should like to know details about this for each apiary site which you manage with **only your own colonies on it**. If all your bees are on a shared site or sites however, then we cannot expect you to supply these details.

10.

(a) Are all your colonies of bees on a shared site or sites?

Yes/No (*Ring the appropriate one.*)

(If your response is "Yes" please go straight on to question 11.)

(b) For hives on apiary site(s) which are all your own, we should like first of all for each such apiary site to know how many **laying queens** there were during the main part of the season for each of 2004 and 2005, and secondly what is the smaller number of **family groups** of laying queens which that represents. Any two queens on the site which are mother-daughter or which are sisters are to be considered as belonging to the same family group. The maximum genetic diversity occurs when all the laying queens are unrelated, and the worst danger of inbreeding will occur if they all belong to a single family group. We should also like to know how many other **adjacent apiaries** there are **that you know of** within drone-flying distance of 5 miles of each of your apiaries, which could supply unrelated drones.

See over.....

<i>Apiary 1</i>	<i>No of laying queens</i>	<i>No of family groups</i>	<i>No of adjacent apiaries</i>
2004			
2005			

<i>Apiary 2</i>	<i>No of laying queens</i>	<i>No of family groups</i>	<i>No of adjacent apiaries</i>
2004			
2005			

<i>Apiary 3</i>	<i>No of laying queens</i>	<i>No of family groups</i>	<i>No of adjacent apiaries</i>
2004			
2005			

<i>Apiary 4</i>	<i>No of laying queens</i>	<i>No of family groups</i>	<i>No of adjacent apiaries</i>
2004			
2005			

<i>Apiary 5</i>	<i>No of laying queens</i>	<i>No of family groups</i>	<i>No of adjacent apiaries</i>
2004			
2005			

(If you have more than 5 apiaries stocked with only your own colonies, then please complete more tables like this on a separate piece of paper, and submit them stapled to your questionnaire. If you have fewer than 5, then just complete as many tables as you need.)

Topic: Queen breeding difficulties perhaps associated with *Varroa*

One of the problems reported by some beekeepers in England has been a high proportion of failures of new queens to go on to become successful laying queens. How have you fared in this regard?

11. For each of the seasons 2004 and 2005 how many of your colonies were permitted or forced to attempt to raise new queens, and of these attempts how many succeeded in producing a **queen that laid normally until the end of the season?**

(Please fill in the table below. If you are not sure of the answer to any of these questions, simply insert "not sure" in the table.)

	<i>No of queenright colonies</i>	<i>No of attempts to raise a queen</i>	<i>No of successes</i>	<i>No of failures</i>
2004				
2005				

12. Have you observed higher than expected numbers of supersedures in 2004 and/or 2005? Yes/No *(Ring the appropriate one.)*

Deformities of queens and/or abnormalities of behaviour

13. Have you observed higher than expected queen deformities in 2004 and/or 2005? Yes/No *(Ring the appropriate one.)*

14. Have you observed any unusual behaviour in your bees in 2004-2005 and 2005-2006 Yes/No *(Ring the appropriate one.)*

(If your answer to question 14 was "Yes", then please answer question 15.)

15. What form did the unusual behaviour take?

.....

Thank you for your help.

We hope to report the results of this survey in a forthcoming issue of “The Scottish Beekeeper”.

But be assured that your identity will not be revealed in any report of this survey.

Local Beekeepers' Associations affiliated to the SBA

Association Name	Code No
Aberdeen & District	1
Ayr	2
Border	3
Caddonfoot	4
Clyde Area	5
Cowal	6
Dingwall	7
Dunblane & Stirling	8
Dunfermline & W. Fife	9
East Lothian	10
East of Scotland	11
Easter Ross	12
Eastwood	13
Edinburgh & Midlothian	14
Fife	15
Fortingall	16
Freuchie	17
Glasgow & District	18
Helensburgh & District	19
Inverness-shire	20
Kelvin Valley	21
Kilbarchan & District	22
Kilmarnock & District	23
Kirriemuir	24
Largs & District	25
Lochaber	26
Moray	27
Mull	28
Nairn & District	29
Oban	30
Olrig	31
Peebles-shire	32
Perthshire	33
Skye & Lochalsh	34
South of Scotland	35
Sutherland	36
West Linton & District	37
Western Galloway	38