Colony losses in Scotland in 2004-2006 from a sample survey

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In the early summer of 2006, a postal survey of beekeeping in Scotland was carried out on behalf of the Executive of the Scottish Beekeepers' Association (SBA), to obtain an overview of some general aspects of current beekeeping practice and experience in Scotland. Of particular interest were colony losses and also extent and impact of the parasitic mite *Varroa destructor* (Anderson and Trueman, 2000). The Scottish experience is of interest, as *V. destructor* is not yet universally present throughout the country.

The survey asked questions on various matters concerning the beekeeping experiences of respondents during the winter of 2004-05, summer of 2005 and winter of 2005-06. Questions covered forage sources, size of beekeeping enterprise, numbers of swarms observed and captured, use and success of bait hives to attract swarms, numbers of colony losses due to unknown causes, and questions relating to the impact of *V. destructor*. The latter included the year of first finding the mite present, and use of treatments and control strategies. Later sections addressed possible inbreeding, and difficulty of queen rearing, and any unusual features or behaviour observed in managed honey bees. The questionnaire designed for this was tested in a small-scale pilot study and revised as necessary.

The target population was SBA members resident in Scotland. Random sampling of beekeepers was unfortunately not possible as permission had not been given at that time to use SBA membership records for sampling purposes. As the best alternative, a sample of 100 people (roughly a 10% sample), stratified by area, was selected by SBA Area Representatives, using Local Association records. The sampled population consisted of just over 1000 people in four administrative areas (Aberdeen, East, North, and West) covering the whole of Scotland except for the Outer Hebrides, Orkney and Shetland (where there are a few beekeepers but no Local Association). A non-random sample of this kind is far from ideal (Schaeffer *et al.*, 2005), but nonetheless gave a useful first impression of Scottish beekeeping, although the possibility of selection bias must be borne in mind in interpreting the results. There was a high response rate of 77%.

We report here on colony losses, summarised in Table 1. Apart from the expected occasional winter losses, some beekeepers in England and Wales have in recent years reported the sudden disappearance of bees from apparently thriving hives, where a hive is suddenly found completely abandoned. Since 2004, there have been reports of occasional similar occurrences in Scotland. Survey respondents were asked to report on their recent unexplained colony losses, and on whether any of them fitted this pattern (termed here "Mary Celeste" (MC) losses). These may or may not be similar to losses due to the widely reported Colony Collapse Disorder (CCD; Johnson, 2007).

Of 77 respondents over all areas, 19 (25% of respondents), 12 (16%) and 29 (38%) reported unexplained losses over winter 2004-2005, summer 2005, and winter 2005-2006 respectively. These overall proportions reporting losses differ significantly between seasons (p-value < 0.01). Corresponding total numbers of unexplained colony losses were 66, 31 and 113, giving reported rates of unexplained loss, per colony kept, of 4.7%, 2.2%, and 7.3% respectively over the three seasons. Small-scale beekeepers suffered proportionately higher losses in general, so mean reported loss percentages over these same periods were higher, at 7.3%, 3.2% and 10.7% respectively. Rates of loss were significantly greater in winter than in summer (p-value < 0.001), as expected, as were the proportions of respondents reporting losses, but there was no significant difference between the winter loss rates. Of the larger areas (East, North and West), the patterns of losses in the East and West were similar. There were fewer reported losses in the North.

The overall proportions of unexplained losses reported as MC

Table 1. Numbers of unexplained and MC colony losses over two years, by area, shown as winter 2004-2005, (summer 2005), [winter 2005-2006] respectively within each cell.

	Aberdeen	**East**	**North**	**West**	**Overall**
No. of respondents	7 (7) [7]	23 (23) [23]	24 (24) [24]	23 (23) [23]	77 (77) [77]
No. reporting losses	1 (1) [1]	7 (5) [12]	7 (1) [6]	4 (5) [10]	19 (12) [29]
No. of colonies kept	83 (75) [96]	463 (478) [455]	202 (183) [204]	656 (642) [795]	1404 (1378) [1550]
Total losses	4 (2) [2]	32 (17) [48]	12 (2) [31]	18 (10) [32]	66 (31) [113]
MC losses	4 (2) [0]	11 (9) [19]	7 (2) [14]	8 (5) [14]	30 (18) [47]

type were about 45% (30 of 66 losses) for the first winter, about 42% (47 of 113 losses) for the second winter, and about 58% (18 of 31 losses) for summer 2005, although there was no statistically significant difference in these proportions. There was also no significant difference between the two winter MC loss rates (average of individual loss rates), but the MC loss rate in summer was very significantly higher (p-value < 0.001) than the average winter rate.

A strongly significant statistical link was found between the length of time of known presence of *V. destructor* in a honey bee colony and the odds of sudden unexplained colony loss during the survey period, providing new scientific evidence to confirm and quantify a long-suspected association (see full survey results at:- http://www.scottishbeekeepers.org.uk/).

References

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