Asian Honeybee incursion into Queensland: eradicable?

The Parameters

In assessing eradicability, a number of parameters may be used:

(1) Extent of spread/area covered
(2) Apparent rate of multiplication – also known as the estimated dissemination ratio. This is calculated from the number of new detections within a regular and constant time interval.
(3) Number of actual detections compared to the estimated number of colonies (based on their known reproductive rates).

All of the above are well-known epidemiological concepts; in this context, they will be applied to Asian honeybees (*Apis cerana*).

The Asian honeybee

A. cerana is thought of as being tougher and more prolific than the European honeybee (*A. mellifera*). Colony sizes are smaller; they are more adept at hiding colonies and avoiding detection; they rapidly abscond upon detection and easily re-establish in a new location; colonies are thought to divide and reproduce every 3-8 months.

They are easily able to "hitch rides" on trucks or trains and thus able to travel long distances to establish new colonies. Although in Queensland they are assumed not inhabit forested areas, it is known they are able to live in Asian forests.

Current extent – Queensland

Although the initial Asian honeybee detections were in Cairns – all within an area of a few hundred square kilometres – the situation over three years later is that colonies are now spread out over an area covering several thousand square kilometres. The ability to maintain a consistent and effective surveillance effort over such a large area is questionable.

Estimated Dissemination Ratio

In traditional epidemiology, an epidemic must maintain an EDR of more than one in order to sustain itself. For most of the past 3.5 years, the Asian honeybee EDR has been in excess of 1.5 and is now well over two. From an epidemiological perspective, this would be seen as a rapidly propagating, "out of control" epidemic.

It has been argued that the apparently high EDR is due more to increased detections than to a true increase in colony propagation. The increased detections have been attributed to the deployment of extra surveillance personnel and improved surveillance methods.

This, however, begs a number of questions:

- If surveillance has recently improved, how many hives went undetected during the earlier period of "poor" surveillance? There is a potential backlog – probably a very large one – of undetected nests that have been reproducing and generating yet more hives that have gone uneradicated. Given the huge area presently colonised by the bee and the relatively small surveillance area, they could be successfully continuing to replicate.

- If the increase in detections is due to a combination of both improved surveillance and a much increased "visibility" of bees due to their greater numbers, is the EDR not an indication of the tip of the iceberg? If better surveillance is leading to detection of an ever greater number of bee colonies, then the EDR is probably an indicator of an out-of-control situation; improved surveillance is simply reflecting reality.

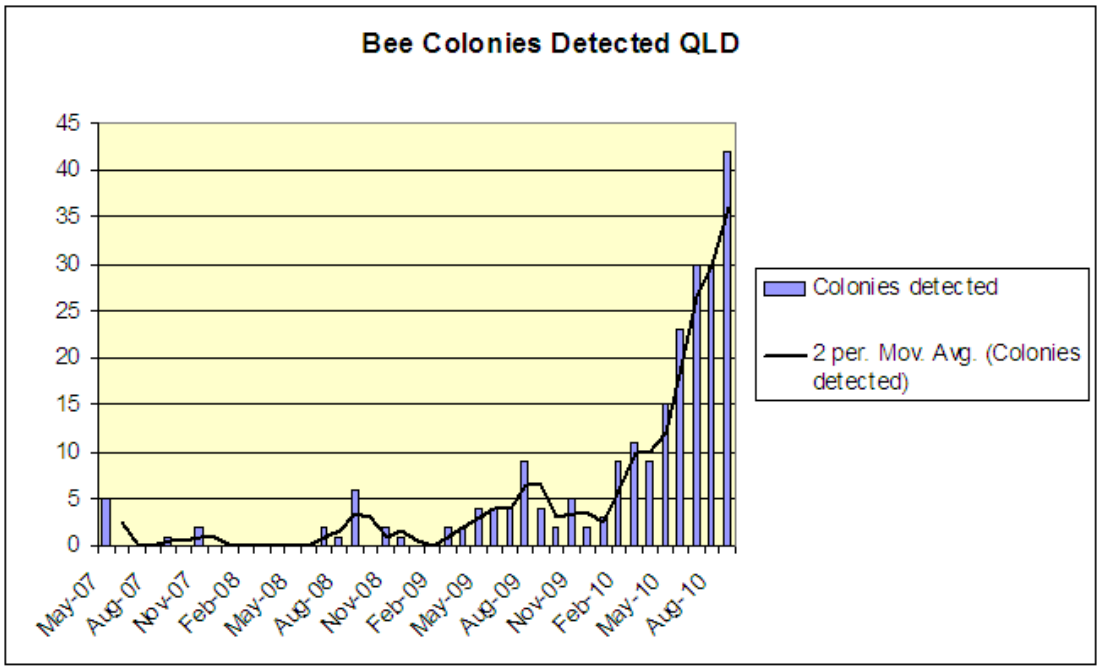

Fig. 1. Bee colony detections May 2007 to date. There has been a marked rise in detections over the past year.

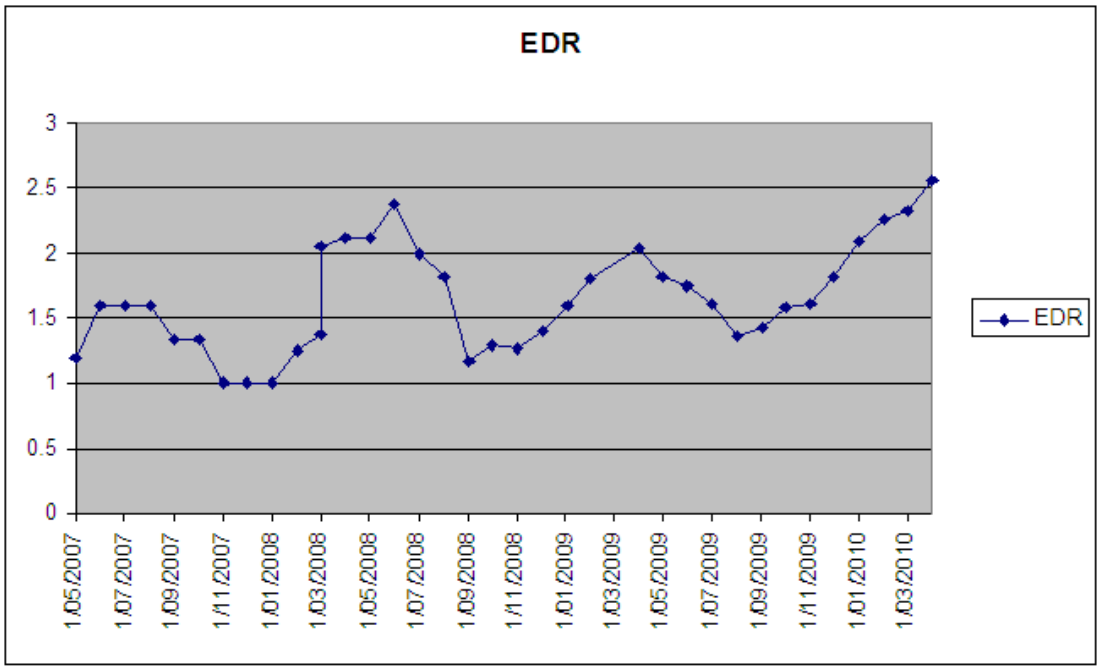

Fig. 2. Estimated dissemination ratio. This has been calculated by measuring the number of new colony detections in the preceding six-month period.

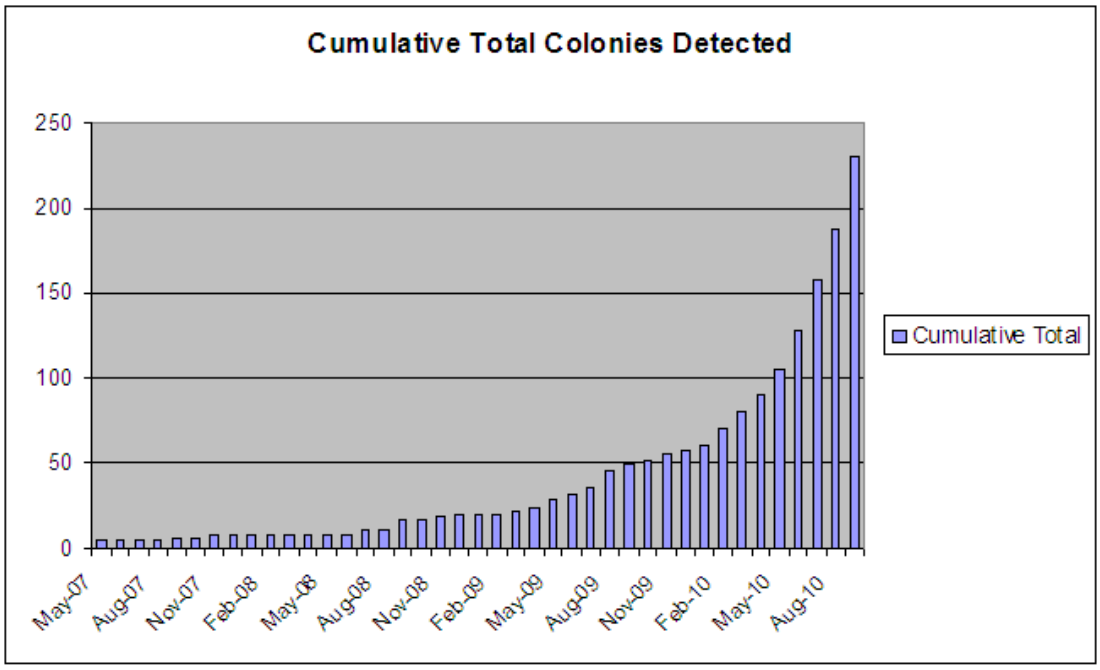

Fig. 3. Cumulative total detections. By the beginning of October, a total of 237 colonies had been detected.

Detections vs predicted colony numbers

It is possible to make a crude population model to predict the "true" number of colonies present and compare this with the number detected.

Although *A. cerana* has a high reproductive rate (one colony dividing every 3-8 months), not all new swarms will be viable. Should a colony generate 1.75 new colonies every 6 months, there should be well over a thousand colonies in existence at present: only about 230-250 have been detected to date.

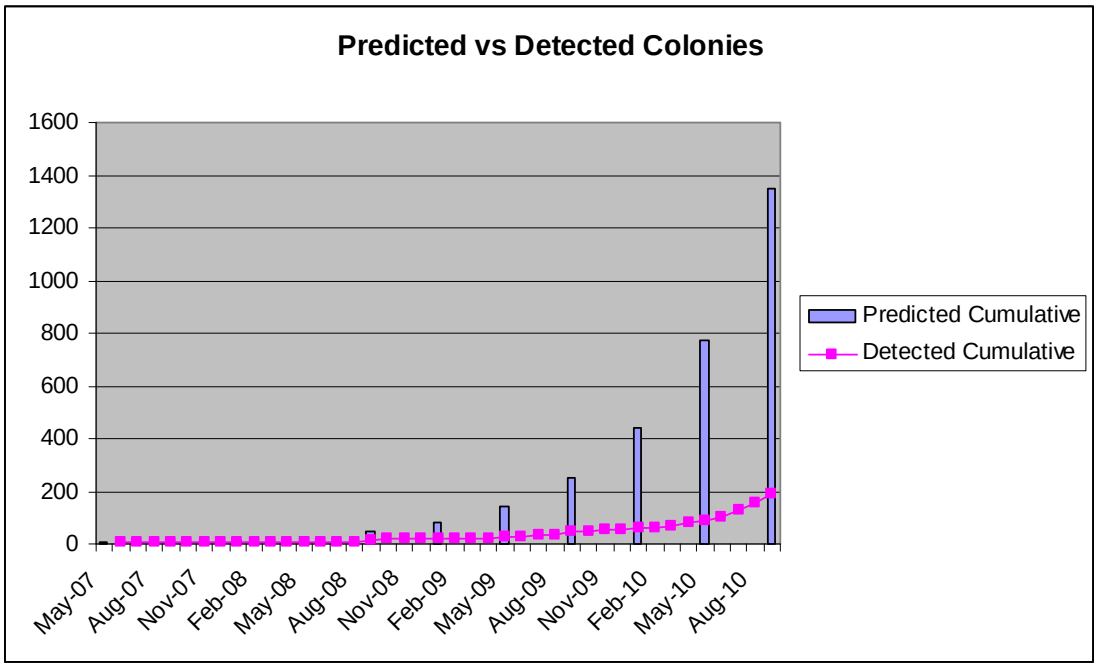

Fig. 4. Detections vs possible actual colony numbers.

The model shown in Fig. 4 is admittedly a pessimistic one; but even if the "true" number of colonies is greatly reduced – to, say 800 colonies – the implication remains that a huge number of colonies are still undetected and still reproducing.

	Detected	Actual	Surveillance sensitivity
Worst case	250	1300	± 20%
Best case	250	800	± 30%

The table above shows a calculation of surveillance sensitivity (what proportion of colonies are being detected by surveillance). It shows that present detection methods are only finding between 20% and 30% of colonies.

From an epidemiological viewpoint, this represents an impossible situation. A surveillance system that is not able detect in excess of 90% of cases will not be able to support an eradication effort. As a comparison, the best available diagnostic test for Johne's disease in livestock only unearths about 40% of cases. After many years of effort, Johne's disease has proved ineradicable.

Conclusion

The likelihood that hundreds of undetected hives continue to exist and multiply, combined with a surveillance system that is only able to detect at the most about 30% of these, means that Asian honeybees will continue to spread undetected in Queensland. The incursion is not seen as eradicable.