REVIEW OF VARROA ECONOMIC IMPACT ASSESSMENT: RECOMMENDATIONS ON REVISION

4 December 2002

Background

This note reports on review of the varroa economic impact assessment of 2000[1] ("the 2000 assessment"), as outlined in the proposal of 21 October 2002, and makes recommendations on revisions to the sector models.

The recommended revisions derive from the availability of new information following experience of the management of varroa in New Zealand and reconsideration of the expert opinion provided previously, but incorporate also the achievements of the current varroa management programme in reducing the effects and slowing the spread of varroa. With the adoption of these recommendations, the revised economic impact assessment therefore models the remaining potential economic impacts of varroa in the absence of further intervention.

Recommended revisions

The recommended revisions to the sector models are as follows.

Beekeeping sector and sectors hiring hives for pollination

Recommendation 1: that the average annual cost of treating hives for varroa be reduced from $55 to $40 per hive per annum.

Reasons: Historically, the annual cost of treating hives for varroa has been in the range $40 to $55 per hive. Subsequent to the 2000 assessment, it was suggested that the cost of treatment may be lower than was modelled, possibly as low as around $20 per hive, with the availability of new organic treatments. A recent survey within the existing infested area has found the costs to beekeepers of materials and requeening, plus some additional labour and transport costs, to lie between $20 and $30 per hive in most cases. The long-run average cost is as yet unclear and estimates vary significantly according to their composition (e.g. material and application costs only, or also monitoring costs, costs associated with increased mortality, etc., which are more uncertain).

Recommendation 2: that pollination charges for hives supplied to the horticultural and arable sectors be increased by the full amount of, but no more than, the average cost of treating hives for varroa, as identified in recommendation 1.

Reasons: Current observations in the existing infested area suggest that most beekeepers supplying hives for pollination believe that they have passed on to their clients the full costs

[1] Ministry of Agriculture and Forestry (2000) *Varroa in New Zealand: economic impact assessment*, November 2000.

of treating hives for varroa. Pollination charge increases of up to 45 per cent have been reported.

The 2000 assessment modelled increases in pollination charges beyond the cost of hive treatment for a return-on-risk, due to some degree of risk-aversion on the part of beekeepers to moving hives into or close to infested areas, and as a result of market forces with elimination of the contribution to pollination of feral and hobbyist bees and intermittent losses of managed hives.

Current observations suggest that beekeepers are not significantly averse to moving hives into the existing infested area.

The hive requirements adopted for the major horticultural crops modelled are believed to be sufficient for no contribution by feral and hobbyist bees, provided that hive strength is maintained, which current observations in the existing infested area support. Whilst there may be some free-riding on pollination by feral and hobbyist bees currently in some avocado and squash crops, which may therefore require additional hives, this demand is thought unlikely to be sufficient to increase pollination charges significantly.

Significant losses of managed hives, without effective treatment, have been reported. The majority of beekeepers in the infested area have suffered increased losses and a minority have been reported to have suffered extremely high losses (25 to 50 per cent). Significant hive losses are expected in the short-term only, however, until beekeepers recognise that effective treatment of infested hives is essential (indeed it has been suggested that there may be fewer hive losses under varroa as beekeepers visit their hives more frequently). It is thought that any inadequate treatment will be short-lived until beekeepers learn from experience, or those who don't adopt effective varroa management practices exit the industry, after which time hive losses due to varroa should be negligible. Until this time, however, there may be some upward pressure on pollination charges. For example, it has been suggested that, for arable producers, the availability and therefore cost of pollinator hives may be affected by increased competition from the North Island horticultural sector (it was reported that a Bay of Plenty beekeeper who lost 30 per cent of his hives to varroa this Winter just bought 200 hives from the South Island to meet kiwifruit pollination demands).

Recommendation 3: that rates of non-pollinator hive industry exits be halved.

Reasons: This follows from recommendation 9, with hive treatment now more effective, as well as cheaper, than was modelled previously, and recommendations 7 and 8, with the suggestion that, although hives are likely to be removed from dryland pasture areas where marginal honey production will not support the additional costs of hive treatment, it may be possible to use such areas periodically (e.g. in good weather years). Exit of hobbyist beekeepers and poorest performing honey producers is still expected, without opportunity to recover hive treatment costs through pollination charges and given evidence that some beekeepers, particularly in some regions of the South Island, are already operating at a loss.

Horticultural sector

Recommendation 4: that production losses through reduced yield and fruit size be reduced to zero (as under the best case scenario modelled previously).

Reasons: The reductions in crop yields modelled previously arose from the supposed effects of varroa on managed hives and feral and hobbyist bees. Significant effects on horticultural crop yields are now thought unlikely. Growers would demand well-maintained, high performance hives. It is considered that most beekeepers would be sufficiently skilled to maintain the strength of hives providing pollination services, even in the absence of further intervention. Hive strength is believed to be improved under more active management, as required in treating for varroa. An enduring legacy of the current varroa management programme, even without a successor, is more effective treatment of managed hives than would have occurred in the absence any intervention, as modelled by the 2000 assessment. Current observations in the existing infested area indicate maintenance of hive strength and there is no evidence of reductions in horticultural crop yields. Significant hive losses, due to inadequate treatment, are expected in the short-term only, as indicated in support of recommendation 2. For most crops, the hive requirements modelled previously are believed to be sufficient, as indicated in support of recommendation 2 for the loss of feral and hobbyist bees not to affect yields. Some avocado and squash crops may experience reductions in yields, however, unless pollinator hive numbers are increased, given some free-riding on pollination by feral and hobbyist bees currently.

Arable sector

Recommendation 5: that production losses through reduced yield be reduced to zero (as under the best case scenario modelled previously).

Reasons: Significant effects on arable crop yields are now thought unlikely, with maintenance of hive strength and more effective treatment of hives than modelled previously, as indicated in support of recommendation 4. There is no evidence of reduced horticultural crop yields in the existing infested area, although this is under use of hives over a typically three week pollination period whilst arable areas require hives for typically a three month pollination period. The contribution of pollination by feral and hobbyist bees is believed likely to be less in Canterbury than in the North Island. Other pollinators of significance, such as flies, make some contribution in the arable sector.

Recommendation 6: that there be no increase in the number of hives provided to the arable sector (as under the best case scenario modelled previously).

Reasons: It is now considered that there would probably be no need to increase hive numbers. It is thought unlikely that there would be significant effects on arable crop yields, as indicated in support of recommendation 5, and current opinion is that arable areas have generally been overpopulated with hives.

Pastoral sector

Reconsideration by technical experts of the opinions that formed the basis for modelling potential impacts on the pastoral sector in the 2000 assessment included the view that "I … see no reason to change the assumptions made in the model." Most of those consulted, however, now consider the potential impacts of varroa on the pastoral sector likely to be of somewhat lesser magnitude, but to arise earlier, than modelled previously.

Recommendation 7: that the magnitude of production losses in Summer dry areas be halved.

Reasons: The basis for modelling more severe impacts in Summer dry than Summer moist areas in the 2000 assessment was the importance in the former of pollination by feral bees and the belief that managed hives would be withdrawn from dryland pasture where marginal honey production is unlikely to be able to support hive treatment costs. Whilst the assertion that feral bees are the main pollinators in South Island high country has been upheld, it is now generally considered that the role of other pollinators in highland areas, such as bumble bees, is greater than was assumed previously and that there is scope for the contribution of some pollinators to increase with reduced numbers of honey bees. Some dryland areas also have subterranean clovers and trefoils, which are self-fertile and to which bee visitation contributes only marginally. Dryland areas may periodically be suitable for honey production (e.g. in good weather years) and this may be sufficient to maintain some legume seed bank. A further consideration is that reduced sulphur and phosphate applications over the years, in response to declining farmgate returns, will have already reduced clover seed set in hill country, such that reduced pollination would have a lesser effect in these areas than if pastures were well fertilised.

In the 2000 assessment, the effect on Summer dry pasture of reduced pollination activity was modelled as a five per cent reduction in atmospheric nitrogen fixation. The relationship between pasture growth and quality and meat and wool production is not linear, but, rather than rework the “Stockpol” and “Overseer” model calculations, a crude revision of halving the production losses and additional nitrogen applications modelled for Summer dry areas is proposed.

Recommendation 8: that additional nitrogen applications in Summer dry areas be halved.

Reasons: See recommendation 7.

Recommendation 9: that additional nitrogen applications in Summer moist areas under the worst case scenario be halved.

Reasons: The levels of additional nitrogen applications modelled for summer moist areas follow from the effects of varroa on managed hives. The level modelled under the worst case scenario is now considered relatively high, particularly in light of the modification to the level of additional nitrogen applications in Summer dry areas under recommendations 7 and 8, and given that, where hives are treated, treatment is now thought likely to be more effective than modelled previously, with honey flows in Summer moist areas more likely to be sufficient to cover the costs of hive treatment. As, again, a simplistic revision, it is suggested that for Summer moist areas additional nitrogen applications under the worst case scenario be halved.

Recommendation 10: that the time lag between effects on pollination in pastoral areas and when these start to impact on the pastoral sector be reduced from ten to eight years.

Reasons: It is now thought that the buried seed data cited in the 2000 assessment is probably on the high side. Even with allowance for soil disturbance by hoof activity, seed below a depth of around two inches is generally unlikely to have sufficient warmth and moisture to germinate. Establishment from buried seed is not a significant source of clover renewal in many pastures, occurring most after soil disturbance or drought. Additionally, since the 2000

assessment, some changes have been seen in the management of lowland permanent pasture; high levels of pasture renewal are occurring, interspersed with much more forage cropping. This will affect potential for regeneration of clover from both rooted stolons (no living clover left) and hard seed (may be buried too deep). Other impacts on clover survival, such as clover root weevil, have been identified. Reduced sulphur and phosphate applications over the years, in response to declining farmgate returns, will have already reduced clover seed set in hill country. Whilst this may cause reduced pollination to have a lesser effect in these areas than if pastures were well fertilised, as indicated is support of recommendation 7, it would cause the effects on pasture clover content to arise earlier; a good flowering and seed set is required every two to three years to sustain an actively contributing seed load. There is widespread agreement that the impact of varroa, if it significantly reduces pollination, would be more likely to begin to be seen within five to ten years of effects on pollinators in pastoral areas.

Recommendation 11: that effects on pollination in South Island pastoral areas continue to follow completion of the seven year period of spread throughout the South Island under the best case scenario but commence after four years of the six year spread period under the middle case scenario and after two years of the five year spread period under the worst case scenario.

Reasons: In the 2000 assessment, effects on pollinators in South Island pastoral areas were assumed not to commence before completion of the spread of varroa throughout the South Island. Added to the ten year lag between effects on pollinators and the commencement of impacts on the pastoral sector, this meant, in effect, modelling up to sixteen years, for parts of the South Island first infested, between establishment of varroa and commencement of impacts on pastoral land in these areas. This arose from the difficulty in modelling the South Island as a single region, given uncertainty as to where in the South Island varroa would first establish, from where it would spread, and the concentration of livestock in the lower half of the island, such that much of the impact of varroa on the South Island pastoral sector would relate to when varroa reached these areas. In light of the basis for recommendation 10, that impacts on the pastoral sector could be expected to be seen within five to ten years of effects on pollinators, this approach has been reconsidered. It is concluded that whilst this approach is not unreasonable, within the simplistic framework of the model, there could be grounds for modelling effects on pollinators in infested areas commencing before completion of spread of varroa throughout the South Island. It is therefore proposed that this be introduced as a new element of variation across the three scenarios, with no change under the best case scenario, but bringing pastoral sector impacts forward somewhat under the middle and worst case scenarios.

Recommendation 12: that there be no adjustment made to include the possibility of payment for pollination in Summer moist areas of the pastoral sector.

Reasons: At the levels of impacts modelled, payment for pollination in Summer moist areas, even at $40 per hive to cover the cost of treating currently non-pollinator hives, would cost the pastoral sector more than the additional nitrogen applications and clover reseeding modelled. Additionally, the link between payment for pollination and benefits to the pastoral sector would be weak due to the time lag between infestation of hives and impacts on the pastoral sector. In some areas, honey flows would already be sufficient to cover the additional cost of hive treatment. It is possible, indeed has been recommended, however, that beekeepers seek to develop opportunities for earning pollination revenue to improve the profitability of their operations.

Rate of spread

Recommendation 13: that the year of establishment of varroa in the South Island (where "established" is defined as a sufficient presence of varroa to begin to have significant effects on pollination, and therefore agriculture, from the following year) be deferred by one year to 2005.

Reasons: The rate of spread of varroa, in the absence of any intervention, modelled in the 2000 assessment is now considered to have been an underestimate, given the role of human-assisted dispersal through the movement of hives relative to natural spread mechanisms. The movement control line under the current varroa management programme is, however, believed to have succeeded in slowing spread south of the existing infested area. Date of arrival in the South Island remains highly unpredictable.

Recommendation 14: that the year of establishment of varroa in the lower North Island remain unchanged at 2003.

Reasons: As indicated in support of recommendation 13, but given the proximity of the lower North Island to the existing infested area.

Updating to 2002

In revising the 2000 assessment, unit costs, other than hive treatment cost and increase in pollination charge, which are based on current observations, are updated to 2002 dollars and future impacts are expressed in terms of their present value in 2002.

Effects of recommended revisions

Magnitudes of impacts

With adoption of the above recommendations, the total remaining potential economic impacts of varroa over the period 2003 to 2035 inclusive, in the absence of further intervention, are estimated to range from $365 million under the best case scenario, through $514 million under the middle case scenario, to $661 million under the worst case scenario (in 2002 dollars and at present value in 2002).

Distributions of impacts

Over half of these impacts occur in the South Island as indicated in Table 1.

Table 1: Total national economic impacts 2003 to 2035 by region
($ million; present value; 2002)

	Upper North Island	Lower North Island	South Island	Total
Best case				
Impacts	95.082	71.105	198.495	364.682
% of total	26	19	54	100
Middle case				
Impacts	116.447	82.860	314.519	513.826
% of total	23	16	61	100
Worst case				
Impacts	134.430	92.803	433.613	660.846
% of total	20	14	66	100

At least two thirds of the national impacts over this period fall on the pastoral sector, as can be seen in Table 2.

Table 2: Total national economic impacts 2003 to 2035 by sector
($ million; present value; 2002)

	Horticultural	Pastoral	Arable	Beekeeping	Total
Best case					
Impacts	63.139	240.416	12.690	48.458	364.703
% of total	17	66	3.48	13	100
Middle case					
Impacts	63.891	402.171	13.171	34.593	513.826
% of total	12	78	2.56	6.73	100
Worst case					
Impacts	64.197	552.097	13.673	30.879	660.846
% of total	9.71	84	2.07	4.67	100

The pastoral sector bears at least three quarters of South Island impacts, as shown in Table 3.

Table 3: Total South Island economic impacts 2003 to 2035 by sector
($ million; present value; 2002)

	Horticultural	Pastoral	Arable	Beekeeping	Total
Best case					
Impacts	7.719	154.610	12.690	23.476	198.495
% of total	3.89	78	6.39	12	100
Middle case					
Impacts	8.011	284.384	13.171	8.952	314.519
% of total	2.55	90	4.19	2.85	100
Worst case					
Impacts	8.317	402.329	13.673	9.293	433.613
% of total	1.92	93	3.15	2.14	100

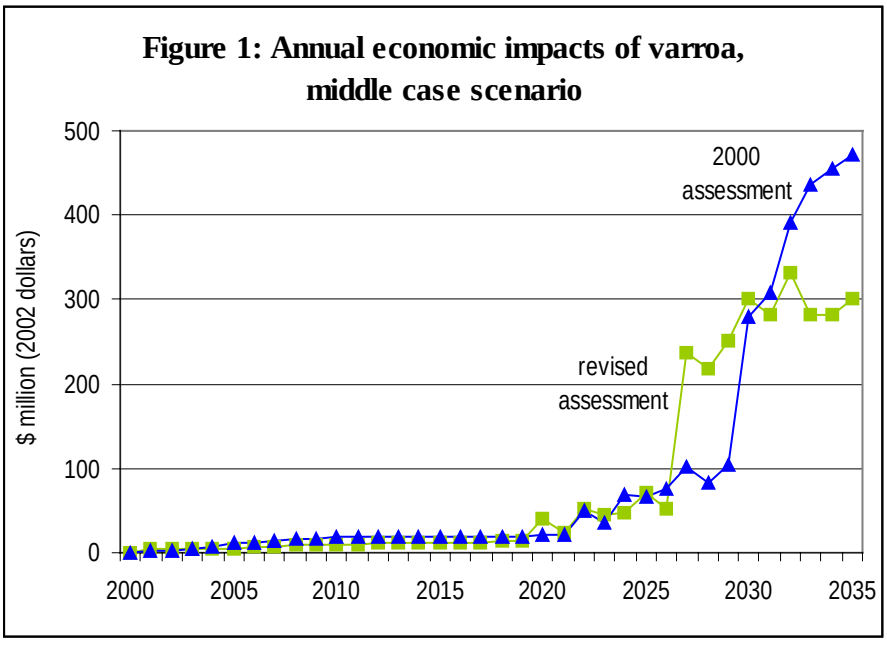
Comparison with 2000 assessment

In the 2000 assessment of the potential economic impacts of varroa in the absence of any intervention, total impacts over the period 2000 to 2035 inclusive were estimated to be in the range $399 million to $908 million (in 2000 dollars and at present value in 2000). Of these, the impacts remaining over the period 2003 to 2035, expressed in 2002 dollars and at present value in 2002 for comparison with the revised assessment, range between $472 million and $1,082 million.

The effect of the recommended revisions is to reduce the estimated remaining potential economic impacts of varroa over this period by 23 per cent under the best case scenario, nine per cent under the middle case scenario and 39 per cent under the worst case scenario. With omission of recommendation 10, which introduces a new element of variation across the three scenarios, bringing pastoral sector impacts further forward under the middle and worst case scenarios, the recommended revisions reduce the estimated impacts over this period by 23 per cent under each of the best and middle case scenarios and 52 per cent under the worst case scenario. Estimated impacts are most reduced under the worst case scenario, reflecting modelling of a narrower range in potential effects.

These reductions in estimated impacts reflect modelling of reduced effects on the horticultural and arable sectors, increased net effects on the beekeeping sector with a smaller increase in pollination charge and reduced, but earlier, effects on the pastoral sector. The influence of the latter on annual impacts, given the dominance of pastoral sector impacts, is clear in Figure 1. The effect is an increase, in present value terms, in the proportion of total impacts over this period falling on the pastoral sector.

Figure 1: Annual economic impacts of varroa, middle case scenario



These changes stem largely from modelling lesser reliance of commercial production on pollination by feral bees and somewhat lesser, but earlier, effects on the pastoral sector of reduced pollination, more effective management of varroa than was expected on the basis of experience overseas, which has been attributed in large part to the skill of New Zealand beekeepers, and the achievements of the current varroa management programme.

Choice of scenario

This review was to advise also on selection of scenario.

Recommendation 15: that "expected impacts" be calculated under the assumption that each of the three scenarios modelled is equally likely.

Reasons: With information on the relative probabilities to the three scenarios modelled, the "expected impacts" of varroa – the sum, across the three scenarios, of the magnitude of impacts under each scenario multiplied by the relative probably of that scenario – could be calculated. In the absence of this information, it is proposed that the Laplace criterion, based on the "principle of insufficient reason"[2], be applied, such that these scenarios be treated as equally likely, each of a probability of one third.

The expected impacts, with adoption of this recommendation, are as shown in Table 4. The largest single area of impacts is impacts on the South Island pastoral sector. These impacts comprise 89 per cent of the total impacts in the South Island, 70 per cent of the total impacts on the pastoral sector and 55 per cent of the total national impacts across all sectors.

Table 4: Expected total national economic impacts 2003 to 2035 by region and sector ($ million; present value; 2002)

	Horticultural	Pastoral	Arable	Beekeeping	Total
Upper North Island					
Impacts	45.588	52.594	0	17.138	115.320
% of regional total	40	46	0	15	100
% of sector total	72	13	0	45	22
% of national total	8.88	10	0	3.34	22
Lower North Island					
Impacts	10.131	65.193	0	6.932	82.256
% of regional total	12	79	0	8.43	100
% of sector total	16	16	0	18	16
% of national total	1.97	13	0	1.35	16
South Island					
Impacts	8.016	280.441	13.178	13.907	315.542
% of regional total	2.54	89	4.18	4.41	100
% of sector total	13	70	100	37	61
% of national total	1.56	55	2.57	2.71	61
Total					
Impacts	63.735	398.228	13.178	37.976	513.118
% of sector total	100	100	100	100	100
% of national total	12.42	78	2.57	7.40	100

[2] This principle, for decision-making under uncertainty, contends that, as the probabilities of the occurrence of the best, middle and worst case scenarios are unknown, we do not have sufficient information to conclude that these probabilities differ. This criterion may be misplaced, however, in that nor do we have sufficient information to conclude that they do not differ.

Conclusions

Review of the economic impact assessment suggests that the remaining impacts of varroa may be smaller than modelled in 2000. With the availability of new information following experience of the management of varroa in New Zealand, reconsideration of the expert opinion provided previously and incorporation of the achievements of the current varroa management programme, the revised assessment models the remaining potential economic impacts of varroa in the absence of further intervention. It estimates these impacts to range between $365 million and $661 million, with expected impacts of $513 million, in total over the period 2003 to 2035 inclusive (in 2002 dollars and at present value in 2002). The largest of these impacts are on the South Island pastoral sector.

The reduction in estimated impacts reflects modelling of reduced effects on the horticultural and arable sectors, increased net effects on the beekeeping sector with a smaller increase in pollination charge, and reduced, but earlier, effects on the pastoral sector. Together, these cause the proportion of total impacts falling on the South Island pastoral sector to increase.

The reduction in estimated impacts stems largely from modelling lesser reliance of commercial production on pollination by feral bees and somewhat lesser, but earlier, effects on the pastoral sector of reduced pollination, more effective management of varroa than was expected on the basis of experience overseas, which has been attributed in large part to the skill of New Zealand beekeepers, and the achievements of the current varroa management programme.