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THE VALUE OF HONEY BEES TO NEW ZEALAND'S PRIMARY PRODUCTION.

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CONTENTS

		Page
1	SUMMARY	1
2	INTRODUCTION	1
3	HORTICULTURE	2
4	VEGETABLES	2
5	SEED CROPS	3
6	PASTURE LEGUMES AND ANIMAL PRODUCTION	3
7	BEE PRODUCTS	4
8	REFERENCES	5

1 SUMMARY

A conservative estimate of the value of the honey bee's contribution to New Zealand agriculture is $2,275 million per year, made of $2,255 million from pollination activities and nearly $20 million from bees and bee products. Thus the honey bee's pollinating activities are worth approximately 113 times more than the value of bees and bee products sold by beekeepers.

Honey bees provide a vital pollination service to New Zealand agriculture and horticulture, which has been the primary justification for much of the support provided by government agencies to the beekeeping industry. It is recognised that an adequate population of honey bee pollinators can only be maintained in the context of a thriving beekeeping industry, though the industry's tangible products (honey and beeswax) are worth only a fraction of the value of the pollination service provided.

2 INTRODUCTION

Honey bees are generally regarded as providing a valuable pollination service to New Zealand agriculture and horticulture. The value of this service has not previously been quantified, and this paper attempts an analysis of such benefits.

United States researchers have assessed the value of honey bee pollination there to be approximately 100 times greater than the value of honey and wax produced (McGregor, 1976). A more recent analysis has shown the pollination value of honey bees to be worth 143 times as much as honey and beeswax production (Levin, 1983).

In New Zealand rather different types of agriculture and horticulture are practised, so a separate study is warranted.

The contribution made by honey bee pollination to New Zealand's primary production is made up of several components:

- nitrogen fixation by legumes which are dependent on bee pollination.

- fruit and vegetable crops which rely on bee pollination for economically viable production.

- crops which require bee pollination to produce their seed.

The following analysis is only a brief calculation of the worth of honey bee pollination in New Zealand. In order to err on the side of conservatism, and because of the types of data available, we have considered only export agricultural and horticultural

crops (with one exception). The total value of bee products has been included, however, and the net effect of these decisions will be to make the benefit ratio in section 1 above somewhat conservative.

3 HORTICULTURE

The following crops are reliant on honey bee pollination to produce commercial crops. While additional pollination agents such as wind and other insects are involved, without honey bees production of these crops is not economically viable.

Crop	Annual export value ($ million f.o.b.)	Reference
Kiwifruit	$295	4
Apples and pears	$117	7
Berryfruit (fresh & frozen)	$ 34	4
Stonefruit	$ 5	4
Citrus	$ 3	4
Misc subtropicals	$ 1	4
	$455	

These figures include fresh and some frozen fruit exports, but do not include the value of further-processed products such as juices or canned fruit.

4 VEGETABLES

The most important vegetable produced in New Zealand which requires pollination is squash.

	Annual export value ($ million f.o.b.)	Reference
Squash	$36	4

Many other vegetables do not need to be pollinated, but arise from seeds for which pollination is necessary. Much of this seed is imported to New Zealand, except onion seed, so only the value of our onion exports is included in this category.

	Annual export production ($ million f.o.b.)	Reference
Onion	$8	4

5 SEED CROPS

Most vegetable seed crops require pollination, and honey bees are the predominant pollinator.

	Annual export production ($ million f.o.b.)	Reference
Vegetable seed	$1	7

In 1984 9,300 tonnes of machine-dressed clover seed was produced in New Zealand (8). No information is readily available on the proportions of red and white clover seed in this. Although a proportion would be red clover seed (value $2.80/kg), for the purposes of this paper a conservative estimate of $1.00/kg is assumed (the value of white clover seed)

	Annual value of production ($ million)	Reference
Clover seed	>$9	4

6 PASTURE LEGUMES AND ANIMAL PRODUCTION

The most significant impact of honey bees on New Zealand's agricultural production is through pollination of the legumes on which our pastoral systems depend. Although clovers are perennial, seeding is still necessary to maintain an adequate seed reservoir to sustain the clover content in pasture, particularly in harsh environments where winter kill is significant.

It is estimated that clovers fix an average of 185 kg/ha of nitrogen per year in New Zealand pastures (Ball *et al.*, 1979). Using this figure an estimate can be made of the replacement cost to farming, if this nitrogen had to be applied artificially.

Area of improved pasture in New Zealand	9.4 million ha
N-fixation by clovers (average)	185 kg/ha/yr
Total nitrogen fixing	1.74 million tonnes/yr
Urea equivalent (46% N)	3.78 million tonnes/yr

Cost to apply urea

urea	$416/tonne
freight	$16/tonne

application	$30/tonne
total cost	$462/tonne

Total replacement cost of nitrogen $1,746 million/yr

7 BEES AND BEE PRODUCTS

Honey

Average production of honey (1984-1986) : 9,100 tonnes per year, at average f.o.b. value of $2,005/tonne = $18,245,500.

Beeswax

Beeswax surplus to the industry's requirements.

Average of 154 tonnes/year at $4,900/tonne = $754,000

Bees

In 1985-86 export of live bees totalled nearly $0.7 million f.o.b. This was made up of 16,480 1 kg-equivalent packages and an additional 25,700 queen bees (Reid, 1986).

The total value of bees, honey and beeswax averages approximately $19.7 million per year.

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Invermay

25 September 1987

Andrew Matheson
Apicultural Consultant
MAF
Private Bag
NELSON

Dear Mr Matheson

THE VALUE OF HONEY BEES TO NZ PRIMARY PRODUCTION

At a recent meeting of the newly established Invermay Apicultural Research and Advisory Unit, the above report was discussed with a view to providing some feedback to you. Alan McCaw was present at the meeting and he was able to give some background on the reasons behind producing the report. We also considered comments on the report from Dr Alan Sinclair, Sector Manager, Plant, Soil and Engineering. On the basis of these collective reactions, we would like to make the following comments.

The most general critism levelled at the report was that it grossly overstates the economic value of honey bees to New Zealand because it distributes the total value of each fruit and vegetable crop to honey bees. We understand that in the absence of honey bees, the quantity of export quality kiwifruit would be reduced from 90% to 30%. This is an impressive figure in itself. Why not use this type of data where possible rather than total overseas export revenue?

Our greatest concerns regarding the claims made in the report relate to those on pasture production. We felt that equating the value of honey bees to replacement of nitrogen was not a fair representation of their economical value. Clover spreads vegetatively and will persist for a considerable length of time given sufficient fertiliser input without plant replacement by reseeding. Dr Sinclair estimated a possible cost of reseeding 9.4 million ha of improved pasture every 10 years of less than $50 million per year. We considered that this was a closer estimate of the value of honey bees in pasture production than the nitrogen replacement cost.

Alan McCaw pointed out to us that the report aimed to bring the value of honey bees to the attention of the Government. We appreciate the need for this in the light of current down-turn that the bee-keeping industry is facing. However, we also felt that such overt and gross exaggerations are likely to threaten the creditibility of the authors possibly to the detriment of the cause.

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We hope you find these comments of some value. We certainly do not want to give the impression that we do not support your cause. However, we would find it easier to give our backing to a more realistic evaluation of the economic value of honey bees.

Yours sincerely

B.I.P. Barratt
Convenor
Apicultural Research and Advisory Unit

Lincoln College

Lincoln College
Canterbury
New Zealand

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/BAM

Department of Plant Science

4 November 1987

Mr A.G. Matheson,
Apicultural Consultant,
MAFTech,
Nelson

Dear Mr Matheson,

Value of Honey Bee Pollination

Thank you for your letter inviting comment on your paper on the value of honey bees to N.Z.'s primary produce. I have circulated the paper to staff, and we forward the following comments:

1. We do not know of any environments currently being farmed in N.Z. where there is a significant winter kill of white clover. The plant survives and spreads by means of stolons i.e. bees and pollination is not a major requirement for persistence.

2. White clover does not require the presence of bees to fix nitrogen. Consequently the estimate of the value of N fixation is on very shaky ground. It would be hard to convince people to accept your evidence.

3. The price for white clover seed to the farmer fluctuates between $2 and $4/kg. I suggest $2.50 as an average figure.

Yours sincerely,

J.G.H. White
Head of Department

Massey University

PALMERSTON NORTH, NEW ZEALAND

TELEPHONES, 69-079, 69-089, 69-099.
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In reply please quote:

Agronomy Department

17 August, 1987

Mr A.G. Matheson
Apicultural Consultant
Ministry of Agriculture and Fisheries
Private Bag
NELSON

Dear Mr Matheson,

Thank you for sight of your paper on the value of honey bees to New Zealand's primary production. I have circulated the report to a number of members of the Agronomy Department and the following notes summarise their comments:

1. Attribution of the total value of a particular crop to the contribution of a particular group of pollinators is in almost all cases an over-simplification and must therefore over-estimate the value of that contribution. Analysis of the opportunity cost of bees as compared to alternative pollinators/pollination procedures would seem to be a more appropriate approach, though almost certainly more complex.

2. White clover. The evidence indicates that seed production makes a minor contribution to the maintenance of an established clover population in most New Zealand conditions. It is therefore questionable whether pollination is necessary in the majority of cases. Pollination of seed crops is of course another matter, but here the options are (a) bees (b) alternative insects, (c) import of seed - with reservations about suitability for New Zealand.

   A rigorous analysis might include the nutritional advantages of white clover, but in view of the above comments this would hardly be justified. The balance of importance of seed production and vegetative reproduction would of course be different for other legume species.

3. Kiwifruit and other horticultural crops.

   The appropriate analyses here would involve comparisons between (a) bees (b) alternative insects - naturally occurring or "farmed" - e.g. solitary bees, and (c) alternative technology - pollen spraying, hormonal fruit setting, selection of self-fertilising genotypes etc.

I hope that you find these comments helpful, though we appreciate that they all involve a substantial increase in the complexity of the analyses. A comment was also made that, even in a report as short as this, there would be some advantage in a summary table of conclusions. We assume that Ted Roberts has had an opportunity to comment?

Yours sincerely,

John Hodgson

John Hodgson
Prof and Head of Agronomy

The value of honey bees to New Zealand

By Andrew Matheson, Apicultural Adviser

How much is beekeeping worth to this country? We all "know" that other people benefit from our industry much more than beekeepers. Pollination, it is usually claimed, is worth many times the value of bee products sold.

But how much is pollination worth? How much of our horticultural production are bees responsible for? What about the clover that bees pollinate — what is that worth to our pastoral industries?

In response to a request from the NBA executive I, with Mark Schrader's help, recently tried to calculate how much beekeeping contributed to New Zealand's economy. Because production figures are difficult to find for many commodities, I've used export figures in most cases.

Horticulture

The crops listed below rely on honeybee pollination to produce commercial crops. Sure, other pollination agents are involved but without managed honey bees production is probably not economically viable.

Crop	Annual export value *($ million f.o.b.)*
Kiwifruit	$295
Applies and pears	$117
Berryfruit (fresh and frozen	$ 34
Stonefruit	$ 5
Citrus	$ 3
Miscellaneous sub-tropicals	$ 1
	$455

These figures include fresh and some frozen fruit exports, but don't include the value of further-processed products such as juices or canned fruit.

Vegetable and seed crops

Squash is the most important vegetable which needs pollination, and last year $36 million-worth of this crop was exported. Many other vegetables don't need pollination, but grow from seeds for which pollination is necessary. Much of this seed is imported to New Zealand — except onion seed — so I've included only the value of our onion exports in this category: some $8 million annually.

Most vegetable seed crops require pollination ($1 million per year exported), and honey bees contribute to the production of at least $9 million worth of clover seed annually.

Total for vegetables and seed crops: $54 million per year.

Pasture legumes

So far this calculation has been relatively easy, but it's more difficult attempting to estimate what our pasture legumes are worth in the way of nitrogen-fixing.

Although clovers are perennial, seeding is still necessary to maintain an adequate seed reservoir to sustain the clover content in pasture, particularly in harsh environments where winter kill is significant.

It is estimated that clovers fix an average of 185 kg/ha of nitrogen per year in New Zealand pastures. Using this figure an estimate can be made of the replacement cost to farming, if this nitrogen had to be applied artificially.

Area of improved pasture in New Zealand	9.4 million ha
N-fixation by clovers (average)	185 kg/ha/yr
Total nitrogen fixing	1.74 million tonnes/yr
Urea equivalent (46% N)	3.78 million tonnes/yr
Cost to apply urea	
urea $416/tonne	
freight $16/tonne	
application $30/tonne	
total cost $462/tonne	
Total replacement cost of nitrogen	$1,746 million/yr.

Wow! It's obvious that honey bees are most important to New Zealand because they pollinate the legumes on which our pastoral systems depend.

Bees and bee products

How does pollination-value stack up against the direct income from honey, queens, wax, and the like? Well, we've run up a "credit" of $2,255 million per year so far, and it's obvious that beekeeping won't come anywhere near that.

A United States researcher called McGregor came up with a ratio of 100:1, that is pollination being worth 100 times as much as beekeeping's direct products. A more recent analysis by Marshall Levin, also of the US, calculated a figure of 143:1.

How much does beekeeping generate in direct income in New Zealand? Again taking fairly conservative figures:

Honey: average 9,100 tonnes per year at $2,005/tonne f.o.b. = $18,245,000 per year

Wax surplus to the industry's requirements: average of 154 tonnes per year at $4,900/tonne = $754,000.

Bees: In 1985-86 export of live bees totalled nearly $0.7 million f.o.b. This was made up of 16,480 1 kg — equivalent packages and an additional 25,700 queen bees.

So the total value of bees, honey, and beeswax averages approximately $19.7 million per year. The pollination benefits are 113 times as much as the value of bees and bee products.

That's a pretty impressive figure. How much do beekeepers collect in pollination fees? Last year, according to MAF figures, 89,760 colonies were hired out for pollination, for a total of $6.1 million in fees. Over 80,000 hives went to kiwifruit alone.

Honey bees provide a vital pollination service to New Zealand agriculture and horticulture. That has been the main justification for much of the support provided by government agencies to the beekeeping industry. It is recognised that an adequate population of honey-bee pollinators can only be maintained in the context of a thriving beekeeping industry. Of course, the industry's tangible products (honey and beeswax) are worth only a fraction of the value of the pollination services provided.

BAKED HAM

1 ham
1 cup honey
cloves

• Select a good quality ham. Wipe meat with a damp cloth and remove unsightly parts. Place ham fat side up in roasting pan. Add no water. Bake uncovered in slow oven (300° F.). Insert a meat thermometer with the bulb at the center of the largest muscle. Cook until the thermometer registers an internal temperature of 170° F. 25 to 30 minutes per pound should be allowed for roasting time. Before the ham is done, take from the oven and remove the rind, Mark fat into squares. Place whole glove in each square. Pour a honey glaze over ham. Return to oven to finish baking. Baste frequently.

The Value of Honey Bee Pollination to New Zealand's Primary Production

MR. A.G. MATHESON,
Ministry of Agriculture and Fisheries,
Nelson, New Zealand.

Introduction

Honey bees are considered in many countries to provide an important pollination service, though quantifying such a service is difficult.

In the United States the value of honey bee pollination has been assessed as approximately 100 times greater than the value of honey and wax produced (9). A more recent analysis has estimated the pollination value of honey bees to be worth 143 times as much as honey and beeswax production (4). In New Zealand rather different types of agriculture and horticulture are practised, so a separate study has been carried out (8).

The contribution made by honey bee pollination to New Zealand's primary production is made up of several components:

- nitrogen fixation by legumes which are dependent on bee pollination.

- fruit and vegetable crops which rely on bee pollination for economically viable production.

- crops which require bee pollination to produce their seed.

The following analysis is only a brief calculation of the worth of honey bee pollination in New Zealand. In order to err on the side of conservatism, and because of the types of data available, I have considered only export agricultural and horticultural crops (with one exception). The total value of bee products has been included, however, and the net effect of these decisions has been to make the benefit ratio somewhat conservative.

(Note: All dollar values are in New Zealand currency. At the time of writing $NZ1.00 = $A0.93 = $US0.66 = Sterling £0.36)

Horticulture

The following crops are reliant on honey bee pollination to produce commercial crops. While additional pollination agents such as wind and other insects are involved, without honey bees production of these crops is not economically viable.

Crop	Annual Export Value ($ million f.o.b.)	Reference
Kiwifruit	$295	3
Apples and pears	117	6
Berryfruit (fresh & frozen)	34	3
Stonefruit	5	3
Citrus	3	3
Miscellaneous subtropicals	1	3
	$455	

These figures include fresh and some frozen exports, but do not include the value of further-processed products such as juices or canned fruit.

Vegetables

The most important vegetable produced in New Zealand which requires pollination is squash, exports of which currently total $36 million per year (3).

Many other vegetables do not need to be pollinated, but arise from seed for which pollination is necessary. Much of this seed is imported to New Zealand except onion seed, so only the $8 million worth of onion exports (3) is included in this category.

Seed Crops

Most vegetable seed crops require pollination, and honey bees are the predominant pollinator. Exports of vegetable seeds are currently worth about $1 million per year (6).

In 1984 9300 tonnes of machine-dressed clover seed was produced in New Zealand (8). At over $1.00/kg clover seed exports are worth over $9 million per year (7).

Pasture Legumes and Animal Production

The most significant impact of honey bees on New Zealand's agricultural production is through pollination of the legumes on which our pastoral systems depend. Although clovers are perennial, seeding is still necessary to maintain an adequate seed reservoir to sustain the clover content in pasture, particularly in harsh environments where winter kill is significant (2).

It is estimated that clovers fix an average of 185 kg/ha of nitrogen per year in New Zealand pastures (1). Using this figure an estimate can be made of the replacement cost to farming, if this nitrogen had to be applied artificially.

Area of Improved Pasture in New Zealand		9.4 million ha
N-fixation by Clovers (average)		185 kg/ha/yr
Total nitrogen fixing		1.74 million tonnes/year
Urea equivalent (46% N)		3.78 million tonnes/year
Cost to apply urea		
urea	$416/tonne	
freight	16/tonne	
application	30/tonne	
Total Cost	$462/tonne	
Total replacement cost of nitrogen		$1,746 million/year

Bee and Bee Products

Honey

Average production of honey (1984-1986): 9100 tonnes per year, at average f.o.b. value of $2005/tonne = $18,245,500.

Beeswax

Beeswax surplus to the industry's requirements.

Average of 154 tonnes/year at $4900/tonne = $745,000.

Bees

In 1985-86 export of live bees totalled nearly $0.7 million f.o.b. This was made up of 16480 1 kg-equivalent packages and an additional 25700 queen bees (10).

The total value of bees, honey and beeswax averages approximately $19.7 million per year.

Summary

A conservative estimate of the value of the honey bee's contribution to New Zealand agriculture is $2,275 million per year, made of $2,255 million from pollination activities and nearly $20 million from bees and bee products. Thus the honey bee's pollinating activities are worth approximately 113 times more than the value of bees and bee products sold by beekeepers.

Honey bees provide a vital pollination service to New Zealand agriculture and horticulture. The money paid by growers for hive rentals is only a minute fraction of the overall worth of honey bee pollination. A profitable beekeeping industry is important to ensure that farmers and horticulturalists have continuity of an adequate population of honey bee pollinators.

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