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## Economic Benefits of Honey Bees in Alberta

Submitted to:

Alberta Beekeepers Commission

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## 1. Introduction

The Alberta Beekeepers Commission (ABC) has operated since 1933 and serves the interest of approximately 175 beekeepers in the province. The commission works with industry and other partners to provide support through various initiatives and funded research in an effort to ensure the health of bees and the sustainability of the industry for years to come.

One of the key focus areas of the ABC is market development and industry advocacy. Through its advocacy role, the commission strives to raise the profile of the province's beekeeping industry amongst consumers, producers, and other stakeholders. To this end, the ABC engaged Nichols Applied Management to evaluate the gross economic benefits of managed honey bees in Alberta in terms of both market and non-market values. This work is intended as a first step toward targeted engagement with primary producers in Alberta on the merits of honey bee activity in the province.

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## 2. Background

### 2.1 Honey Bees

The European honey bee is the most popular species managed by beekeepers in Alberta. Other species of managed bees include leaf cutter bees, bumble bees, mason bees, and mining bees, all to a much smaller extent than honey bees (Pollinator Partnership Canada 2017). Unlike many other bee species who live solitary lives and nest individually, honey bees are social bees that live in colonies made up of a queen and worker bees (Pollinator Partnership Canada 2017).

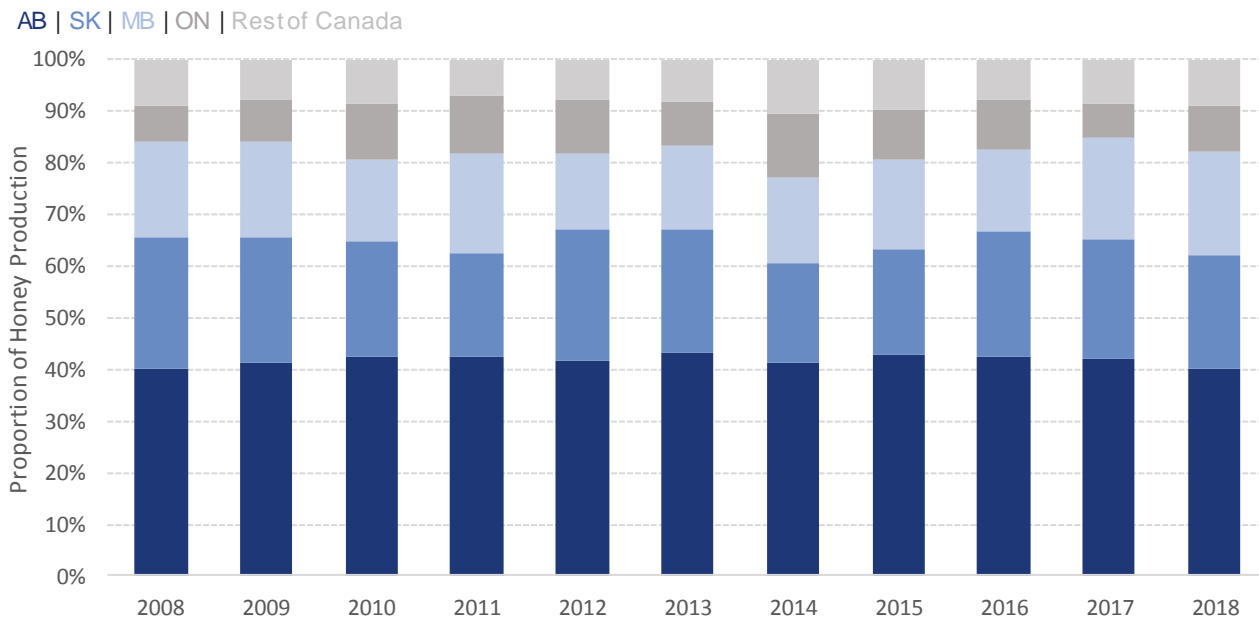
Honey bees are perhaps best-known for their role in the production of honey. However, like other insects, honey bees also provide a suite of important ecosystem services, defined as ecosystem functions that provide a benefit for human life (Allsopp et al. 2008). Some of the ecosystem services provided by insects include pollination, pest control, and decomposition (Kremen and Chaplin-Kramer 2007). As a commercially managed insect, honey bees offer ecosystem services akin to their wild counterparts. Pollination is arguably the most important ecosystem service provided by insects as approximately 35% of global food crop production comes from crops that depend on pollinators (Klein et al. 2007), most of which are honey bees (Allsopp et al. 2008).

In Alberta, honey bees are managed for both the production of honey as well as the pollination of agricultural crops. The management of honey bees for crop pollination began in the 1900s and today honey bees provide effective pollination for a variety of crops across Canada such as canola, blueberries, and apples (Pollinator Partnership Canada 2017).

### 2.2 Industry Overview

The important relationship between agricultural crops and honey bees has resulted in a large concentration of Canada's honey bee industry in the Prairie provinces. For example, hybrid canola seed, which is grown almost exclusively in Alberta, has a reliance on honey bee pollination. As such, Alberta hosts the largest honey bee industry in the country in terms of number of colonies and honey production – both in terms of volume and value. The province has over 1,500 beekeepers managing over 300,000 colonies and, over the last decade, Alberta has produced an average of 35 million pounds of honey each year, representing over 40% of the country's honey production (Figure 2-1) (Statistics Canada 2018a).

Figure 2-1 Canadian Honey Production by Province (%), 2018

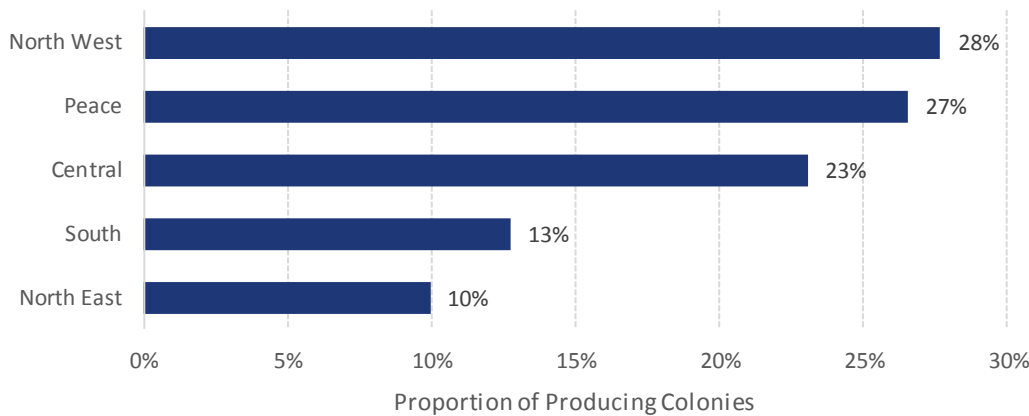


Source: Statistics Canada 2018a.

The vast majority of beekeepers in Alberta are hobbyists who operate several colonies in addition to an alternative primary source of income. However, most of the province’s bee colonies are managed by a relatively small number of commercial-sized beekeepers. In 2016, over 90% of the province’s bee colonies were operated by about 115 commercial beekeepers, each managing at least 400 hives (Laate 2017). Unlike hobby beekeepers, who have an alternative source of income, commercial beekeepers derive their income from their beekeeping operation.

Both hobby and commercial beekeepers operate all over the province. According to Alberta Agriculture and Forestry’s 2017 survey of Alberta beekeepers, the province’s North West region hosts the largest proportion of honey bee colonies (28%), followed closely by the Peace region (27%), and Central region (23%). The South and North East regions each host less than 15% of the province’s honey bee colonies (Figure 2-2).

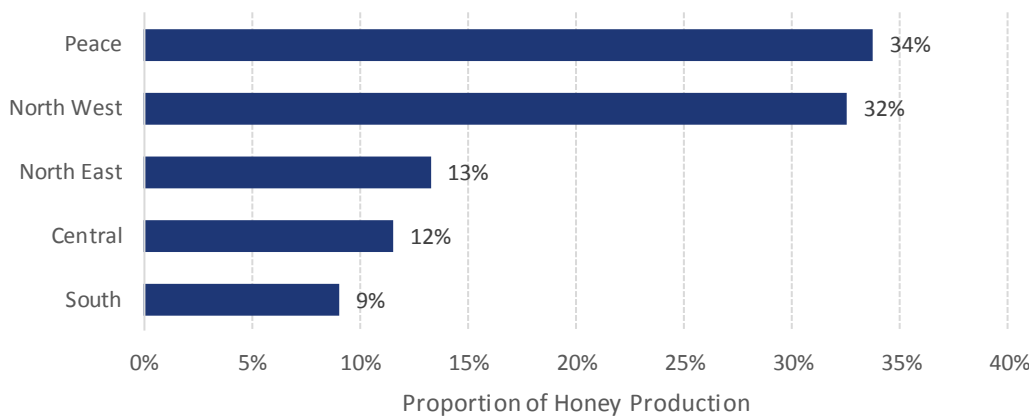
Figure 2-2 Active Honey Bee Colonies by Region, Alberta, 2017



Source: Alberta Agriculture and Forestry 2017.

Although the Central region hosts the largest proportion of active beekeepers in the province, it ranks second to last in terms of total honey production. The Peace region produces the largest proportion of Alberta’s honey (34%), followed closely by the North West region (32%) (Figure 2-3).

Figure 2-3 Active Honey Production by Region, Alberta, 2017

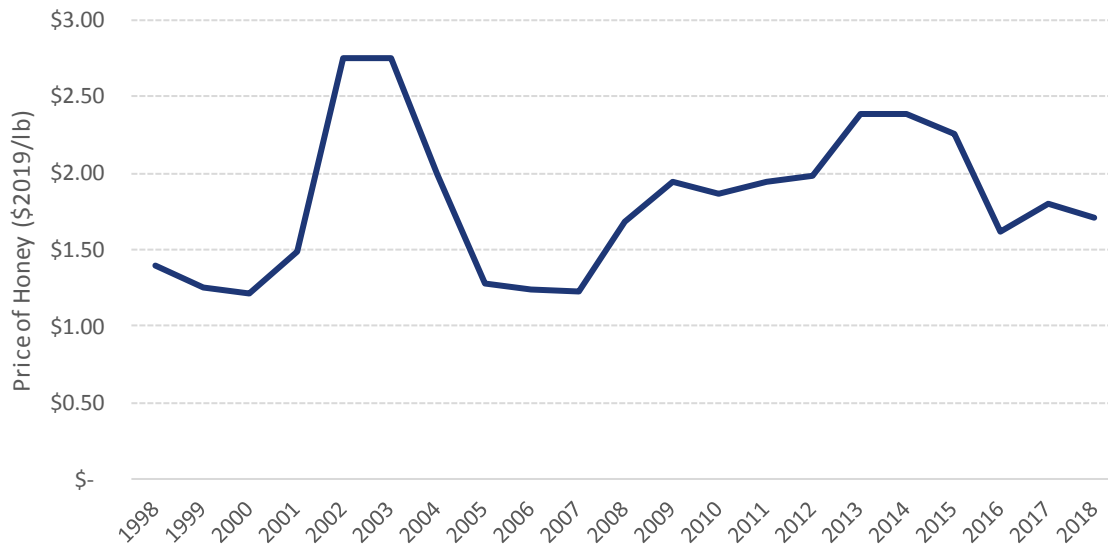


Source: Alberta Agriculture and Forestry 2017.

Honey is one of the largest revenue sources for Alberta beekeepers. However, producer prices of honey have been relatively volatile over the last 20 years (Figure 2-4). The highest price occurred in 2002 at \$2.76/lb.<sup>1</sup> By 2007 the price had dropped by over 55% to \$1.22/lb but has since rebounded slightly and in 2018 the price was approximately \$1.71/lb.

<sup>1</sup> All prices are real \$2019 unless otherwise stated.

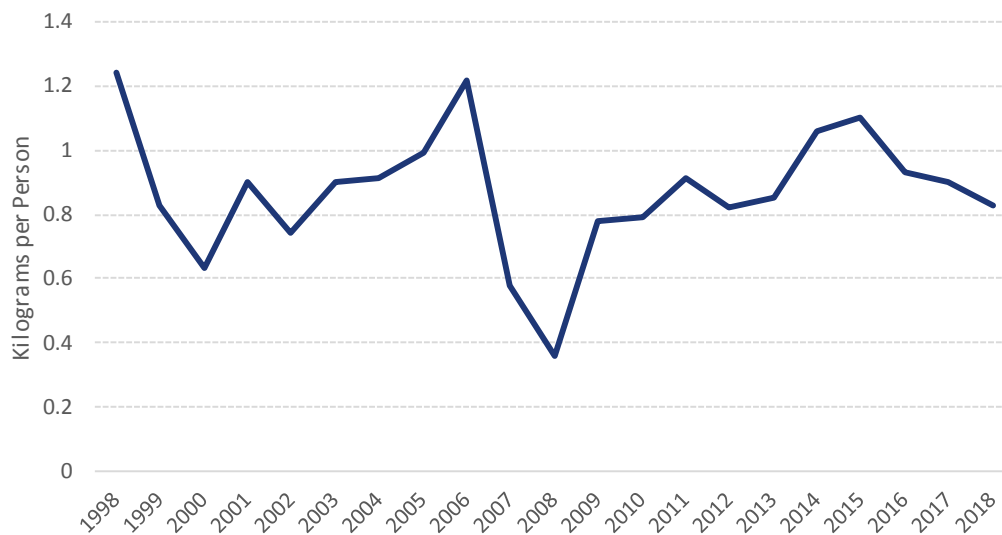
Figure 2-4 Alberta Honey Prices, 1998-2018



Source: Statistics Canada 2018a.

Honey consumption in Canada has also varied over the last 20 years (Figure 2-5). The lowest year of consumption was 2008, where consumption was just 0.4 kilograms per person, per year. Honey consumption has since increased, and in 2018 per capita consumption was approximately 0.6 kilograms.

Figure 2-5 Honey Consumption, Canada, 1998-2018<sup>2</sup>



Source: Statistics Canada 2018b.

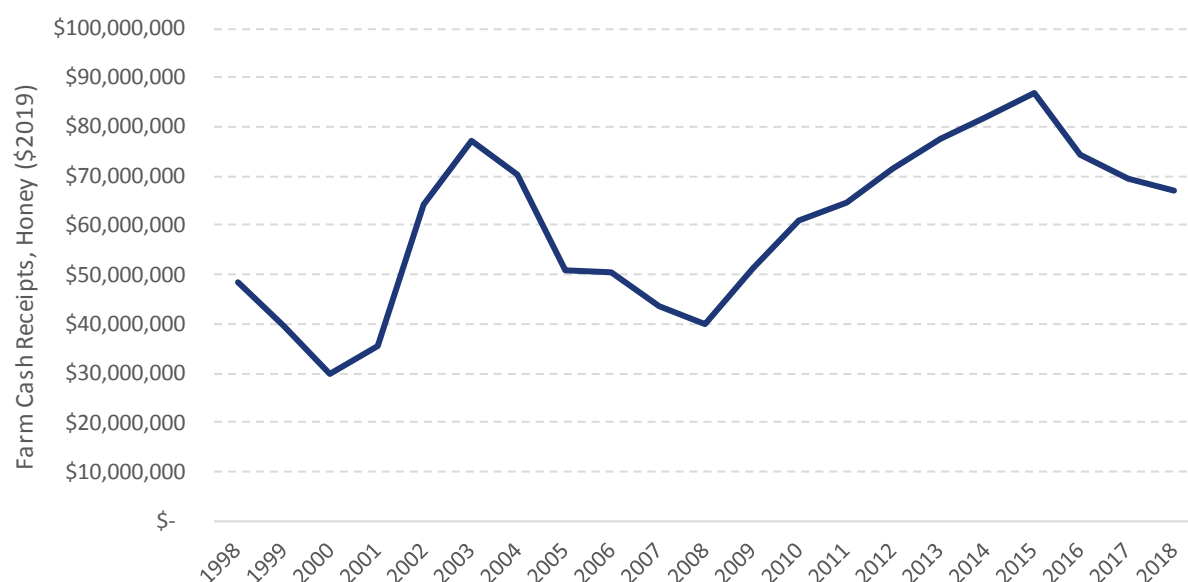
In addition to supplying domestic honey consumption, international exports of honey have been increasing from the province as well. Indeed, international exports are sometimes preferred to domestic sales by honey producers

<sup>2</sup> Note: These data do not adjust for losses such as waste or spoilage in stores, households, institutions, or restaurants.

due to cumbersome interprovincial trade requirements in Canada (e.g. labelling requirements). Between 2013 and 2017, Alberta’s honey exports have increased from approximately \$13 million to about \$27 million, representing about 35% of total Canadian honey exports (AAFC 2017). The United States is the largest export market for Canadian honey (79%), followed by Japan (16%) (AAFC 2017).

Variability in honey revenues can be depicted through farm cash receipts, which have fluctuated for honey farms over the last twenty years. In general, cash receipts have trended upwards since 1998, increasing at an average annual rate of about 1.6%. Year-to-year however, cash receipts have been variable, reaching an annual low of about \$30 million in 2002, and an annual high of almost \$87 million in 2015. In 2018, farm cash receipts for honey were approximately \$67 million.

Figure 2-6 Alberta Farm Cash Receipts, Honey (1998-2018)



Source: Statistics Canada 2018c.

In addition to honey, beekeepers also produce and sell beeswax, pollen, and bees (queens, nucs<sup>3</sup>, or hives). According to Laate (2017), Alberta beekeepers produce about \$10.10 worth of beeswax and pollen per hive, for an approximate total of about \$3 million provincially. The sale of bees is an emerging venture for Alberta beekeepers. Relative to honey sales, bee sales make up a much smaller portion of beekeeper revenues, at just \$0.30 per hive on average, for a provincial total of about \$94,000.

### 2.3 Honey Bee Pollination

As mentioned earlier, pollination is a key ecosystem service provided by honey bees. Honey bees pollinate a variety of agricultural crops in Canada such as:

- oilseeds (e.g. canola, soybeans);

<sup>3</sup> Nucs (nucleus hives) are small colonies formed from larger colonies centred on their own queen. Nucs are often sold to hobbyists as a stand-alone hive or commercial beekeepers to combine with a larger colony that may have lost a queen.



- horticulture crops (e.g. apples, blueberries, cucumbers); and
- forage (e.g. alfalfa, clover) (AAFC 2017).

### 2.3.1 Oilseeds

Arguably the most important crop pollinated by honey bees in Canada (and Alberta) is canola. In 2018, farm crop receipts for canola in Canada totaled \$9.3 billion, representing about 27% of all crop receipts, more than any other individual crop (Statistics Canada 2018c). In Alberta, farm crop receipts for canola topped \$2.6 billion, or 40% of all crop receipts. The next most lucrative crop both nationally and provincially is wheat, which does not benefit from insect pollination.

The majority of canola grown in Alberta is hybrid canola, and virtually all hybrid canola seed is produced in Alberta. Hybrid seed canola is not self-pollinating; thus, its production requires carefully timed insect pollination. About 50% of the pollination for seed canola in Canada is done by honey bees, while the other 50% is done by leafcutter bees (AAFC 2017).

Unlike seed canola, commodity canola produced by farmers benefits from wind-pollination; however, research has suggested that flower morphology is reducing the effectiveness of wind pollination for canola (Ouvrard shown that by honey bees can improve both the quantity and quality of commodity canola production (AAFC 2017). Benefits of bee-pollinated commodity canola include:

- reduced undesirable green seed counts;
- increased pods per plant and seeds per pod;
- reduced the blooming period; and
- increased seed weight (Canola Council of Canada 2017).

Research has suggested a wide range of canola yield increases associated with honey bee pollination. According to AAFC (2017), estimates have ranged from as low as 2% to as high as 20%. Sabbahi et al. (2005) have suggested that honey bee pollination can improve commodity canola yields by as much as 46% in the presence of three hives per hectare (about 1.2 hives per acre). However, while there have been many studies that have researched the relationship between honey bees and canola, the exact nature of this relationship is not conclusive. According to Melathopolous et al. (2015), our current understanding of the value of pollinator contributions to the yield of most crops is highly uncertain. The authors assert that the dependency of a given crop on insect pollination often does not account for pollinator density, varying crop varieties, or changing growing conditions that we see in practice. Furthermore, the pollination contribution of managed insects like honey bees is often entangled with the contributions of wild pollinators including native bees and other insects. Researchers have also suggested that pollinator diversity can have a non-linear impact on crop yields, whereby the instance of multiple pollinator species (e.g. honey bees and wild bees) can improve crop yields by more than the sum of each individual pollinator's contribution (Alberta Agriculture and Forestry personal comm. 2019a). As such, while it appears that there is a tangible benefit from honey bee pollination on canola yields, there is substantial uncertainty around the exact yield impact associated with honey bee pollination.

Honey bee pollination of canola also provides benefits to the beekeepers. Canola is a premium food source for honey bees. Canola fields bloom for relatively long periods during the growing season, providing bees with a consistent and easily accessible source of nectar and pollen. Indeed, one field of canola can act as a source of nectar for honey bees for up to a month (Canola Council of Canada 2017). For consumers, honey produced from

canola-pollinating bees has been noted to be preferred due to its light colour and mild flavor (Canola Council of Canada 2017).

### 2.3.2 Horticulture Crops

According to AAFC (2017), honey bees play a critical role in the pollination of certain horticultural crops in Canada. Pollination from honey bees is noted to contribute to over 80% of the production of apples, blueberries, cherries, cranberries, and cucumbers (AAFC 2017). However, the production of these crops outside of greenhouses (where bumble bees are the preferred pollinator) in Alberta is relatively low. In 2018 farm cash receipts for fresh fruit in Alberta was approximately \$3.3 million (Statistics Canada 2018c). Furthermore, the production value of field cucumbers in the province was less than \$1 million in 2017 (Statistics Canada 2017).

### 2.3.3 Forage

Honey bees also pollinate important rangeland crops such as alfalfa and clover. However, while honey bees are sometimes situated near alfalfa fields for nectar collection and pollination, their effectiveness as pollinators of alfalfa is questionable. The stamen of the alfalfa flower hits the honey bee on the head when it trips to flower for nectar. As such, honey bees learn to steal the nectar from the side without pollinating the crop (Scott 2018). Alfalfa plants are therefore primarily pollinated by leaf cutter bees, rather than honey bees.

Honey produced from bees that pollinate clover is some of the most desired honey in the province due to its light colour and slightly floral flavour. As an ecosystem service, the pollination of clover by honey bees has additional benefits to society by improving forage for cattle. Bees, both native bees and honey bees, improve the health of grassland ecosystems through pollination. Researchers have indicated that a robust and diverse community of pollinators supports the resilience and overall health of grasslands (Alberta Beef Magazine 2016). Rangeland forage like clover has reciprocal benefits for honey bees as well. Unlike canola, which flowers for a relatively short period of time, the diversity of flowering plants on rangelands can provide forage for bees throughout the season, as different species flower at different times during the year (Society for Range Management 2017).

## 3. Methods

### 3.1 Study Approach

The most robust analytical framework for quantifying the net social benefit of a good or service such as honey bee activity in Alberta is a cost-benefit analysis (CBA). Conceptually, a CBA consists of identifying and pricing all of the market and non-market costs and benefits expected to flow to society from a given activity to determine if the former outweigh the latter.

As a first step in understanding the social benefit of honey bees, and given the objective of the ABC, the Study Team has undertaken a valuation of the gross economic benefits of honey bees in Alberta as opposed to a full accounting of costs and benefits conducted in a traditional CBA. As such, it is important to note that this study does not speak to the net benefits of honey bee activities in Alberta, as the identification of the costs was beyond the scope of this study.

To generate the necessary measures of gross economic benefits resulting from honey bee activity in Alberta, the Study Team:

- Established which benefits are included in the analysis. This step involved mapping the pathways through which honey bee activities impact end-point users (e.g. consumers of honey products, primary producers).
- Catalogued the benefits of honey bee activity accruing to the identified end-point users across the province.
- Assigned a dollar value to each of the identified benefits. Goods and services are not always traded in markets with clear prices. In some cases, a qualitative discussion of selected benefits was most appropriate.
- Conducted sensitivity analyses to determine how robust the study results are to changes in key assumptions or parameters.

It is important to note that, like a traditional CBA, our valuation of the gross economic benefits of honey bees is limited to the direct benefits resulting from this economic activity. The indirect or induced effects that may occur as honey bee-related impacts ripple throughout the economic and society are not included in this analysis. Specifically, indirect benefits that would accrue to the suppliers of honey bee operations (e.g. equipment suppliers) and induced benefits that occur as a result of employees of honey bee operations and their suppliers spending their income, are not accounted for in this study.

### 3.2 Data Sources

Data sources for this study included a combination of secondary data acquired from public sources including Statistics Canada, the Government of Alberta, and academic literature, as well as primary data and insights collected through stakeholder interviews with:

- commercial beekeepers (both those who offer contract pollination services and those who do not);
- seed companies contracting pollination services; and
- ABC board members.

The Study Team ensured that there was an appropriate geographic representation amongst sampled stakeholders. Beekeepers interviewed for this work operate across many regions of the province including the South, Central, North East, and Peace regions of Alberta, as well as one interviewee who operates in both Southern Alberta and British Columbia.

## 4. Results

### 4.1 Gross Economic Benefits of Honey Bees in Alberta

There are three primary economic activities associated with honey bees in Alberta:

- products associated with honey bees (including honey, wax, and pollen);
- pollination; and
- bee sales (including nucleus colonies and queens).

In addition, there are also non-market benefits associated with honey bee activities that are not quantifiable. All market and non-market activities, their end-point users, and their estimated gross economic benefit are described in the following subsections.

#### 4.1.1 Honey/Wax/Pollen Production

##### 4.1.1.1 Activity

Arguably the largest economic activity associated with honey bees in Alberta is the production and sale of honey. Alberta produces the most honey of any province in Canada and sells to customers within Alberta, elsewhere in Canada, and internationally. Revenue from honey sales is the largest source of income for most of Alberta's commercial beekeepers. To a lesser extent, beekeepers also produce and sell beeswax and pollen from their operations.

##### 4.1.1.2 Gross Economic Benefit

For this activity, the revenues gained by beekeepers through honey, wax, and pollen sales represent the gross economic benefit of honey production in Alberta. Like most agricultural products, the production value of these items can vary year to year depending on a number of factors such as weather, winter-loss, and bee health. For example, over the last decade the value of honey production in Alberta has ranged between \$57 million and \$89 million. In 2018, the value of honey production in Alberta was approximately \$64 million (Statistics Canada 2018a), while the estimated value of beeswax and pollen sales in 2018 is \$3 million, for a total of \$67 million in gross economic benefits.

#### 4.1.2 Pollination

##### 4.1.2.1 Activity

Honey bee pollination is the most complex economic activity in the beekeeping industry. Honey bees pollinate agricultural crops in Alberta each year under both formal and informal arrangements. Formal pollination contracts in Alberta exist almost exclusively for the pollination of hybrid seed canola. The use of honey bees to pollinate seed canola began almost twenty-five years ago in 1995 with the introduction of transgenic canola. Hybrid seed canola is not self-pollinating, and wind-pollination is ineffective. As such, insect pollination is a necessary requirement for seed canola production, and approximately 50% of that pollination can be attributed to honey bees, while the remaining half can be attributed to leaf cutter bees (AAFC 2017). In the 1990s, about 20,000 bee colonies were rented to pollinate seed canola in Southern Alberta (Laate 2017). Since then, the area of transgenic canola has grown and today the number of bee colonies used to pollinate seed canola has more than tripled to about 75,000 (Laate 2017). There are approximately 200 commercial beekeepers in Alberta, around 5% of whom have pollination contracts with canola seed companies.

Formal pollination contracts between Alberta beekeepers and seed canola companies provide the beekeepers with a predictable source of revenue. Honey production is generally lower in a seed canola pollination yard as compared to a typical honey yard (approximately 35% lower) as pollination yards are heavily stocked with insect pollinators, increasing the competition for nectar (Alberta Agriculture and Forestry personal comm. 2019a). However, like other agricultural products, honey prices are variable and can be an unstable source of income for beekeepers. Commercial beekeepers in Southern Alberta have a particularly hard time relying on honey production as compared to beekeepers in more northern parts of the province as much of the crop area in the Southern region is under irrigation and the weather can be more challenging for bees. In addition, it can be difficult for commercial beekeepers to access financial assistance in the early stages of their operations. As such, some beekeepers rely on pollination contracts and are willing to accept reduced honey production in exchange for stable, recurring pollination contracts with canola seed producers.

Pollination contracts were reported by beekeepers as being either revolving (i.e. ongoing contracts for a specified number of hives) or year-to-year. Some beekeepers have a revolving contract for some hives and negotiate a separate contract each year for additional hives if appropriate. The value of pollination contracts is relatively standard across canola seed companies:

- The baseline price per hive is around \$150.
- A sample of approximately 10% of a beekeeper's hives are graded by an inspector based on the strength of the hives.
- Based on the sampled hives, higher grades can earn beekeepers' "bonuses", with payments increasing up to about \$200 per hive.

Due to the standardized pricing arrangements of pollination contracts, there is limited opportunity for beekeepers to negotiate contract values apart from ensuring that they are providing strong hives that can earn them bonuses. Historically, the relationship between seed companies and beekeepers in Alberta has been such that beekeepers are treated as a large group; individual negotiations are uncommon and communications between companies and beekeepers is generally open to avoid deteriorating relationships with individual beekeepers. Overall, Alberta beekeepers receive approximately \$13 million per year in revenue from canola seed pollination contracts.<sup>4</sup>

In addition to formal pollination contracts for seed canola, honey bees also pollinate commodity canola, horticulture crops, as well as forage crops (i.e. clover) across Alberta through informal arrangements between beekeepers and private landowners. These arrangements do not involve a contract or monetary transaction; however, beekeepers will occasionally offer "rent honey" to the landowner as an in-kind payment for allowing their hives to pollinate their crops.

#### 4.1.2.2 *Gross Economic Benefit*

The gross economic benefit of honey bee pollination in Alberta can be broken down by two specific activities:

- pollination of seed canola; and
- pollination of commodity crops, namely canola, berries and field vegetables, and forage (i.e. clover).

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<sup>4</sup> Note that the value of pollination contracts does not represent the gross economic benefit of canola seed pollination in Alberta, which is estimated in section 4.1.2.2 as the proportion of annual canola seed sales in the province that can be attributed to honey bee pollination.

The value of seed canola in Alberta varies year to year; over the last three years, the average value of all seed canola in the province was approximately \$62 million (AFSC 2019 personal comm.; Alberta Agriculture and Forestry 2019b personal comm.). Given that honey bees pollinate approximately 50% of the seed canola in Alberta, their gross economic benefit is estimated to be \$31 million.<sup>5</sup>

The value of honey bee pollination to other crops in Alberta depends on three key variables:

- the dependency of the crop on insect pollinators;
- the proportion of insect pollinators of the crop that are honey bees; and
- the value of the crop (AAFC 2017).

The relationship between honey bee pollination and canola yields has been studied carefully; however, as mentioned earlier, the results of these studies are highly uncertain, and more research is required to understand the measured impact of honey bees on canola yields. The current study makes use of recent data published by AAFC (2017) that suggests that asserts that commodity canola has a 20% dependence on insect pollinators, with approximately 90% of those pollinators being honey bees.<sup>6</sup> As such, about 18% of the value of commodity canola in Alberta can be attributed to honey bees. Over the last decade, the value of canola has ranged between \$1.9 and \$3.4 billion. The proportion of this value that can be attributed to honey bee pollination ranges between \$343 and \$ 613 million. In 2018, the value of commodity canola was about \$2.6 billion, with approximately \$466 million attributable to honey bee pollination.

As mentioned earlier, the value of horticulture crops pollinated by honey bees in Alberta is relatively low, particularly when compared to the value of commodity canola. Farm cash receipts for fresh fruit in Alberta in 2018 was approximately \$3.3 million (Statistics Canada 2018c). Recent years of production data for vegetables pollinated by honey bees (cucumbers, pumpkin, and squash/zucchini) suggest an annual value for these crops of around \$3 million (Statistics Canada 2017). As such, the proportion of honey bee pollination that contributes to the production of these crops is insufficient to impact the results. However, growth in horticulture field crops has grown in the last decade. Since 2010, farm cash receipts for fresh fruit in Alberta increased by around 75%, from \$1.9 million to about \$3.3 million (Statistics Canada 2018c). Honey bees therefore may provide a more substantial economic benefit in the future should the province's fruit production continue to increase.

The pollination of clover and other forage crops by honey bees has been noted to have beneficial impacts to the health of rangelands and ultimately the health of cattle herds that forage those rangelands. However, the value of honey bee contributions to rangelands and the livestock that graze on them has not been studied sufficiently to allow for an estimation of the gross economic benefits resulting from this relationship. Further study is required to examine the relationship between honey bees and the livestock industry.

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<sup>5</sup> It is important to note that in a typical cost-benefit analysis, the costs and benefits accounted for would be incremental costs and benefits as compared to the next-best alternative. In this study, we assume that since honey bees pollinate about half of the province's seed canola, they contribute to half of the gross economic benefit associated with that production. However, in the absence of honey bee pollination, the next best alternative would likely be the use of leaf cutter bees for all seed canola pollination. The practicality of this alternative is debatable, and as such, the gross economic benefits presented in this study can be viewed as the benefit of existing honey bee activities, as opposed to incremental benefits relative to next-best alternatives.

<sup>6</sup> We employ the same data and methodology used by AAFC (2017) to estimate the pollination contribution of honey bees to commodity canola. However, we recognize that research on this topic is evolving and that the number of available honey bees in the province is a limiting factor. The lack of available and accurate data is certainly a limitation of this estimate.

Overall, the total quantifiable contribution of honey bees to seed canola and other crops through pollination in 2018 was an estimated \$497 million.

### 4.1.3 Bee Sales

#### 4.1.3.1 Activity

The sale of bees is a relatively small activity within Alberta's beekeeping industry. Commercial beekeepers in the province have recently used the sale of bees, typically either queens or small nucleus hives, as an alternative source of revenue to combat the variability in honey prices. Both queens and nucs are popular purchases for hobby beekeeping, which has become increasingly popular in Alberta (Laate 2017), as well as commercial beekeeping to combat winter losses or boost hive strength.

#### 4.1.3.2 Gross Economic Benefit

Compared to honey, wax, and pollen production, as well as pollination services, the sale of bees is a much smaller revenue generating activity for Alberta's beekeepers. In 2018, the estimated value of bee sales (including nucs, queens, and hives) in Alberta was approximately \$94,000.

### 4.1.4 Non-Market Benefits

In addition to the market activities associated with honey bees in Alberta described above, there are also non-market activities of honey bees that, though difficult to quantify, provide important socio-economic benefits.

One of the major non-market benefits of the honey bee industry in Alberta is the way in which it improves perceptions and promotes the importance of all bees, both managed and wild. In a way, honey bees have acted as the "poster child" for bee conservation. Both managed bees and wild bees have faced ecological challenges, such as colony collapse disorder and other diseases. But while issues amongst honey bees are well monitored, there is a lack of data on many of the native bee species, so instances of population declines are often caught too late (Hristova 2019). Recently, biologists have noted that the honey bee industry has been effective in providing a spotlight on bees, educating the public as to the importance of bees as insect pollinators and helping to quell many of the fears and misperceptions around bees, benefiting both honey bees and native bees (Hristova 2019).

Indeed, commercial beekeepers have asserted that they are constantly engaging with landowners and the public to promote the importance of honey bees and bolster the reputation of Alberta's beekeeping industry. Engagement with landowners to discuss placing hives on their fields has, in some cases, improved neighbor relations and encouraged a sense of community and cooperation between beekeepers and primary producers. This cooperation has contributed to the adoption of land management practices by some producers that improve conditions for honey bees, such as reduced spraying or appropriately timed spraying of fungicides and pesticides to avoid contact with bees (US Canola Association 2019). These practices can also benefit wild bees that are foraging in the same fields or in natural areas adjacent to crop fields.

Finally, the pollination services offered by honey bees have additional benefits to the market benefits discussed above. Overall improved ecosystem quality and sustainability is an important contribution of pollinators. While some of these benefits can be considered market benefits (e.g. the pollination of cash crops) there are also intrinsic, non-market values for environmental sustainability that are difficult to quantify but important to highlight.

### 4.1.5 Total Gross Benefit

Together, the total gross economic benefit of honey bee activity in Alberta in 2018 was approximately \$564 million (Table 4-1). However, given that there is substantial variability in the factors associated with honey bee activity

each year (e.g. honey prices, winter losses, canola production), this value can differ substantially. Based on data from the last 10 years, sensitivity analyses suggest that the gross economic benefit of honey bees in Alberta ranges between \$431 and \$740 million per years (Table 4-1).

**Table 4-1 Gross Economic Benefits of Honey Bees in Alberta**

Economic Activity	Gross Economic Benefit		
	Low	High	2018
Honey/wax/pollen production	\$60 million	\$92 million	\$67 million
Pollination	\$371 million	\$648 million	\$497 million
Bee sales (nucs/queens) <sup>7</sup>	\$0.085 million	\$0.104 million	\$0.094 million
<b>Total</b>	<b>\$431 million</b>	<b>\$740 million</b>	<b>\$564 million</b>

## 4.2 Industry Challenges

### 4.2.1 Landowner Relations

While many beekeepers spoke to strong relationships with private landowners, several challenges with respect to landowner neighbours were mentioned. The most common challenge cited was that while a landowner will allow bee hives on their land and undertake certain management practices regarding spraying to accommodate those hives, their neighbours are not always as amenable. Often any issues with improper timing of pesticide spraying that harms honey bees are a result of a neighbour’s refusal to cooperate. Furthermore, some neighbours maintain negative perceptions and fears around honey bees, creating issues for the beekeepers and landowners that are allowing the hives.

An additional landowner challenge described instances in British Columbia where blueberry farmers attempt to lure bees onto their fields to avoid renting hives themselves. Honey bee pollination is a critical factor for blueberry farming, and blueberry farmers often enter into monetary contracts with beekeepers for pollination services. However, farmers looking to avoid paying for pollination services will purchase specialty sprays with the intention of “luring” bees onto their fields for pollination from adjacent fields. This issue was not mentioned by any operations in Alberta.

### 4.2.2 Honey Prices and Adulteration

Perhaps the biggest challenge noted by Alberta beekeepers is the recent low price of honey. In the last decade, honey prices reached as high as \$2.40 per pound. Last year however, prices were almost 30% lower, putting pressure on Alberta beekeepers. Part of the decline in prices can be attributed to a surge in adulterated honey entering the global marketplace. Honey is consistently one of the most frequently adulterated agricultural products (Booker 2018). Fraudulent honeys often contain substantial amounts of syrups or sweeteners that are cheaper to producer but ultimately reduce the quality of the product. In a study published in Nature, over half of the honeys sampled were found to be adulterated (Zhou et al. 2018). In Canada, strict CFIA guidelines prohibit the adulteration of honey products. Unfortunately, processors in the United States, a major market for Canadian

<sup>7</sup> As the sale of bees is an emerging enterprise, there is insufficient data to estimate a historical range of gross economic benefits. As such, a range of +/- 10% from the 2018 value has been assumed.



honey, treats unadulterated and adulterated honey the same, putting Canadian beekeepers producing a higher quality product at a higher cost at a disadvantage.

#### 4.2.3 Grazing Lands

Another issue highlighted through beekeeper engagement is the placement of hives on public lands leased for grazing in the province. Not many beekeepers look to place their colonies on grazing leases, but those who do have noted that some lease holders have a negative perception of honey bees and do not necessarily view bees as a foraging animal. According to the ABC, in 2017 all beekeepers with hives on grazing lands were asked to remove their hives as a result of a complaint. Since then, Alberta Environment has worked with the Commission to develop a set of protocols and guidelines for placing bees on public lands. Now, beekeepers require permission from both the government and the lease holder to place their hives on public lands. Several beekeepers interviewed noted that lease holders often respond positively to a conversation that provides some additional insights and information regarding honey bee pollination.

## 5. Conclusion

Alberta has the largest honey bee industry in the country in terms of both colony size and honey production. Honey bees provide economic benefits in Alberta through three primary economic activities:

- products associated with honey bees (including honey, wax, and pollen);
- pollination; and
- bee sales (including nucleus colonies and queens).

Together, these activities contributed to estimated gross economic benefits in 2018 of approximately \$564 million, although estimated benefits have ranged from \$431 to \$740 million over the last decade given the level of variability in the agriculture sector. Stakeholder engagement with beekeepers and primary producers also revealed several non-market benefits associated with honey bee activities in Alberta such as improved relationships between landowners through engagement about honey bee pollination, the adoption of certain management practices by landowners to encourage bees, as well as the spotlight that the honey bee industry has shone on the importance of all bees, both managed and non-managed. The pollination services provided by honey bees can also improve ecosystem quality and sustainability, providing additional environmental non-market benefits.

Stakeholder interviews also revealed several major industry challenges facing Alberta beekeepers. One of the biggest challenges cited by beekeepers is the increasing presence of adulterated honey in the global market. Challenges related to landowner cooperation to accommodate honey bees, particularly landowner neighbours who have negative perceptions of bees, were also highlighted. Finally, a relatively minor challenge noted by beekeepers is the difficulty in placing honey bees on grazing leases for pollination.

In addition to the current challenges highlighted by industry stakeholders, there are a number of potential future challenges and risks to the industry as well. Like other agriculture sectors, the honey bee industry can be severely impacted in any given year by factors such as:

- pests and disease (most notably Varroa mites);
- climate change;
- consumer demand for honey; and
- demand for canola pollination.

Finally, it is important to note that there are several areas of future study that would help improve the estimated economic benefit of honey bees in Alberta. First, the relationships between honey bee pollination and crop yields are highly uncertain. Pollination impacts on commodity canola has been studied several times in Alberta, but available data are not sufficiently nuanced to account for variations in canola varieties, growing conditions, or the complex relationship between honey bees and wild pollinators. Research in this area is evolving, and while our understanding of the impact of honey bees on commodity canola is continually improving, data are not yet sufficiently concrete so as to quantify this relationship with a high level of accuracy. Future work in this area would greatly improve the estimated value of honey bee pollination on Alberta's most valuable crop. Furthermore, additional research into the relationship between honey bees and forage crops would provide additional insights into the economic value that honey bees contribute to the province's beef industry.

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