An Analysis of Almond Pollination Rates Received by Rocky Mountain Beekeepers

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Abstract

Over the last decade, the average rates received by beekeepers for almond pollination have increased approximately four fold, suggesting new marketing opportunities for migratory beekeepers from the Rocky Mountains. The current research analyzes the almond pollination rate received by beekeepers in the Northern Rocky mountains. Using primary data from 32 beekeepers servicing the almond market, we test the role of alternative marketing arrangements in pollination service rates received by beekeepers. The data are analyzed using an ordinary least squares regression analysis. We find almond pollination rates received by beekeepers decline when beekeepers use cooperative transportation arrangements and increase for beekeepers in direct contracts with growers. Rates are also higher for beekeepers with mid-level off-farm earnings and from firms actively engaged in honey marketing efforts. The results indicate migratory beekeepers from the Rocky Mountains would benefit from opportunities to network directly with almond growers. Also, when feasible, there is a premium available to those beekeepers willing and able to transport their colonies directly to California themselves. It appears beekeepers with mid-income earning potential outside of beekeeping, fare better than those with low outside earning potential and high outside income earners. Finally, beekeepers who market honey from their colonies are also obtain higher rates for their almond pollination services.

Introduction

The rates beekeepers receive from pollinating almonds in California has increased near four fold in the last decade (Rodriguez, 2015; Sumner & Boriss, 2006). These increasing rates suggest there are entrepreneurial opportunities for migratory beekeepers in California's almond industry. However, when a beekeeper decides to enter the almond pollination service industry, he or she will need to make a number of marketing decisions. Decision points include the number or proportion of their colonies they will transport for almond pollination, how the colonies will be transported, how they will contract their bees for the pollination work, and how those bees will be cared for in California. These decisions may affect the pollination rate received by the beekeeper.

Current literature on pollination marketing arrangements is relatively undeveloped. Beekeepers, especially those entering the pollination services industry, face uncertainty about the possible returns to pollination services due to marketing information deficiencies. For example, almond pollination market prices are often revealed ex-post from field surveys of almond growers and beekeepers in the preceding season.

The objective of this paper is to measure the effect of contract and transportation arrangements on rates received for almond pollination services to beekeepers in the Northern Rocky Mountain states of Montana, Utah, and Wyoming. We focus our attention on two specific aspects of the beekeeper's pollination services marketing: 1) whether they use a pollination services broker or contract directly with the almond grower and 2) whether they transport their hives directly or work with other beekeepers through cooperative transport agreements. Our general hypothesis is that marketing arrangements do affect migratory beekeeper rates. More specifically, we expect beekeeper rates to decrease with the use of a contract broker compared to those returns from services provided through direct contract with growers. We also expect rates to increase when using cooperative transport agreements, especially when controlling for size of operation. We accomplish our objective through econometric analysis of data from a survey of beekeepers in the Montana, Utah and Wyoming.

Background

Over the last decade, multiple forces have increased almond pollination opportunities for migratory beekeepers throughout the United States. Globally, nut demand, especially almond demand, has increased (Economic Research Service, 2017). The upward trend in almond demand has led to increased almond acreage in California's Central Valley, home to 83 percent of global almond production (Almond Board of California, 2016). There, the acreage dedicated to almond cultivation grew from 430 thousand to 890 thousand bearing acres from 1996 to 2015 (Sumner & Boriss, 2006; United States Department of Agriculture, 2016).

This increased almond crop created a surge in demand for an essential input into almond growth: insect pollination. The local wild pollinators are not sufficient to meet the pollination demand, especially since almond orchard expansion encroaches on their native habitats (Klein et al., 2012). Managed honey bees, *Apis Millafera*, are more suited to the biological demands of almond pollination than most wild pollinators. Therefore, managed honeybees are required to pollinate burgeoning almond acreage. In 2004, approximately 1.4 million colonies were required

for almond pollination (Sumner & Boriss, 2006). Today, the number of honeybee colonies needed for almond pollination is approximately 2.2 million.[1]

The increase managed bee demand requires more bees to be transported to California from beekeeping operations in other regions for the February to March almond bloom. Almond pollination fees paid to beekeepers have increased from an average of $54 per colony in 2004 to between $165 and $200 per colony in 2015 (Rodriguez, 2015; Sumner & Boriss, 2006). This opportunity has created a veritable gold rush for beekeepers willing to transport their hives to the almond fields of California. Beekeepers in the Rocky Mountain States of Montana, Utah and Wyoming have been active players in this phenomenon, transporting their bees to the California almond fields during the winter months.

While researchers have examined the market forces determining pollination fees (e.g., Rucker, Thurman, & Burgett, 2012), there is little readily available information on the effects of different marketing arrangements on beekeeper returns from providing almond pollination services. Earlier research by Ehmke et al. (Forthcoming), shows beekeepers in the Northern Rocky Mountain regions still obtain the greatest portion of their returns from honey production, on average. Still, beekeepers may diversify and increase returns through almond market pollination. It is unclear, however, how their almond marketing arrangements affect returns to this enterprise.

Theory and Methods

Almond revenue is an important determinant of overall firm returns. The revenue beekeepers receive is most directly a function of the almond pollination service fee and the number of colonies placed in almond fields. In a perfectly competitive market, beekeepers will be price takers for their services and their services should be homogenous—only fluctuations in market demand should affect the price their receive. However, a number of beekeepers make their pollination service agreements with the help of a broker. Others form cooperative transport arrangements to deliver their bees to California rather than providing transportation themselves. Further, it is not clear whether beekeeper services are homogenous. Pollination services may be characterized by differences in beekeeper firm size and location in addition to marketing decisions.

We construct a simple linear model of almond pollination service fees to test the relationships between the service fees beekeepers receive, their contract and transportation arrangements, location, and size. In this model, price a firm receives, p_i, is a function of the j service agreement arrangements and k firm characteristics for each beekeeper i or,

$$p_i = a_0 + \sum_{j=1}^{m} \beta_j X_{ij} + \sum_{k=1}^{t} \gamma_k X_{ik} + \varepsilon_i. \qquad (1)$$

We will use this model to test a number of hypotheses related to the rate received by the beekeepers for almond pollination. First, we test the null hypothesis that almond pollination rates are not affected by contract principal. This would suggest the rate is the same whether the beekeeper enters a direct contract with the grower or through a contract with a broker or middleman. Second, we test the null hypothesis that the almond pollination rate received is not affected by transportation arrangements. In other words, the pollination rate received will be the

[1] This estimate assumes 2.5 colonies for each acre of almonds following Sumner and Boris (2006).

same whether the beekeeper delivers his or her hives directly or through a third-party, cooperative transportation arrangement. Finally, we test null hypotheses that the pollination rate received is the same for all firms, regardless of their size, length of operation, and location. The alternative hypotheses to this set of null hypotheses would be that pollination rate received does differ across firms, based on their size, location, and length of operation.

Data

The data were collected through a survey of beekeepers registered with beekeeping associations and/or state Departments of Agriculture in Montana, Utah and Wyoming. University of Wyoming Internal Review Board approved the survey methods. There are a total of 1,026 registered beekeepers the three states with 239 beekeepers in Montana, 645 in Utah, and 142 in Wyoming. A stratified sample of beekeepers was surveyed to receive a more equitable sample across the states. The survey sample included all Wyoming beekeepers and half of the Montana and Utah beekeepers. Montana and Utah beekeepers were selected for study inclusion adhering to a random sample selection method. Thus, the final sample size of 585 beekeepers included 120, 323, and 142 beekeepers from Montana, Utah and Wyoming, respectively.

The survey was developed using the Dillman method to maximize the response rate (Dillman, 1978). All survey sample members received a pre-survey post card; and individually signed cover letter and survey, appreciation token, self-addressed stamped envelope, and return postcard. Early non-respondents also received an additional post card reminder to complete the survey[2]. In all, we received 41 surveys from Montana, 140 from Utah, and 76 from Wyoming, resulting in an overall response rate of nearly 44 percent.

Results

There were a total of 36 beekeepers in the sample who were involved in pollination servicing, but only 32 of these serviced the California almond market. Our analysis focuses on these 32 beekeepers.

A histogram of the dependent variable, almond pollination rate received, is presented in figure one. Although the mean rate received is $140.48 per colony, there is considerable variance (σ=$31.87 per colony). The minimum pollination fee beekeepers reported receiving was $50 per colony and the maximum was $185 per colony.

[2] Please see Appendix A for the survey content.

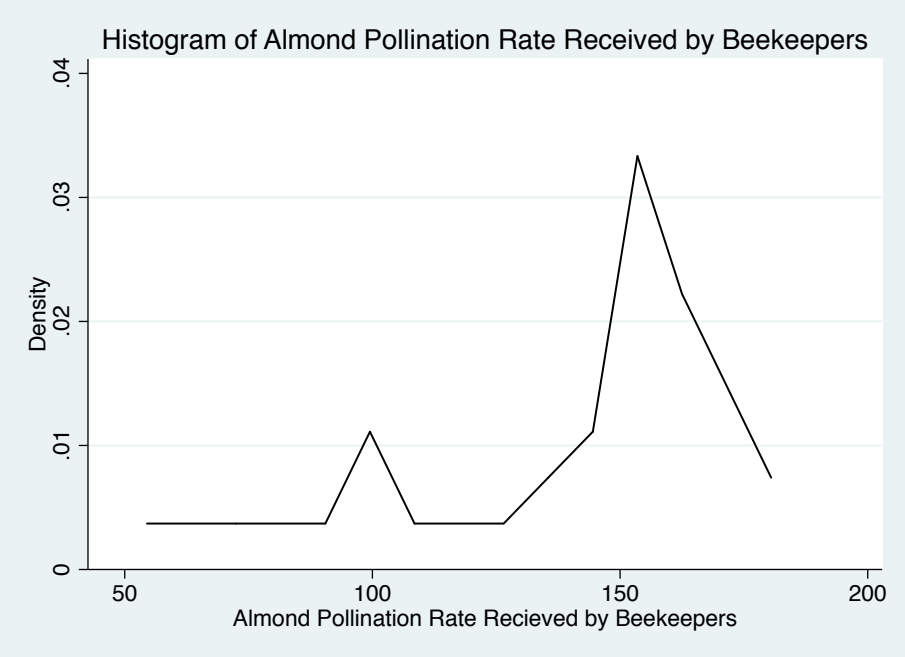

Figure 1. Histogram of Almond Pollination Rate Received by Rocky Mountain Beekeepers in 2013

The independent variables for the model are summarized in Table 1. Half of the almond pollinating beekeepers were from Wyoming (1= "Yes" and 0= "No") while 19 and 31 percent were from Montana and Utah, respectively. The average age of the beekeeper enterprise was 37 years. Only 28 percent of the almond pollinating beekeepers reported off-farm earnings that we could classify as low ($0 to $20,000), medium ($20,001 to 100,000), or high (more than $100,000). Sixteen percent of almond pollinating beekeepers reported mid-level off-farm earnings. Only nine percent reported low off-farm earnings, and even less, three percent, reported high off-farm earnings. The remaining 72 percent of almond pollination servicing beekeepers either do not have off-farm income or were not willing to share it on the survey. The mean age of the beekeepers was 54. This age variation indicates some beekeepers may not have off farm wages due to various retirement and labor market age barriers.

Table 1. Summary statistics of independent explanatory variables

Variable	N	Mean	Std. Dev.	Min	Max
Montana	32	0.19	0.40	0	1
Utah	32	0.31	0.47	0	1
Wyoming	32	0.50	0.51	0	1
Age of Enterprise	31	36.58	29.50	4	98
Low Off-Farm Salary	32	0.09	0.30	0	1
Medium Off-Farm Salary	32	0.16	0.37	0	1
High Off-Farm Salary	32	0.03	0.18	0	1
Cooperative Transport Agreement	31	0.65	0.49	0	1
Grower Contract	32	0.47	0.51	0	1
Average Pounds of Honey	32	53.21	33.24	0	123.6

Marketed Per Colony					
Number of Colonies	32	1,429.88	1,800.22	26.00	8,000.00

A majority (65 percent) of the almond pollination servicing beekeepers reported having a cooperative transport agreement (1= "Yes" and 0= "No"). Nearly half, of 47 percent, of the beekeepers had a direct contract with a grower (1= "Yes" and 0= "No"). The remaining 53 percent used a pollination contract broker, typically located near the almond groves, to obtain their pollination contract.

Other firm characteristics include the firm's age, size and honey marketing activities. On average, the firms in this sub-group are 36.58 years old. However, one has been in business for nearly a century, 98 years. The newest firms are only four years old. Firm size is measured by the total number of colonies the beekeepers manage. The average firm size is large at 1,429.88 colonies. However, some firms remain small (e.g., 26 colonies), while some surpass 5,000 colonies. We measure the firms honey marketing activities by the average amount of honey marketed per colony. The mean honey marketed per colony is 53.21 pounds (σ=33.24).

Two sets of box plots were generated to compare pollination rates with different marketing arrangements. In the first set of box plots, the distribution of almond pollination rates for those producers who use a broker and do not have a direct contract with a grower (Figure 2). The portion of the box with solid shading represents the portion of observations that are between the 25th and 75th percentiles of the distribution. The median rate received for beekeepers not contracting directly with almond growers is slightly lower than that of those who have direct grower contracts. There is slight overlap on the upper 75th percentile of rates using a broker and lower 25th percentile of rates obtained directly with the grower.

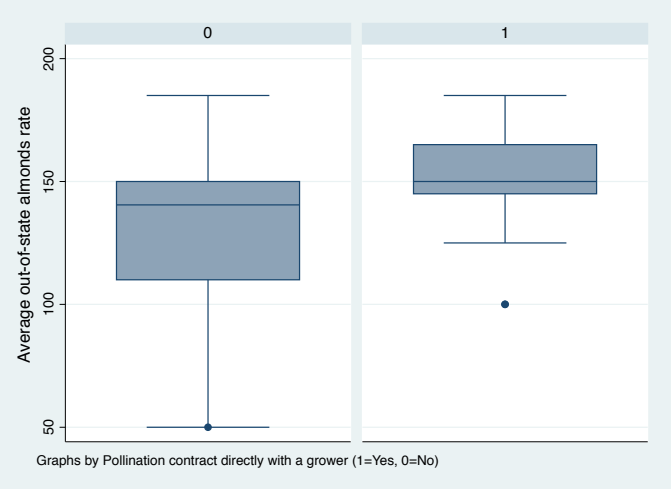

Figure 2. Box plots of almond pollination rate received without and with direct grower contracts.

In Figure 3, the box plots indicate median almond pollination rate decreases for those growers using a cooperative transportation agreement. In the box plot, it appears there is no overlap between the 25th to 75th percentile portions of the respective distribution. There is only overlap in the tails of the distributions, as those without transportation arrangements are most likely to receive almond pollination rates of at least $150 per colony while those with cooperative transportation rates typically received less than $150 per colony.

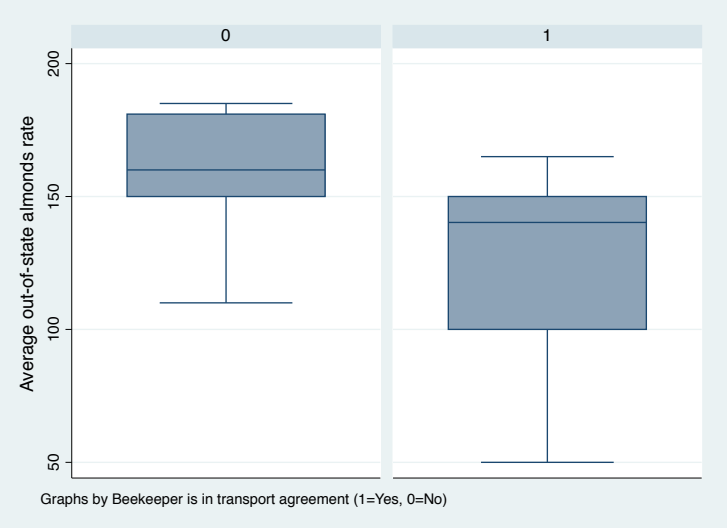

Figure 3. Box plot of almond pollination rate beekeepers receive by transportation agreement (1=Yes, 0=No)

In a perfectly competitive market with no transaction costs, we would expect all beekeepers to receive the same rate for almond pollination services, ceteris paribus. Instead, the reported almond pollination rate is heterogeneous across beekeepers. This substation standard deviation (more than 20 percent of the mean price) indicates the market price does not easily converge to a common price for all beekeepers.

The objective of this analysis is to examine non-demand factors that may affect the pollination fee beekeepers receive. Specifically, we use an ordinary least squares (OLS) regression to test hypotheses relating to the role of contractual brokers, transportation arrangements, and firm characteristics in pollination fee determination. The model is specified according to equation 1.

The results of the regression analysis indicate beekeepers marketing rates do depend on marketing arrangements when controlling for other firm and management characteristics. Three different models were estimated. In Model 1, the coefficient for a cooperative transport arrangement is estimated without controlling for whether a broker negotiated the contract. In Model 2, we look solely at the presence of the parameter indicating a direct grower contract while omitting the marketing variable measuring transport arrangement. Finally, in Model 3, we estimate both marketing arrangement parameters.

We find Model 1 does not sufficiently explain the dependent variable variation (Table 2). The F-Statistic is not significant although the cooperative transport arrangement coefficient is. Our estimation of Model 2 is stronger, with a significant F-Statistic and significant result for the grower contract coefficient. Beekeepers who contract directly with the grower receive a higher rate, $30.21 more per colony on average, for their pollination services. Other firm characteristics are also significant. Beekeepers from Utah received an average of $23.74 per colony more than beekeepers from Wyoming. Beekeepers from more established firms earned an average of $0.37 per colony for each additional year of firm life. Finally, in Model 2, there was a positive relationship between the amount of honey marketed per colony and the almond pollination contract rate received by the beekeeper. The beekeeper received an average of $0.34 more per colony, for every additional pound of honey produced by the average colony. Thus, according to

Model 2, beekeepers from established firms with greater levels of honey production are expected to secure higher almond pollination rates.

Table 2. Ordinary Least Squares model of the almond pollination rate beekeepers receive[α]

	Model 1	Model 2	Model 3
Montana	10.386	25.288	13.944
	(-0.64)	(-1.72)	(-0.93)
Utah	1.941	23.739	9.865
	(-0.14)	(-1.91)*	(-0.73)
Age of Enterprise	0.019	0.37	0.199
	(-0.09)	(-1.84)*	(-0.91)
Low Off Farm Salary	44.29	24.003	39.886
	(-1.67)	(-0.98)	(-1.64)
Medium Off Farm Salary	29.205	23.882	28.351
	(-1.88)*	(-1.61)	(-1.99)*
Cooperative Transport Agreement	-36.855		-27.556
	(2.58)**		(-2.01)*
Grower Contract		30.21	24.646
		(2.77)**	(2.24)**
Average Pounds of Honey Marketed Per Colony	0.199	0.34	0.31
	(-1.09)	(-1.88)*	(-1.75)*
Number of Colonies	-0.002	-0.002	-0.003
	(-0.45)	(-0.66)	(-0.81)
Constant	145.681	81.966	116.003
	(6.30)***	(4.74)***	(4.65)***
R^2	0.42	0.44	0.54
F	1.93	2.13	2.61
Prob>F	0.11	0.08*	0.04**
N	30	31	30

* indicates p<0.10, ** indicates p<0.05, and *** indicates p<0.01
[α]t-statistics in parentheses

In Model 3, we include dummy variables measuring both the use of cooperative transport arrangements and direct contract arrangements with growers as explanatory variables. In this model, where we control for the presence of a direct contract with the grower, both the model and the coefficient for a cooperative transport arrangement are significant. Beekeepers who enter into a cooperative transport arrangement receive approximate $27.56 less per colony than those who provide their own transportation. The inclusion of the transport parameter brings down the average earnings gained by entering into a direct contract with the grower from $30.21 per colony in Model 2 to $24.65 in Model 3. Firm age is no longer significant in Model 3, but firm honey marketing activity is. For each additional pound of honey marketed per colony, on average, beekeepers receive an additional $0.31 in from their almond pollination rate per colony.

We see the first significant coefficient associated with an individual beekeeper characteristic in Model 3; income. Beekeepers reporting a mid-level off-farm income (e.g., from $20,000 to $100,000) received an average of $28.35 per colony more than beekeepers who with higher incomes (e.g., greater than $100,000). The coefficient value only holds for those beekeepers who reported a middle income.

Conclusion

The findings of this research indicate almond pollination service marketing arrangements do affect the rates beekeepers receive for servicing to the California almond market. Primary data were collected from beekeepers in the Rocky Mountain States of Montana, Utah, and Wyoming. They key indicator analyzed in the paper was the contract rate beekeepers received for California almond pollination. Employing multivariate regression analysis, we test the effects of alternative marketing options and firm and individual characteristics on the almond pollination rate beekeepers receive.

Our results suggest beekeepers receive higher almond pollination rates when shepherd their colonies for delivery to the almond fields and have a direct contracting relationship with the almond grower. The almond pollination rate received is lower for beekeepers when they do not deliver their colonies to almond growers themselves, but use a cooperative transport arrangement. The rate is higher for beekeepers with a direct contractual arrangement with an almond grower rather than using a third-party contract grower. These results indicate beekeepers benefit from cultivating and maintaining direct commercial relationships with growers.

While firm size and age is not statistically related to almond pollination fees received, other aspects of a beekeeper's personal and firm characteristics are significant. Beekeepers with mid-level off-farm earnings (e.g., between $20,000 and $100,000) receive higher almond pollination rates. While we were not able to obtain income information for all beekeepers, it appears those capable of obtaining moderate off-farm income also have the skills necessary to negotiate higher contracts rates, whether with a grower or a broker. Likewise, beekeepers engaged in more honey marketing per hive also receive higher almond pollination rates.

These results offer a variety of insights for beekeepers entering the California almond market. First, there are financial incentives to personal business relationships directly with California almond growers. While our results show these benefits are not related to firm size, we recommend research to analyze the extent of these findings. Specifically, while firm size was not a significant explanatory variable in our regression analysis, there is a moderate correlation between firm size and utilizing cooperative transport agreements (ρ =-0.45). More research is needed to determine at what point in firm expansion (e.g., 50, 100, or 1,000 colonies), is it economically feasible for a beekeeper to invest in their own, in-house transportation equipment rather than use cooperative arrangements. The almond pollination rate received by beekeepers is higher when they provide their own transportation, but the transportation takes considerable investment.

In the future, other pollination-related marketing variables need further consideration. Two of these we asked about, but did not get enough variables to calculate. They were yard fees and grower payments. Our respondents indicated their use of holding yards and the total yard fee charges for different types of yards. Unfortunately, we did not measure the number of colonies kept in such yards or total number of yards used. It may be the yard fees are deducted from cooperative transport arrangements, but beekeepers providing their own transportation have to pay these post-contract agreement. Therefore, improved yard fee information will enhance our

ability to compare cooperative transport and individual transport arrangements in the future. Future surveys need to measure yard costs, the total number of yards accessed, and the average number of colonies per yard.

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Appendix A

Section I. Pollination

1. What state is your beekeeping business located in?

   ☐ Montana(1) ☐ Utah(2) ☐ Wyoming(3)

2. How many honeybee colonies do you manage? _____ colonies

3. Are you in an agreement with a grower or broker to provide crop pollination services?

   ☐ No(0) ☐ Yes, direct with grower(s)(1) ☐ Yes, through a broker(2)

   If your answer to question 3 is **YES**, please answer the remaining questions in Section I. If your answer to question 3 is **NO**, please proceed to Section II.

4. Are your colonies transported out of your home state to any of the following states to perform pollination services? (check all that apply)

   ☐ Arizona(1) ☐ Mississippi(6) ☐ North Dakota(11) ☐ Washington(16)
   ☐ California(2) ☐ Montana(7) ☐ Oregon(12) ☐ Wyoming(17)
   ☐ Florida(3) ☐ Nebraska(8) ☐ South Dakota(13) ☐ Other(18) ___
   ☐ Idaho(4) ☐ Nevada(9) ☐ Texas(14)
   ☐ Louisiana(5) ☐ New Mexico(10) ☐ Utah(15)

5. In the last three years, for which crops did you provide pollination services and what is the average number of colonies you have placed on **in-state** pollination or nectar source? (answer all that apply)

Pollination Source (In-State)	Days of Pollination	Number of Colonies	Average Frames per Colony	Colonies Per Acre
1. Alfalfa(a)	___ days	___ colonies	___ frames	___ colonies
2. Apples(c)	___ days	___ colonies	___ frames	___ colonies
3. Cherries(f)	___ days	___ colonies	___ frames	___ colonies
4. Clover(g)	___ days	___ colonies	___ frames	___ colonies
5. Rapeseed(j)	___ days	___ colonies	___ frames	___ colonies
6. Squash and/or Pumpkins(k)	___ days	___ colonies	___ frames	___ colonies
7. Vetch(l)	___ days	___ colonies	___ frames	___ colonies
8. Other(m) _____	___ days	___ colonies	___ frames	___ colonies

6. In the last three years, for which crops did you provide pollination services and what is the average number of colonies you have placed on **out-of-state** pollination or nectar source? (answer all that apply)

Pollination Source (Out-of-State)	Days of Pollination	Number of Colonies	Average Frames per Colony	Colonies Per Acre
1. Alfalfa(a)	___ days	___ colonies	___ frames	___ colonies
2. Almonds(b)	___ days	___ colonies	___ frames	___ colonies
3. Apples(c)	___ days	___ colonies	___ frames	___ colonies
4. Blueberries(d)	___ days	___ colonies	___ frames	___ colonies
5. Broccoli(e)	___ days	___ colonies	___ frames	___ colonies
6. Cherries(f)	___ days	___ colonies	___ frames	___ colonies
7. Clover(g)	___ days	___ colonies	___ frames	___ colonies
8. Cranberries(h)	___ days	___ colonies	___ frames	___ colonies

9. Melons$_{(i)}$	___ days	___ colonies	___ frames	___ colonies
10. Rapeseed$_{(j)}$	___ days	___ colonies	___ frames	___ colonies
11. Squash and/or Pumpkins$_{(k)}$	___ days	___ colonies	___ frames	___ colonies
12. Vetch$_{(l)}$	___ days	___ colonies	___ frames	___ colonies
13. Other$_{(m)}$ _____	___ days	___ colonies	___ frames	___ colonies

7. Did you cooperate with any other beekeepers in transporting your colonies out-of-state (e.g., shared space on a semi-truck)?

   ☐ Yes$_{(1)}$ ☐ No$_{(0)}$

8. In the last three years, did you pay rent to have your bees held at holding yard? If so, what was the rental rate?

   ☐ Yes$_{(1)}$ $_____ per colony ☐ No$_{(0)}$

9. According to your response in question 5 and 6, please indicate if you **received payment** for your pollination services by reporting the average gross price per colony you received in 2013: (answer all that apply)

Pollination Source	**Average In-State Rate Received**$_{(1)}$	**Average Out-of-State Rate Received**$_{(2)}$
1. Alfalfa$_{(a)}$	$_____per colony	$_____per colony
2. Almonds$_{(b)}$	$_____per colony	$_____per colony
3. Apples$_{(c)}$	$_____per colony	$_____per colony
4. Blueberries$_{(d)}$	$_____per colony	$_____per colony
5. Broccoli$_{(e)}$	$_____per colony	$_____per colony
6. Cherries$_{(f)}$	$_____per colony	$_____per colony
7. Clover$_{(g)}$	$_____per colony	$_____per colony
8. Cranberries$_{(h)}$	$_____per colony	$_____per colony
9. Melons$_{(i)}$	$_____per colony	$_____per colony
10. Rapeseed$_{(j)}$	$_____per colony	$_____per colony
11. Squash and/or Pumpkins$_{(k)}$	$_____per colony	$_____per colony
12. Vetch$_{(l)}$	$_____per colony	$_____per colony
13. Other $_{(m)}$_____	$_____per colony	$_____per colony

10. According to your response in question 5 and 6, please indicate if you **paid** for the opportunity to access a nectar source or a honey production yard by reporting the average rental price you **paid** per colony or for the total yard rental, depending on you situation, in 2013: (answer all that apply)

Pollination Source	Average In-state Rental Paid(1) Per Colony Rental	OR	Total Yard	Average Out-of-State Rental Paid(2) Per Colony Rental	OR	Total Yard
1. Alfalfa(a)	$_____per colony		$_____for yard	$_____per colony		$_____for yard
2. Almonds(b)	$_____per colony		$_____for yard	$_____per colony		$_____for yard
3. Apples(c)	$_____per colony		$_____for yard	$_____per colony		$_____for yard
4. Blueberries(d)	$_____per colony		$_____for yard	$_____per colony		$_____for yard
5. Broccoli(e)	$_____per colony		$_____for yard	$_____per colony		$_____for yard
6. Cherries(f)	$_____per colony		$_____for yard	$_____per colony		$_____for yard
7. Clover(g)	$_____per colony		$_____for yard	$_____per colony		$_____for yard
8. Cranberries(h)	$_____per colony		$_____for yard	$_____per colony		$_____for yard
9. Melons(i)	$_____per colony		$_____for yard	$_____per colony		$_____for yard
10. Rapeseed(j)	$_____per colony		$_____for yard	$_____per colony		$_____for yard
11. Squash and/or Pumpkins(k)	$_____per colony		$_____for yard	$_____per colony		$_____for yard
12. Vetch(l)	$_____per colony		$_____for yard	$_____per colony		$_____for yard
13. Other(m) _____	$_____per colony		$_____for yard	$_____per colony		$_____for yard

11. According to your response in question 5 and 6, please indicate if you **gave an in-kind rental payment (or a gift such as honey) in lieu of money, to pollinate crops** by reporting the type and quantity of gifts given for access to a nectar source or honey production yard in 2013: (answer all that apply)

Pollination Source	To In-State Grower(1) Type of Gift	To In-State Grower(1) Quantity of Gift per Colony	To Out-of-State Grower(2) Type of Gift	To Out-of-State Grower(2) Quantity of Gift per Colony
1. Alfalfa(a)				
2. Almonds(b)				
3. Apples(c)				
4. Blueberries(d)				
5. Broccoli(e)				
6. Cherries(f)				
7. Clover(g)				
8. Cranberries(h)				
9. Melons(i)				
10. Rapeseed(j)				
11. Squash and/or Pumpkins(k)				
12. Vetch(l)				
13. Other(m) _____				

Section II. Honey Production and Marketing

1. How many of your colonies produced honey in 2013? _____ colonies

2. What were the total pounds of honey you harvested in 2013? _____ pounds

3. Do you preform your own honey extraction?

☐ Yes(1) ☐ No(0)

4. Where are you currently marketing your honey and what was the average price per pound in 2013 that you received? (answer all that apply)

Distribution Channel	Price per pound(1)	Number of pounds(2)
☐ Cooperative (e.g., Sue Bee Honey)(a)	$_____ per pound	_____lbs
☐ Commercial Extractor (Non-Cooperative)(b)	$_____ per pound	_____lbs
☐ Farmers' Market(c)	$_____ per pound	_____lbs
☐ Own Stand/Retail Outlet(d)	$_____ per pound	_____lbs
☐ Wholesale(e)	$_____ per pound	_____lbs
☐ On-line(f)	$_____ per pound	_____lbs
☐ Local Food Co-op(g)	$_____ per pound	_____lbs
☐ Other(h) _____	$_____ per pound	_____lbs

5. What do you think consumers value most about your honey? (Check one or all that apply.)

☐ Color(1)
☐ Geographic Origin(2)
☐ Nectar Source(3)
☐ Your Reputation(4)
☐ Processing(5)
☐ Raw State(6)
☐ Other(0)_____

6. In the last five years, have you altered your marketing strategies to sell honey or honey products in local markets (e.g., farmers' markets, local retail stores, CSAs, etc.)?

☐ Yes(1) ☐ No(0)

7. There may be additional, untapped opportunities for honey producers to gain increased value for their honey. Please indicate which of the following possible programs you find appealing. Please rate them individually on a scale from 1 to 5 where 1 is not appealing and 5 is very appealing. Please circle the number that corresponds to your interest in each marketing idea.

Marketing Strategy	Not Appealing	Less Appealing	Neutral	Somewhat Appealing	Very Appealing
1. Guaranteeing ethical production practices(a)	1	2	3	4	5
2. Marketing under a regional or Rocky Mountain origin label(b)	1	2	3	4	5
3. Promoting pollinator habitat(c)	1	2	3	4	5
4. Specialty product marketing including mead, vinegars, salves and creams, etc.(d)	1	2	3	4	5

Section III. General Business Information

1. Are you the owner and operator of your beekeeping business?

☐ Yes(1) ☐ No(0)

2. What is the primary form of ownership for your beekeeping business?

☐ Sole proprietorship$_{(1)}$ ☐ Corporation$_{(4)}$
☐ Partnership$_{(2)}$ ☐ Joint Venture$_{(5)}$
☐ Limited Liability Corporation$_{(3)}$ ☐ Other$_{(0)}$ _____

3. How many years has your beekeeping business or enterprise been in operation? _____ years

4. In 2013, did you keep bees as part of a larger agricultural business?

☐ Yes$_{(1)}$ ☐ No$_{(0)}$

5. If the answer to question 4 is yes, select all of the agricultural enterprises that you keep bees as part of: (check all that apply)

☐ Grain$_{(1)}$ ☐ Livestock$_{(5)}$
☐ Dairy$_{(2)}$ ☐ Hay or Alfalfa$_{(6)}$
☐ Fruits$_{(3)}$ ☐ Aquaculture$_{(7)}$
☐ Vegetables$_{(4)}$ ☐ Other$_{(0)}$ _____

The following questions all pertain to the time period from **January 1, 2013 to December 31, 2013**.

6. Approximately how much did you spend on varroa mite and other disease and parasite prevention, antibiotics, and equipment sterilization in 2013? $_____

7. How much did you spend on live bees in 2013, including queen bee replacement? $_____

8. Approximately how much did you spend, total, on supplemental feeding for your bees in 2013? $_____
9. In 2013, approximately how much time did you spend managing hives or colonies for <u>pollination</u>?
_____ hours per week

10. In 2013, how many hours of labor did you **hire** to help care for the colonies providing <u>pollination services</u>?
_____ hours per week

11. If the answer to question 10 is greater than zero, what was the total wages paid to hired labor? $_____

12. Approximately how much did you spend on transportation costs to transport colonies to their pollination sites or nectar sources in 2013 (total, both in-state and out-of-state)? $_____

13. Compared to the last five years, which of the following options best describes your 2013 expenses?

☐ Extremely High$_{(1)}$ ☐ Lower than Average$_{(4)}$
☐ Higher than Average$_{(2)}$ ☐ Extremely Low$_{(5)}$
☐ Average$_{(3)}$

14. Did you invest in or repair hives in 2013? If so, how many hives were bought and repaired and what was the total cost?

Total Hives Repaired/Bought$_{(a)}$ _____ Total Cost$_{(b)}$ $ _____

15. Approximately how much did you spend on the following expenses in 2013 at both the whole farm level (your total enterprise if it includes activities besides beekeeping) and/or within the beekeeping enterprise? (If beekeeping is your only enterprise, please list expenses in that category only.)

Overhead Item	**Whole Farm**$_{(1)}$	**Beekeeping**$_{(2)}$
Accounting/Legal Fees$_{(a)}$	$_____	$_____
Advertising$_{(b)}$	$_____	$_____
Computer/Office Equipment$_{(c)}$	$_____	$_____
Education$_{(d)}$	$_____	$_____
Farm Shop$_{(e)}$	$_____	$_____
Vehicles$_{(f)}$	$_____	$_____
Property/Casualty Insurance$_{(g)}$	$_____	$_____
Packaging$_{(h)}$	$_____	$_____
Publications$_{(i)}$	$_____	$_____
Umbrella Insurance$_{(j)}$	$_____	$_____
Utilities/Phone$_{(k)}$	$_____	$_____

16. In 2013, what were your gross revenues on your entire agricultural operation (including beekeeping and other enterprises)?

- ☐ Less than \$0$_{(1)}$
- ☐ \$0 to \$500$_{(2)}$
- ☐ \$500 to \$1,000$_{(3)}$
- ☐ \$1,000 to \$4,999$_{(4)}$
- ☐ \$5,000 to \$9,999$_{(5)}$
- ☐ \$10,000 to \$19,999$_{(6)}$
- ☐ \$20,000 to \$39,999$_{(7)}$
- ☐ \$40,000 to \$59,999$_{(8)}$
- ☐ \$60,000 to \$99,999$_{(9)}$
- ☐ \$100,000 to \$249,999$_{(10)}$
- ☐ \$250,000 to \$499,999$_{(11)}$
- ☐ \$500,000 to \$999,999$_{(12)}$
- ☐ \$1,000,000 or more$_{(13)}$

17. Did you receive wages from off-farm employment in 2013?

☐ Yes$_{(1)}$ ☐ No$_{(0)}$

If you answered **YES** to question 18, please continue to the next two questions. If you answer **NO** to question 18, please continue to question 21.

18. Approximately how many hours do you work per week in your off-farm employment? _____ hours

19. Approximately what is your off-farm employment annual salary?

- ☐ \$0 to \$500$_{(1)}$
- ☐ \$500 to \$1,000$_{(2)}$
- ☐ \$1,000 to \$4,999$_{(3)}$
- ☐ \$5,000 to \$9,999$_{(4)}$
- ☐ \$10,000 to \$19,999$_{(5)}$
- ☐ \$20,000 to \$39,999$_{(6)}$
- ☐ \$40,000 to \$59,999$_{(7)}$
- ☐ \$60,000 to \$99,999$_{(8)}$
- ☐ \$100,000 to \$249,999$_{(9)}$
- ☐ \$250,000 to \$499,999$_{(10)}$
- ☐ \$500,000 to \$999,999$_{(11)}$
- ☐ \$1,000,000 or more$_{(12)}$

20. What is the highest degree of education you have completed?

- ☐ Less than high school$_{(1)}$
- ☐ High School Diploma$_{(2)}$
- ☐ Some college$_{(3)}$
- ☐ Bachelor's degree$_{(4)}$
- ☐ Graduate degree (e.g., M.Sc. or Ph.D.)$_{(5)}$
- ☐ Professional degree (e.g., medical or law degree)$_{(6)}$

21. What is your age? _____ years

22. Are you male or female?

☐ Female(1) ☐ Male(0)

23. Are you of Hispanic, Latino, or Spanish origin? (check all that apply)

☐ No, not of Hispanic, Latino, or Spanish origin(1)
☐ Yes, Mexican, Mexican America, Chicano(2)
☐ Yes, Puerto Rican(3)
☐ Yes, Cuban(4)
☐ Yes, another Hispanic, Latino, or Spanish origin(0)_____

24. Do you consider your race to be…(check all that apply)

☐ White(1)
☐ Black, African American, or Negro(2)
☐ American Indian or Alaska Native(3)
☐ Asian(4)
☐ Native Hawaiian or Pacific Islander(4)
☐ Other(0)_____

Additional Thoughts and Comments:

_____

_____

_____

Thank you for completing your survey. We greatly appreciate your cooperation and will guard the confidentiality of your responses.

Please place the survey in the self-addressed and stamped return envelope. As you do so, please fold it so that it is as flat as possible to ensure timely delivery. Mail in the survey and return post card separately.