Supplementary Material

Table S1: Survey instrument. All statement response options: Not at all, Slightly, Somewhat, Very, Extremely. For all other question types (not including open ended), response options are listed.

1. By clicking yes below, I consent to participate in the survey portion of the project: "Conserving the buzz: An interdisciplinary, multi-stakeholder approach to pollinator conservation in Canada", conducted by Rachel Nalepa, PhD. I have understood the nature of this project and wish to participate. I am not waiving any of my legal rights by consenting to participate in this survey.

Y/N

1. If you would like a Tim Horton's gift card emailed to you for participating in our survey, please provide your email address. This information will NOT be linked to your survey responses
2. How many years have you been farming?
3. How many years have you farmed apples?
4. How many varieties of apples do you grow?
5. Do you collect or sell honey from honeybees on your property? Y/N
6. How many acres do you farm? Rented \_\_\_ Owned\_\_\_\_
7. Which crop is economically your most important?
8. What percentage of your total land (rented or owned) would you call "natural" or "minimally managed"?
9. What percentage of land within a 1 km buffer of the edges of your land (include rented and owned land) would you call "natural" or "minimally managed"?
10. Please list the postal code(s) where you farm apples:
11. Please indicate whether you use the following management practices on your farm:

|  | This season | Past |
| --- | --- | --- |
| I rent honeybees seasonally | Y/N | Y/N |
| I purchase to own honeybee hives | Y/N |  Y/N |
| I purchase bumblebees seasonally |  Y/N |  Y/N |
| I have a resident beekeeper (beekeeper with hives on land for mutual exchange of services) | Y/N | Y/N |
| Other managed commercial bees | Y/N | Y/N |
| Other types of managed bees (please list):  |  |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1. What is the most recent cost per hive for your honeybees?  If you don't pay for honeybees, write N/A. If you use another type of managed bee, please include bee name and price per unit (i.e., bumblebees, $360 per quad)

|  | **Do you use this management practice?** |
| --- | --- |
| Leaving areas of my property intentionally undisturbed  |  Y/N |
| Delaying mowing until after bloom time |  Y/N |
| Keeping an herb or vegetable garden (or potted garden) | Y/N |
| Leaving dead wood/shrubs standing |  Y/N |
| Keeping hedgerows | Y/N |
| Planting flowering trees/shrubs (other than crops) |  Y/N |
| Leaving weeds to flower |  Y/N |
| Leaving old plant stems |  Y/N |
| Breaking up orchards or fields with different types of habitat | Y/N |
| Intercropping | Y/N |
| Keeping uncultivated field margins |  Y/N |
| Building bee boxes or nesting sites |  Y/N |
| IPM |  Y/N |
| Organic Farming  |  Y/N |
| Planting wildflowers | Y/N |

1. Please indicate whether you use the following management practices on your farm:
 |

1. If you plant wildflowers, are the wildflowers you plant native to your province? Y/N/DK/NA
2. I am interested in the wild native bees on my farm
3. I am motivated to look up, read about, or talk to others about wild native bees
4. I am aware of where wild native bees might be nesting on my property
5. I am aware of where wild native bees are foraging (getting food) on my farm
6. I am knowledgeable about wild native bees
7. How many types of wild native bees have you noticed on your property?

0-1, 2-3, 4-5, 6-7, 8-9+

1. Please list any types you have noticed and you know the names of:
2. Wild native bee populations are \_\_\_\_\_\_\_\_\_\_\_\_\_ at risk in my province
3. Wild native bee populations are currently being threatened by habitat loss
4. Wild native bee populations are currently threatened by climate change
5. Wild native bee populations are currently threatened by pesticides
6. Wild native bee populations are currently threatened by pests and diseases
7. Wild native bee populations are currently threatened by a loss of food resources
8. If you had to choose the single MOST important threat to wild native bees what would it be? (Can be from the threats listed above or one of your own)
9. If you had to choose the single LEAST important threat to wild native bees what would it be? (Can be from the threats listed above or one of your own)
10. I am concerned about wild native bee populations in my province
11. Any loss of wild native bees visiting my apples can be made up for with more honeybees?
12. Wild native bees make a significant contribution to my crop yield
13. I think that the presence of wild native bees means that my farm is healthy
14. I am motivated to make changes on my farm that might benefit wild native bees
15. I am concerned it would cost too much money to make changes on my farm that might benefit wild native bees
16. I am concerned it would take too much time to make changes on my farm that might benefit wild native bees
17. I’ve done all I can to provide good habitat on my farm for wild native bees
18. I think improving my farm for wild native bees would create other problems I would have to deal with
19. If you answered anything other than "not at all" to the last question, what problems do you think might arise if you improved your farm for wild native bees? \_\_\_\_\_\_\_\_\_\_
20. I am knowledgeable about what actions to take if I wanted to improve wild native bee habitat on my farm
21. I am able to impact wild native bee populations in the area through decisions I make on my farm
22. If wild native bee populations need help, it is partly my responsibility to make management decisions that help them
23. I am concerned about discovering an at-risk species on my property
24. I am concerned about the future cost of honeybees
25. I am concerned about future shortages of honeybees
26. I am concerned about finding beekeepers that will accept my pesticide practices
27. If I found out that wild native bees increased my fruit set by \_\_\_\_\_\_% in an average season, I would be likely to put more effort into improving my farm for wild native bee habitat

 - 0-10%, ~10-20%, ~20-30%, ~30-40%, ~40--50%, ~50-60%, ~60-70%, ~70-80%, ~80-90%, ~90%+,

 No amount of increased fruit set would increase my effort toward improving native bee habitat

1. If I wanted to improve the habitat on my farm for wild native bees, I am confident I would know where to go to get information that could help me
2. The number of honeybee hives I rent or purchase depends on the price of honeybees
3. For me, the rental price of honeybees per acre in the last 10 years has:

 Stayed the same, increased gradually, increased suddenly, other (please specify):

1. At what price per hive would you decrease the number of hives you rent or purchase?
2. My neighbours’ honeybees probably contribute to the pollination on my farm
3. List up to five people you communicate with regarding pollination management (can include job title and organization or relationship to you (for example: ‘my beekeeper’ or ‘my neighbour’):
4. Who/what is your most trusted source for information on pollination management in general? Can be person, organization, online resource, etc. If you include a person, you don't need a name but please include job title, organization or relationship to you:
5. Where would you go to if you wanted to know more about improving habitat for wild native pollinators on your farm?  (Can be people, organizations, web resources, etc). Please list up to 3:
6. Do you have anything else that you would like to share about your pollination practices or thoughts/opinions about bees?

Table S2: Variable descriptions

|  |  |
| --- | --- |
| Variable | Question |
| AWARENESS  |
| Interest | I am interested in the wild native bees on my farm  |
| Motivation | I am motivated to look up, read about, or talk to others about wild native bees  |
| Aware nesting | I am aware of where wild native bees might be nesting on my property  |
| Aware foraging | I am aware of where wild native bees are foraging (getting food) on my farm  |
| Knowledge | I am knowledgeable about wild native bees  |
| THREATS  |
| Overall threat | Wild native bees are \_\_\_\_\_\_\_\_\_\_\_\_\_ at risk in my province (fill in the blank with an answer choice below) |
| Habitat  | Wild native bee populations are currently threatened by habitat loss |
| Climate  | Wild native bee populations are threatened by climate change |
| Pesticide  | Wild native bee populations are threatened by pesticides |
| Pest & disease  | Wild native bee populations are threatened by illness caused by pests and diseases |
| Food  | Wild native bees are threatened by a loss of food resources |
| BENEFITS |
| Substitute | Any loss of wild native bees visiting my apples can be made up for with more honeybees |
| Yield | Wild native bees make a significant contribution to my crop yield |
| Healthy | I think that the presence of wild native bees means that my farm is healthy |
| COSTS |
| Financial costs | I am concerned it would cost too much money to make changes on my farm that might benefit wild native bees. |
| Time investment | I am concerned it would take too much time to make changes on my farm that might benefit wild native bees. |
| Operational Problems | I think improving my farm for wild native bees would create other problems I would have to deal with. |
| RISKS  |
| Honeybee cost | I am concerned about the future cost of honeybees |
| Honeybee shortage | I am concerned about future shortages of honeybees |
| Pesticide practices | I am concerned about finding beekeepers that will accept my pesticide practices |

Table S3: Awareness of wild bees

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Eigenvalue | Difference | Proportion | Cumulative | Variable | Factor 1 | Uniqueness | ScoringCoefficients |
| Factor 1 | 3.108 | 2.341 | 0.622 | 0.622 | Interest | 0.813 | 0.340 | 0.261 |
| Factor 2 | 0.767 | 0.208 | 0.153 | 0.775 | Motivation | 0.746 | 0.443 | 0.240 |
| Factor 3 | 0.559 | 0.224 | 0.112 | 0.889 | Aware nesting | 0.803 | 0.355 | 0.259 |
| Factor 4 | 0.336 | 0.105 | 0.067 | 0.954 | Aware foraging | 0.836 | 0.301 | 0.269 |
| Factor 5 | 0.231 |  | 0.046 | 1.000 | Knowledge | 0.739 | 0.454 | 0.238 |

 LR test: independent vs. saturated: χ2 = 155.60; p-value = 0.0000

Table S4: Threats to wild bees

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Eigenvalue | Difference | Proportion | Cumulative | Variable | Factor 1 | Uniqueness | ScoringCoefficients |
| Factor 1 | 3.852 | 3.145 | 0.642 | 0.642 | Overall threat | 0.808 | 0.347 | 0.210 |
| Factor 2 | 0.707 | 0.161 | 0.118 | 0.760 | Habitat threat | 0.915 | 0.163 | 0.238 |
| Factor 3 | 0.546 | 0.064 | 0.091 | 0.851 | Climate threat | 0.801 | 0.358 | 0.208 |
| Factor 4 | 0.483 | 0.162 | 0.080 | 0.931 | Pesticide threat | 0.744 | 0.447 | 0.193 |
| Factor 5 | 0.321 | 0.230 | 0.054 | 0.985 | Pest & disease threat | 0.693 | 0.520 | 0.180 |
| Factor 6 | 0.091 | ‘-- | 0.015 | 1.000 | Food threat | 0.829 | 0.313 | 0.215 |

 LR test: independent vs. saturated: χ2 = 259.42; p-value = 0.0000

Table S5: Benefits of wild bees

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Eigenvalue | Difference | Proportion | Cumulative | Variable | Factor 1 | Uniqueness | ScoringCoefficients |
| Factor 1 | 1.993 | 1.42 | 0.664 | 0.664 | Substitute | -0.789 | 0.378 | -0.396 |
| Factor 2 | 0.551 | 0.095 | 0.184 | 0.848 | Yield | 0.833 | 0.307 | 0.418 |
| Factor 3 | 0.456 | -- | 0.152 | 1.000 | Healthy | 0.456 | 0.323 | 0.413 |

LR test: independent vs. saturated: : χ2 = 46.42; p-value= 0.0000

Table S6: Costs of change

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Eigenvalue | Difference | Proportion  | Cumulative | Variable | Factor 1 | Uniqueness | Scoring Coefficients |
| Factor 1 | 1.871 | 0.884 | 0.624 | 0.624 | Financial costs | 0.962 | 0.075 | 0.514 |
| Factor 2 | 0.986 | 0.844 | 0.329 | 0.953 | Time investment | 0.956 | 0.086 | 0.511 |
| Factor 3 | 0.143 | -- | 0.048 | 1.000 | Operational Problems | 0.180 | 0.968 | 0.096 |

LR test: independent vs. saturated: : χ2 = 89.66; p-value= 0.0000

Table S7: Risks to honeybee supply

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Eigenvalue | Difference | Proportion  | Cumulative | Variable | Factor 1 | Uniqueness | Scoring Coefficients |
| Factor 1 | 2.235 | 1.794 | 0.745 | 0.745 | Honeybee cost | 0.886 | 0.215 | 0.396 |
| Factor 2 | 0.440 | 0.116 | 0.147 | 0.892 | Honeybee shortage | 0.864 | 0.254 | 0.386 |
| Factor 3 | 0.325 | -- | 0.108 | 1.000 | Pesticide practices | 0.839 | 0.296 | 0.375 |

LR test: independent vs. saturated: : χ2 = 72.04; p-value= 0.0000

Table S8: Summary statistics

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variable | Obs | Mean | Std. Dev. | Min | Max |
| Undisturbed | 73 | 0.753 | 0.434 | 0 | 1 |
| IPM | 74 | 0.986 | 0.116 | 0 | 1 |
| Delay mowing | 73 | 0.671 | 0.473 | 0 | 1 |
| Garden | 73 | 0.562 | 0.500 | 0 | 1 |
| Dead wood | 72 | 0.583 | 0.496 | 0 | 1 |
| Hedgerow | 68 | 0.691 | 0.465 | 0 | 1 |
| Flowering plants | 72 | 0.569 | 0.499 | 0 | 1 |
| Weeds | 73 | 0.589 | 0.495 | 0 | 1 |
| Old stems | 65 | 0.462 | 0.502 | 0 | 1 |
| Habitat | 67 | 0.269 | 0.447 | 0 | 1 |
| Intercropping | 71 | 0.211 | 0.411 | 0 | 1 |
| Margins | 72 | 0.667 | 0.475 | 0 | 1 |
| Beebox | 72 | 0.236 | 0.428 | 0 | 1 |
| Organic | 71 | 0.056 | 0.232 | 0 | 1 |
| Wildflowers | 75 | 0.307 | 0.464 | 0 | 1 |
| Count | 48 | 7.708 | 3.017 | 2 | 14 |
| Knowledge | 71 | 0.000 | 0.961 | -2.160 | 2.009 |
| Threats | 70 | 0.013 | 0.941 | -1.823 | 1.951 |
| Benefits | 69 | 0.000 | 0.969 | -2.763 | 1.854 |
| Costs | 69 | 0.000 | 0.963 | -1.452 | 1.852 |
| Risks | 65 | 0.000 | 0.957 | -1.807 | 2.315 |
| Log Farm size | 74 | 4.116 | 1.490 | 0 | 8.294 |
| Rented land | 61 | 0.174 | 0.294 | 0 | 1 |

Table S9: Logistic regression models. Clustered robust standard errors reported in parentheses below coefficient.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Undisturbed | Delaymowing | Garden | Dead wood | Hedgerow | FloweringPlants | Weeds | Old Stems | Wildflowers | Habitat | Intercropping | Margins | Beebox | Organic |
| Knowledge | 1.506\*\* | 0.459 | 1.149\*\*\* | 0.546\*\*\* | 0.977\*\*\* | 0.995\* | 0.793\* | 1.047\* | 0.564\*\*\* | 0.291 | 0.543 | 0.558 | 0.899 | 0.419 |
|  | (0.611) | (0.317) | (0.12) | (0.119) | (0.237) | (0.52) | (0.435) | (0.548) | (0.073) | (0.661) | (0.589) | (0.413) | (0.846) | (0.375) |
| Threats | -0.535 | 0.010 | -0.362\*\* | -0.179 | -0.346 | 0.503\* | 0.171 | -0.106\*\*\* | 0.635\* | 0.200 | -0.526 | 0.314 | -0.062 | -0.768\*\* |
|  | (0.33) | (0.243) | (0.149) | (0.176) | (0.468) | (0.29) | (0.381) | (0.04) | (0.337) | (0.435) | (0.371) | (0.209) | (0.56) | (0.308) |
| Benefits | 1.157\*\* | -0.263 | 0.916\*\*\* | 0.430 | 1.144\*\* | 0.508\*\* | 0.215 | 0.649 | 1.064\*\*\* | 1.071\*\*\* | 0.316 | -0.251 | -0.393\*\* | -0.168 |
|  | (0.541) | (0.261) | (0.208) | (0.342) | (0.525) | (0.224) | (0.513) | (0.529) | (0.367) | (0.262) | (0.298) | (0.284) | (0.175) | (1.085) |
| Costs | 0.570 | -0.275\*\* | 0.143 | 0.255 | 0.079 | -0.198 | -0.158 | 0.417\*\*\* | -0.951\*\*\* | -0.249 | -0.651 | -0.056 | -0.625\*\* | -0.049 |
|  | (0.378) | (0.13) | (0.232) | (0.209) | (0.419) | (0.42) | (0.201) | (0.083) | (0.164) | (0.368) | (0.617) | (0.233) | (0.302) | (0.402) |
| Risks | -1.122\*\* | 0.425\*\*\* | -0.352 | -0.017 | 0.365 | -0.219 | 0.329 | 0.571\*\*\* | -0.409 | 0.940\*\* | -0.027 | -0.152 | 0.411 | -0.692 |
|  | (0.515) | (0.07) | (0.323) | (0.333) | (0.232) | (0.258) | (0.248) | (0.203) | (0.498) | (0.366) | (0.28) | (0.52) | (0.478) | (0.764) |
| Log Farm Size | -0.032 | -0.014 | -0.781\*\*\* | 0.096 | 0.083 | -0.287 | 0.605\* | 0.138 | -0.340 | 0.058 | 0.073 | 0.025 | -0.272\*\* | -0.230 |
|  | (0.061) | (0.259) | (0.116) | (0.164) | (0.138) | (0.209) | (0.331) | (0.247) | (0.252) | (0.359) | (0.434) | (0.071) | (0.113) | (0.726) |
| Rented Land | 0.839 | 2.784 | -3.671\*\*\* | 0.743\*\*\* | -0.405 | -1.856\*\* | 0.652 | -0.583 | 0.041 | -1.808\* | -1.000 | 1.003 | 2.623\*\*\* | -2.292\* |
|  | (1.125) | (2.083) | (0.202) | (0.272) | (0.709) | (0.817) | (0.698) | (1.307) | (0.418) | (1.062) | (2.717) | (0.978) | (0.682) | (1.183) |
| Constant | 1.973\*\*\* | 0.226 | 4.393\*\*\* | -0.446 | 0.923 | 1.642 | -1.897 | -1.129 | 0.475 | -1.553 | -1.864 | 0.704 | -1.254\*\*\* | -1.386 |
|  | (0.54) | (1.434) | (0.601) | (0.939) | (0.744) | (1.019) | (1.586) | (1.37) | (1.106) | (2.026) | (2.791) | (0.496) | (0.342) | (3.446) |
| N | 51 | 50 | 50 | 51 | 47 | 49 | 51 | 48 | 52 | 47 | 50 | 50 | 51 | 50 |
| McFadden’s R2 | 0.324 | 0.148 | 0.281 | 0.094 | 0.275 | 0.225 | 0.239 | 0.228 | 0.305 | 0.264 | 0.121 | 0.077 | 0.295 | 0.137 |
| Count R2 | 0.804 | 0.760 | 0.760 | 0.627 | 0.787 | 0.653 | 0.784 | 0.750 | 0.827 | 0.809 | 0.760 | 0.740 | 0.824 | 0.920 |
| Adj Count r2 | 0.167 | 0.333 | 0.429 | 0.208 | 0.231 | 0.227 | 0.353 | 0.400 | 0.526 | 0.308 | -0.333 | 0.071 | 0.182 | 0.000 |
| Log-likelihood | -18.813 | -27.846 | -24.448 | -31.946 | -20.098 | -26.126 | -24.698 | -25.154 | -23.729 | -20.399 | -20.729 | -27.735 | -18.745 | -12.022 |

\*\*\* p <0.01; \*\* p<0.05; \* p<0.10

Table S10: Poisson regression results. Clustered robust standard errors reported in parentheses below coefficient.

|  |  |
| --- | --- |
| Variable | Estimates |
| Knowledge | 0.207\*\*\* |
|  | (0.060) |
| Threats | 0.047\* |
|  | (0.025) |
| Benefits | 0.091\*\*\* |
|  | (0.028) |
| Costs | -0.031 |
|  | (0.061) |
| Risks | 0.003 |
|  | (0.079) |
| Farm Size | -0.020 |
|  | (0.060) |
| Rented Land | -0.100 |
|  | (0.527) |
| Constant | 2.095\*\*\* |
|  | (0.342) |
| N | 36 |
| Log-likelihood | -81.776 |
| McFadden’s R2 | 0.095 |
| Cox-Snell R2 | 0.380 |

\*\*\* p <0.01; \*\* p<0.05; \* p<0.10