Data Article

A survey dataset to better understand the honey bee industry, use and value of natural resources and challenges for beekeepers in Western Australia: A beekeepers’ perspective

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Dataset link: A survey dataset to better understand the honey bee industry, use and value of natural resources and challenges for beekeepers in Western Australia: A beekeepers’ perspective (Original data)

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ABSTRACT

The summary data presented in this paper describes beekeeping practices, use of natural resources and economic attributes associated with honey bee products, native flora and environmental challenges relating to apiary sites. Despite being a well-established industry, information and data about productivity and the behavior of beekeepers, particularly those who migrate across the state of Western Australia, is lacking. We developed an online quantitative survey, the Natural Resources for Beekeepers Questionnaire (Western Australia) 2020-21, the first comprehensive, spatially referenced survey of beekeepers in Western Australia since 1990. It is also the first survey of small-scale amateur beekeepers that estimates their supply to the local honey market. For commercial beekeepers, a focus of the survey was to estimate the value of apiary sites and the productivity of migratory beekeepers. The data gives measures related to the production system and profitability of the Western Australian beekeeping industry, focusing on the 2019-2020 season and historical production. It includes tables describing memberships and certification; years beekeeping; hive types; apiary site availability, productivity, use, exchange and value; logistics; pollination services; honey bee products, sales and distribution; yields by season and site; targeted flora and

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Specifications

| Subject | Type | How of data were acquired |
|---------|------|----------------------------|
| Subject | Type  | How the data were acquired |
| Specific subject area | Agricultural Sciences - Agricultural Economics | Honey bee (Apis mellifera) beekeeping and apiary sites, Valuing natural resources, Sustainable industry and Ecosystem services, Natural resource management decisions, Honey bee products |
| Type of data | Tables and Figures | Online survey questionnaire "Natural Resources for Beekeepers Questionnaire (Western Australia) 2020-21" developed using Qualtrics software. |
| How the data were acquired | Survey questionnaire available at 10.26182/j335-5867 |

The target population for the survey included all current and retired beekeepers in Western Australia in December 2020 through to June 2021. In addition, non-beekeepers who held a licence for registered apiary sites on land managed by the state government’s Department of Biodiversity, Conservation and Attractions (DBCA) were also included. This target population could be stratified into industry sub-groups such as Backyard beekeepers; Hobbyist-Amateur (part-time) beekeepers; Commercial (full-time) beekeepers; Retired commercial beekeepers; and Non-beekeepers with registered apiary sites.

Privacy and confidentiality restrictions meant it was not possible to draw a random stratified sample from the target population directly. Therefore, those who completed the questionnaire were self-selected, however this still provided a sample from a cross section of the whole population which reflected the relative frequency of each strata. Every effort was made to invite all potential participants to complete the survey voluntarily and no payment or incentive was offered. DBCA shared the email addresses of all beekeepers who held a licence for a registered apiary site, and we sent an email inviting them to participate in the survey online.

In Western Australia, registration with the Department of Primary Industries and Regional Development (DPIRD) is mandatory. DPIRD sent an email to all registered beekeepers inviting them to participate with a link to the online survey and a reminder follow up email. For privacy reasons these email addresses could not be shared with us. To increase the response rate, promotion of the survey and link were also delivered through industry networks, such as the Beekeeping Industry Council of Western Australia and the Western Australian Apsiarist Society, targeting both commercial and hobbyist beekeepers. Communication via newsletters, websites and Facebook were also used, as well as reminder emails.

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The questionnaire was developed to meet our research project purpose, to value bush apiary sites in the south west of Western Australia and provide spatially referenced economic and biophysical data. The online survey questionnaire design is a novel approach to gathering data from a diverse industry. Respondents’ answered questions tailored to their scale of production and use of natural resources with the pathway through the questionnaire dependent on previous responses. This avoided the presentation of irrelevant questions and allowed a single questionnaire to be used for small-scale backyard beekeepers and large scale migratory commercial beekeepers.

**Data format**
Raw – for peer review process only (Confidential Restricted)
Cleaned and Analyzed

**Description of data collection**
Data was collected between December 2020 and June 2021 through an online survey developed in Qualtrics. Potential participants from our target population were invited to complete the online survey anonymously using their personal electronic devices such as mobile phone, iPad or personal computer by following the survey link. Respondents could suspend the questionnaire and return to the link using the same computer and web browser when convenient.

Response data underwent a thorough data cleaning and validation process using Stata/SE 16.1 [6] to exclude irrelevant data and duplicates, fix errors and missing data, identify outliers and verify data accuracy. The data was stratified according to beekeeper classifications. If a respondent failed to provide the number of sites and number of hives, or the amount of honey harvested for the study season 2019-20 they were categorized as invalid and removed from the data.

**Data source location**
City/Town/Region: Western Australia
Country: Australia

**Data accessibility**
Repository name: Pure, The University of Western Australia Research Repository
Data identification number: 10.26182/j335-5867
Direct URL to data: https://research-repository.uwa.edu.au/en/datasets/a-survey-dataset-to-better-understand-the-honey-bee-industry-use-

Raw data for peer-review process only – Confidential Restricted

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**Value of the Data**

- Valuing natural resources for beekeepers and identifying the impact of management decisions on bee health.
- This data set provides useful information about operating as a beekeeper at various levels of commercial and non-commercial operation, use and value of natural resources at an apiary site and challenges facing the industry with the loss of nectar and pollen sources.
- This data set fills a gap in knowledge about the production of honey bee products and pollination services, particularly for non-commercial and migratory beekeepers.
- The data set may be used by other researchers, government agencies, industry bodies and individuals as a data source, further analysis and/or evidence for policy and decision-making. The accompanying questionnaire may be used by others who aim to repeat it to compare over years or reproduce partially or wholly in other jurisdictions.
- The authors’ work provides extensive detail for a cross section of beekeepers, including capturing the migratory behaviour to source nectar and pollen, and the potential for industry benchmarking, hindsight assessments and strategic planning for the future.

1. **Data Description**

The dataset file contains sixty-six tables of analyzed and aggregated survey data (Dataset link) [1]. Here tables are presented in a non-identifiable format to ensure anonymity. Each table refers to a survey question or combination of survey questions as described. A summary
of descriptive statistics, sample size and reference to survey question number(s) are provided in tabulated format in Excel. There are eighteen Excel worksheets within the workbook, which comprise of tables relating to similar topics (Table 1).

The results given below in this paper are a selection of tables to provide a snapshot of the beekeeping industry of Western Australia, and a sample of the full dataset.

Due to human research ethics requirements and agreement with the Beekeeping Industry Council of Western Australia and conditions in the respondents’ consent, responses must be non-identifiable and aggregated, therefore raw survey data cannot be made publicly available.

Survey questions and answer options as seen by respondent can be viewed in the survey questionnaire (Survey link).

1.1. Sample Description (Table 2 and Fig. 1)

There were approximately 4000 beekeepers registered in Western Australia at the time the survey was opened. Including invalid responses there was an 18% response rate, however when invalid responses were excluded the response rate was about 14% of the population.

Beekeepers were reclassified into a beekeeper category based on number of hives, number and type of sites and honey harvested, as described below.

Table 2
Survey sample size, by beekeeper category and whether questionnaire was completed or not.

| Questionnaire status | Backyard | Hobbyist-Amateur | Commercial | Invalid | Total |
|----------------------|----------|------------------|------------|---------|-------|
| Incomplete           | 23       | 84               | 29         | 100     | 236   |
| Completed            | 162      | 244              | 25         | 51      | 482   |
| Total                | 185      | 328              | 54         | 151     | 718   |
• Backyard beekeeper – anyone only using backyard sites; and has 2 or less hives; and 5 or less sites; and not missing harvested honey 2019-20 season amount.
• Hobbyist-Amateur beekeeper – anyone who does not meet Backyard beekeeper criteria; and has 39 or less hives; and any number of sites; and not missing harvested honey 2019-20 season amount.
• Commercial beekeeper – anyone who does not meet Backyard beekeeper or Hobbyist-Amateur beekeeper criteria; and has 40 or more hives; and any number of sites and not missing harvested honey 2019-20 season amount.

Any respondents with missing values for the number of sites; and number of hives; or honey harvested for 2019-20 season were categorized as invalid entries.

1.2. Key production parameters of the Western Australian apiculture industry (Table 3)

Production values, sales and distribution, and sites used relate to beekeeping season 1 July 2019–30 June 2020, inclusive of incomplete responses.

Table 3
Key production parameter summary, by beekeeper category [Various questions, repeated in detail in other tables in dataset file].

| Backyard beekeepers | Obs | Mean | Std Dev. | 25th PC | 50th PC | 75th PC |
|---------------------|-----|------|----------|---------|---------|---------|
| Number of hives     | 185 | 1    | 0.5      | 1       | 1       | 2       |
| Honey per hive (kg/hive)² | 143 | 24   | 22.1     | 10      | 20      | 30      |
| Honey from pollination services (kg) | 0 | | | | | |
| Honey harvested, including pollination (kg)³ | 143 | 32   | 29.3     | 10      | 25      | 40      |
| No honey harvested, including pollination (kg)³ | 42 | | | | | |
| Honey sold/distributed (kg) | 117 | 32   | 28.6     | 12      | 24      | 40      |
| Pollen sold/distributed (kg) | 2 | 11   | 13.4     | 1       | 11      | 20      |
| Wax sold/distributed (kg) | 7 | 2    | 1.5      | 1       | 2       | 3       |
| Propolis sold/distributed (kg) | 0 | | | | | |
| Royal jelly sold/distributed (kg) | 0 | | | | | |
| Queens sold/distributed (no.) | 0 | | | | | |
| Nucleus hives sold/distributed (no.) | 3 | 2    | 1.7      | 1       | 1       | 4       |
| Packaged bees sold/distributed (no.) | 0 | | | | | |
| More than one site used (no.) | 9 | 1    | 0.4      | 1       | 1       | 1       |
| Operating costs - not required | 0 | | | | | |
| Number of hives by 2025 | 155 | 3    | 3.8      | 1       | 2       | 2       |

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Table 3 (continued)

| Response | Obs | Mean | Std Dev. | 25th PC | 50th PC | 75th PC |
|----------|-----|------|----------|---------|---------|---------|
| Number of hives | 328 | 8 | 7.8 | 3 | 5 | 11 |
| Honey per hive (kg/hive) | 267 | 19 | 23.8 | 6 | 13 | 25 |
| Honey from pollination services (kg) | 0 | 0 | 0 | 0 | 0 | 0 |
| Honey harvested, including pollination (kg) | 272 | 146 | 229.7 | 20 | 60 | 175 |
| No honey harvested, including pollination (kg) | 20 | 20 | 20 | 20 | 20 | 20 |
| Honey sold/distributed (kg) | 240 | 148 | 240.1 | 20 | 58 | 183 |
| Pollen sold/distributed (kg) | n/a | n/a | n/a | n/a | n/a | n/a |
| Wax sold/distributed (kg) | 48 | 12 | 18.0 | 3 | 5 | 15 |
| Royal jelly sold/distributed (kg) | n/a | n/a | n/a | n/a | n/a | n/a |
| Queens sold/distributed (no.) | 3 | 17 | 11.0 | 10 | 12 | 30 |
| Nucleus hives sold/distributed (no.) | 21 | 7 | 9.0 | 2 | 4 | 10 |
| Package bees sold/distributed (no.) | 0 | 0 | 0 | 0 | 0 | 0 |
| Sites used (no.) | 240 | 2 | 2.1 | 1 | 2 | 3 |
| Operating costs per hive ($/yr) | 37 | 190 | 179.0 | 75 | 142 | 229 |
| Number of hives by 2025 | 230 | 15 | 37.3 | 3 | 5 | 12 |

Commercial beekeepers

| Response | Obs | Mean | Std Dev. | 25th PC | 50th PC | 75th PC |
|----------|-----|------|----------|---------|---------|---------|
| Number of hives | 54 | 275 | 320.5 | 68 | 139 | 336 |
| Honey per hive (kg/hive) | 33 | 46 | 40.5 | 19 | 38 | 56 |
| Honey from pollination services (kg) | 5 | 880 | 938.5 | 150 | 350 | 1,800 |
| Honey harvested, including pollination (kg) | 37 | 16,156 | 36,587.9 | 1,530 | 3,400 | 13,800 |
| Honey sold/distributed (kg) | 30 | 9,557 | 12,981.3 | 1,300 | 3,150 | 15,000 |
| Pollen sold/distributed (kg) | 7 | 2,994 | 3,862.5 | 57 | 500 | 5,194 |
| Wax sold/distributed (kg) | 18 | 785 | 1,400.4 | 30 | 86 | 600 |
| Propolis sold/distributed (kg) | 7 | 51 | 68.3 | 2 | 51 | 100 |
| Royal jelly sold/distributed (kg) | n/a | n/a | n/a | n/a | n/a | n/a |
| Queens sold/distributed (no.) | 5 | 183 | 149.8 | 100 | 200 | 200 |
| Nucleus hives sold/distributed (no.) | 10 | 28 | 31.8 | 10 | 11 | 50 |
| Package bees sold/distributed (no.) | n/a | n/a | n/a | n/a | n/a | n/a |
| Sites used (no.) | 42 | 12 | 13.4 | 5 | 9 | 13 |
| Operating costs per hive ($/yr) | 27 | 403 | 426.0 | 60 | 250 | 674 |
| Number of hives by 2025 | 22 | 488 | 566.3 | 90 | 335 | 500 |

Notes
25th PC i.e. 25th percentile, 25% of values are below this value.
50th PC i.e. 50th percentile, 50% of values are below this value.
75th PC i.e. 75th percentile, 75% of values are below this value.

1.3. Apiary Site Types, Regional Location and Usage Purpose (Table 4 and Figs. 2 and 3)

There are different types of apiary sites used by beekeepers. We have described apiary sites as follows.

- Backyard site – in an urban environment – sites in a populated area with parks and garden flora the primary food source.
- Registered site from DBCA – sites in National and conservation parks, state forests, nature and timber reserves, pastoral leases, mining tenements and unallocated crown land where the government Department of Biodiversity, Conservation and Attractions manage apiary permits and licences.
- Private site – any privately owned rural land used for honey production or bee health, not specifically for pollination.
- Other – roadsides, council/shire land etc.
- Pollination sites – sites in agricultural fields for the purpose of pollination services, where honey bees interact with food and fibre plants at the onset of crop flowering to produce
Fig. 2. Purpose of using sites in each region of the south west, by beekeeper category. Blue: Hobbyist-Amateur beekeepers, Orange: Commercial beekeepers [Q126].
Table 4
Type and number of apiary sites available for use by the beekeeper in the beekeeping season 1 July 2019–30 June 2020, by beekeeper category [Q44].

| Site type | Observations | Mean | Std Dev. | 25th PC | 50th PC | 75th PC |
|-----------|--------------|------|----------|---------|---------|---------|
| **Backyard beekeepers** | | | | | | |
| Backyard in an urban environment | 185 | 1 | 0 | 1 | 1 | 1 |
| Registered (DBCA) - own | 0 | | | | | |
| Registered (DBCA) - other people's | 0 | | | | | |
| Private | 0 | | | | | |
| Other | 0 | | | | | |
| Pollination | 0 | | | | | |
| **Response total** | **185** | | | | | |
| **Hobbyist-Amateur beekeepers** | | | | | | |
| Backyard in an urban environment | 169 | 2 | 2 | 1 | 1 | 3 |
| Registered (DBCA) - own | 7 | 1 | 0 | 1 | 1 | 1 |
| Registered (DBCA) - other people's | 2 | 13 | 10 | 6 | 13 | 20 |
| Private | 209 | 3 | 5 | 1 | 1 | 3 |
| Other | 3 | 2 | 1 | 1 | 1 | 3 |
| Pollination | 6 | 2 | 1 | 1 | 1 | 3 |
| **Response total** | **328** | | | | | |
| **Commercial beekeepers** | | | | | | |
| Backyard in an urban environment | 11 | 4 | 3 | 1 | 4 | 8 |
| Registered (DBCA) - own | 25 | 80 | 123 | 11 | 56 | 100 |
| Registered (DBCA) - other people's | 17 | 78 | 179 | 5 | 7 | 26 |
| Private | 53 | 29 | 51 | 5 | 10 | 32 |
| Other | 3 | 14 | 20 | 2 | 3 | 37 |
| Pollination | 18 | 12 | 39 | 1 | 3 | 5 |
| **Response total** | **54** | | | | | |

Notes
25th PC i.e. 25th percentile, 25% of values are below this value.
50th PC i.e. 50th percentile, 50% of values are below this value.
75th PC i.e. 75th percentile, 75% of values are below this value.
Response total is the number of respondents who answered this question.

Fig. 3. Reasons why not all sites used in a year, by beekeeper category (a) Hobbyist-Amateur, (b) Commercial [Q76].

seed, nut, fruit and vegetables, and not for the specific purpose of honey production or bee health.
1.4. Honey Production and Yields by Region (Tables 5–7)

Table 5
Honey harvested in season July 2019-June 2020, by beekeeper category and by site region [Q93, Q94, Q95].

| Backyard beekeepers\(^{a,b}\) | Pollination crop honey incl. |
|-------------------------------|-----------------------------|
| **Observations** | **Honey harvested (kg/yr)** | **Mean** | **Std Dev.** | **25th PC** | **50th PC** | **75th PC** | **Responses** |
|---------------------|---------------------------|---------|--------------|------------|------------|------------|--------------|
| Geraldton Sandplains | 0 | 0 | | | | | |
| Swan Coastal Plain | 5 | 58 | 50.6 | 40 | 45 | 60 | 0 |
| Jarrah Forest | 1 | 20 | 20 | 20 | 20 | 0 | 0 |
| Warren | 0 | 0 | | | | | |
| Avon Wheatbelt-Yalgoo | 0 | 0 | | | | | |
| Mallee | 0 | 0 | | | | | |
| Esperance | 0 | 0 | | | | | |
| Murchison-Coolgardie | 0 | 0 | | | | | |
| Northwest-Nullarbor-Deserts | 0 | 0 | | | | | |
| **Response total** | **6** | **0** | | | | | |

| Hobbyist-Amateur\(^{c}\) | Pollination crop honey incl. |
|-------------------------------|-----------------------------|
| **Observations** | **Honey harvested (kg/yr)** | **Mean** | **Std Dev.** | **25th PC** | **50th PC** | **75th PC** | **Responses** |
|---------------------|---------------------------|---------|--------------|------------|------------|------------|--------------|
| Geraldton Sandplains | 9 | 331 | 374.6 | 14 | 250 | 700 | 0 |
| Swan Coastal Plain | 95 | 165 | 248.1 | 26 | 100 | 200 | 1 |
| Jarrah Forest | 74 | 138 | 246.0 | 20 | 40 | 150 | 1 |
| Warren | 31 | 106 | 116.9 | 35 | 80 | 160 | 0 |
| Avon Wheatbelt-Yalgoo | 9 | 51 | 66.6 | 10 | 20 | 50 | 0 |
| Mallee | 1 | 200 | 200 | 200 | 200 | 0 | 0 |
| Esperance | 5 | 50 | 37.8 | 11 | 60 | 80 | 0 |
| Murchison-Coolgardie | 0 | 0 | | | | | |
| Northwest-Nullarbor-Deserts | 1 | 60 | 60 | 60 | 60 | 0 | 0 |
| **Response total** | **209** | **4** | | | | | |

| Commercial\(^{d}\) | Pollination crop honey incl. |
|-------------------------------|-----------------------------|
| **Observations** | **Honey harvested (kg/yr)** | **Mean** | **Std Dev.** | **25th PC** | **50th PC** | **75th PC** | **Responses** |
|---------------------|---------------------------|---------|--------------|------------|------------|------------|--------------|
| Geraldton Sandplains | 8 | 9,389 | 20,677.5 | 215 | 425 | 6,900 | 0 |
| Swan Coastal Plain | 16 | 7,790 | 16,162.4 | 200 | 2,000 | 3,000 | 0 |
| Jarrah Forest | 19 | 9,785 | 29,374.2 | 250 | 2,000 | 7,000 | 0 |
| Warren | 4 | 975 | 1,231.2 | 300 | 500 | 1,650 | 0 |
| Avon Wheatbelt-Yalgoo | 5 | 4,401 | 7,129.8 | 700 | 1,300 | 3,000 | 0 |
| Mallee | 2 | 3,050 | 3,606.2 | 500 | 3,050 | 5,600 | 0 |
| Esperance | 5 | 11,080 | 9,478.0 | 2,000 | 13,000 | 20,000 | 0 |
| Murchison-Coolgardie | 4 | 5,205 | 9,864.7 | 160 | 350 | 10,250 | 0 |
| Northwest-Nullarbor-Deserts | 0 | 0 | | | | | |
| **Response total** | **31** | **1** | | | | | |

Notes
25th PC i.e. 25th percentile, 25% of values are below this value.
50th PC i.e. 50th percentile, 50% of values are below this value.
75th PC i.e. 75th percentile, 75% of values are below this value.
\(^{a}\) Excludes honey harvested values < 1
\(^{b}\) Backyard beekeepers with more than 1 backyard site.
\(^{c}\) Excludes honey harvested values < 1
\(^{d}\) Response total is the number of respondents who answered the question.
Table 6
Estimated honey yield per hive, based on honey harvested in season 2019-2020 and number of hives used in each region, by beekeeper category, and by region.

| Region                      | Observations | Mean  | Std Dev. | 25th PC | 50th PC | 75th PC |
|-----------------------------|--------------|-------|----------|---------|---------|---------|
| **Hobbyist-Amateur<sup>a</sup>** |              |       |          |         |         |         |
| Geraldton Sandplains        | 6            | 28    | 19.9     | 9       | 30      | 42      |
| Swan Coastal Plain          | 59           | 22    | 24.9     | 6       | 14      | 28      |
| Jarrah Forest               | 70           | 18    | 12.9     | 8       | 13      | 24      |
| Warren                      | 26           | 18    | 11.3     | 8       | 19      | 25      |
| Avon Wheatbelt-Yalgoo       | 8            | 17    | 11.3     | 10      | 13      | 27      |
| Mallee                      | 0            |       |          |         |         |         |
| Esperance                   | 5            | 21    | 15.8     | 10      | 11      | 30      |
| Murchison-Coolgardie        | 0            |       |          |         |         |         |
| Northwest-Nullarbor-Deserts | 1            | 33    | 33       | 33      | 33      | 33      |
| **Response total**          |              |       |          | 163     |         |         |
| **Commercial<sup>b</sup>**  |              |       |          |         |         |         |
| Geraldton Sandplains        | 7            | 20    | 17.9     | 6       | 15      | 30      |
| Swan Coastal Plain          | 15           | 41    | 54.4     | 13      | 27      | 42      |
| Jarrah Forest               | 18           | 37    | 32.5     | 13      | 30      | 47      |
| Warren                      | 4            | 8     | 4.7      | 4       | 8       | 12      |
| Avon Wheatbelt-Yalgoo       | 4            | 33    | 27.5     | 9       | 32      | 57      |
| Mallee                      | 2            | 15    | 9.7      | 8       | 15      | 22      |
| Esperance                   | 5            | 39    | 23.0     | 31      | 40      | 50      |
| Murchison-Coolgardie        | 3            | 13    | 15.2     | 2       | 7       | 31      |
| Northwest-Nullarbor-Deserts | 0            |       |          |         |         |         |
| **Response total**          |              |       |          | 29      |         |         |

Notes
25th PC i.e. 25th percentile, 25% of values are below this value.
50th PC i.e. 50th percentile, 50% of values are below this value.
75th PC i.e. 75th percentile, 75% of values are below this value.
<sup>a</sup> Excludes honey harvested values < 1
<sup>b</sup> Excludes honey harvested values <= 1
<sup>c</sup> Excludes estimated yields <1
Response total is the number of respondents who answered the question.

Table 7
Estimated honey yield per site, based on honey harvested in season 2019-2020 and number of sites used in each region, by beekeeper category, and by region.

| Region                      | Observations | Mean  | Std Dev. | 25th PC | 50th PC | 75th PC |
|-----------------------------|--------------|-------|----------|---------|---------|---------|
| **Hobbyist-Amateur<sup>c</sup>** |              |       |          |         |         |         |
| Geraldton Sandplains        | 6            | 173   | 157.0    | 14      | 167     | 333     |
| Swan Coastal Plain          | 60           | 66    | 79.5     | 16      | 33      | 100     |
| Jarrah Forest               | 70           | 87    | 150.4    | 20      | 34      | 120     |
| Warren                      | 28           | 69    | 114.3    | 20      | 37      | 66      |
| Avon Wheatbelt-Yalgoo       | 9            | 31    | 32.6     | 10      | 20      | 50      |
| Mallee                      | 0            |       |          |         |         |         |
| Esperance                   | 5            | 37    | 36.5     | 11      | 20      | 60      |
| Murchison-Coolgardie        | 0            |       |          |         |         |         |
| Northwest-Nullarbor-Deserts | 1            | 350   | 350      | 350     | 350     | 350     |
| **Response total**          |              |       |          | 167     |         |         |

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Table 7 (continued)

| Commerciala | Estimated site honey yield (kg/site)c | Observations | Mean  | Std Dev. | 25th PC | 50th PC | 75th PC |
|-------------|---------------------------------------|--------------|-------|----------|---------|---------|---------|
| Commercial  |                                       |              |       |          |         |         |         |
| b Geraldton Sandplains |                                   | 8            | 1,247 | 1,630.4  | 88      | 265     | 2,633   |
| b Swan Coastal Plain   |                                    | 16           | 931   | 1,081.0  | 91      | 447     | 1,750   |
| b Jarrah Forest        |                                    | 19           | 1,334 | 1,511.8  | 125     | 305     | 2,667   |
| b Warren               |                                    | 4            | 333   | 322.7    | 66      | 313     | 600     |
| b Avon Wheatbelt-Yalgoo|                                    | 4            | 1,600 | 1,224.7  | 850     | 1,150   | 2,350   |
| b Mallee               |                                    | 2            | 1,525 | 1,803.1  | 250     | 1,525   | 2,800   |
| b Esperance            |                                    | 5            | 2,784 | 4,096.8  | 400     | 1,300   | 2,800   |
| b Murchison-Coolgardie |                                    | 4            | 934   | 1,600.2  | 102     | 160     | 1,767   |
| b Northwest-Nullarbor-Deserts |                  | 0            |       |          |         |         |         |
| Response total         |                                    | 31           |       |          |         |         |         |

Notes
25th PC i.e. 25th percentile, 25% of values are below this value.
50th PC i.e. 50th percentile, 50% of values are below this value.
75th PC i.e. 75th percentile, 75% of values are below this value.

a Excludes honey harvested values < 1.
b Excludes honey harvested values < = 1.
c Excludes estimated yields <1

Estimated honey yield per site is based on honey harvested and number of sites used in each region [Q75].
Response total is the number of respondents who answered the question.

1.5. Natural Resources Utilized Including, Bee Flora Targeted, and Commercial Significance

Refer to dataset Table 16.2 Flora species or type of honey targeted by beekeeper and bees for each region, by specific flora species or simplified vegetation zones, by beekeeper category. [Q128, Q129] Dataset link.

The species/flora honey type ranking according to the commercial significance to the beekeeping operation is given as:

High: critical to have access to sites with this species to be commercially viable.
Medium: significant risk to commercial viability without access to sites with this species.
Low: without access to sites with this species commercial viability can continue with some impact.

1.6. Natural Resource Management Impact, Production After Fire and Logging (Tables 8–11)

Table 8
Ever had site and surrounding 3 km impacted by fire, by beekeeper category, by region [Q83].

| Response                  | Fire impacted site | Response total |
|---------------------------|--------------------|---------------|
|                           | Yes    | Unsure | No    |         |
| Hobbyist-Amateur          |        |        |       | 194     |
| Geraldton Sandplains      | 2      | 0      | 7     |         |
| Swan Coastal Plain        | 14     | 3      | 56    |         |
| Jarrah Forest             | 30     | 3      | 55    |         |
| Warren                    | 7      | 2      | 26    |         |
| Avon Wheatbelt-Yalgoo     | 4      | 1      | 8     |         |
| Mallee                    | 0      | 0      | 0     |         |

(continued on next page)
### Table 8 (continued)

| Response                       | Fire impacted site |  |  |  |  |
|---------------------------------|--------------------|---|---|---|---|
|                                 | Yes | Unsure | No | Response total |
| Esperance                       | 2   | 1      | 3  |                |
| Murchison-Coolgardie            | 0   | 0      | 0  |                |
| Northwest-Nullarbor-Deserts     | 0   | 0      | 1  |                |
| **Commercial**                  | 40  |        |    |                |
| Geraldton Sandplains            | 10  | 1      | 3  |                |
| Swan Coastal Plain              | 16  | 0      | 13 |                |
| Jarrah Forest                   | 20  | 0      | 10 |                |
| Warren                          | 8   | 2      | 6  |                |
| Avon Wheatbelt-Yalgoo           | 6   | 2      | 5  |                |
| Mallee                          | 7   | 2      | 2  |                |
| Esperance                       | 6   | 2      | 8  |                |
| Murchison-Coolgardie            | 8   | 2      | 3  |                |
| Northwest-Nullarbor-Deserts     | 0   | 0      | 0  |                |

### Table 9

Regional recovery after site and surrounding burnt, expected number of years until use site again, and for a 50 and 100% return to production, by beekeeper category [Q87].

| Impact of fire  |
|-----------------|
| **Hobbyist-Amateur** |
| **Geraldton Sandplains** |
| Use site again (yrs) | 1 | 10 | 10 | 10 | 10 |
| Return to 50% production (yrs) | 1 | 6 | 6 | 6 | 6 |
| Return to 100% production (yrs) | 1 | 10 | 10 | 10 | 10 |
| **Swan Coastal Plain** |
| Use site again (yrs) | 10 | 6 | 3.9 | 2 | 6 | 10 |
| Return to 50% production (yrs) | 9 | 4 | 3.4 | 1 | 3 | 5 |
| Return to 100% production (yrs) | 8 | 11 | 9.1 | 3 | 9 | 20 |
| **Jarrah Forest** |
| Use site again (yrs) | 17 | 2 | 1.5 | 1 | 2 | 3 |
| Return to 50% production (yrs) | 20 | 3 | 5.5 | 1 | 2 | 3 |
| Return to 100% production (yrs) | 20 | 6 | 8.4 | 2 | 3 | 5 |
| **Warren** |
| Use site again (yrs) | 4 | 3 | 1.6 | 2 | 3 | 4 |
| Return to 50% production (yrs) | 4 | 1 | 0.5 | 1 | 1 | 2 |
| Return to 100% production (yrs) | 3 | 3 | 2.1 | 1 | 2 | 5 |
| **Avon Wheatbelt-Yalgoo** |
| Use site again (yrs) | 1 | 2 | 2 | 2 | 2 |
| Return to 50% production (yrs) | 1 | 1 | 1 | 1 | 1 |
| Return to 100% production (yrs) | 1 | 7 | 7 | 7 | 7 |
| **Mallee** |
| Use site again (yrs) | 0 | 0 | 0 | 0 | 0 |
| Return to 50% production (yrs) | 0 | 0 | 0 | 0 | 0 |
| Return to 100% production (yrs) | 0 | 0 | 0 | 0 | 0 |
| **Esperance** |
| Use site again (yrs) | 2 | 3 | 2.8 | 1 | 3 | 5 |
| Return to 50% production (yrs) | 2 | 3 | 2.8 | 1 | 3 | 5 |
| Return to 100% production (yrs) | 2 | 5 | 3.5 | 2 | 5 | 7 |
| **Murchison-Coolgardie** |
| Use site again (yrs) | 0 | 0 | 0 | 0 | 0 |
| Return to 50% production (yrs) | 0 | 0 | 0 | 0 | 0 |
| Return to 100% production (yrs) | 0 | 0 | 0 | 0 | 0 |
| **Northwest-Nullarbor-Deserts** |
| Use site again (yrs) | 0 | 0 | 0 | 0 | 0 |
| Return to 50% production (yrs) | 0 | 0 | 0 | 0 | 0 |
| Return to 100% production (yrs) | 0 | 0 | 0 | 0 | 0 |

(continued on next page)
Table 9 (continued)

| Impact of fire\(^a\) | Observations | Mean | Std. Dev. | 25th PC | 50th PC | 75th PC |
|----------------------|--------------|------|-----------|---------|---------|---------|
| **Commercial** | | | | | | |
| Geraldton Sandplains | | | | | | |
| Use site again (yrs) | 9 | 8 | 3.9 | 5 | 7 | 10 |
| Return to 50% production (yrs) | 10 | 8 | 4.8 | 5 | 6 | 10 |
| Return to 100% production (yrs) | 9 | 20 | 14.8 | 8 | 15 | 30 |
| Swan Coastal Plain | | | | | | |
| Use site again (yrs) | 15 | 4 | 1.6 | 3 | 4 | 5 |
| Return to 50% production (yrs) | 15 | 6 | 3.5 | 3 | 5 | 7 |
| Return to 100% production (yrs) | 15 | 12 | 12.0 | 6 | 10 | 19 |
| Jarrah Forest | | | | | | |
| Use site again (yrs) | 17 | 4 | 1.6 | 3 | 4 | 5 |
| Return to 50% production (yrs) | 17 | 6 | 4.4 | 4 | 4 | 5 |
| Return to 100% production (yrs) | 15 | 13 | 12.8 | 6 | 10 | 20 |
| Warren | | | | | | |
| Use site again (yrs) | 5 | 10 | 11.4 | 4 | 5 | 5 |
| Return to 50% production (yrs) | 6 | 8 | 6.9 | 5 | 5 | 6 |
| Return to 100% production (yrs) | 5 | 11 | 11.0 | 7 | 7 | 7 |
| Avon Wheatbelt-Yalgoo | | | | | | |
| Use site again (yrs) | 4 | 6 | 3.0 | 4 | 5 | 8 |
| Return to 50% production (yrs) | 3 | 6 | 3.5 | 3 | 6 | 10 |
| Return to 100% production (yrs) | 3 | 12 | 7.2 | 6 | 10 | 20 |
| Mallee | | | | | | |
| Use site again (yrs) | 5 | 12 | 4.8 | 10 | 10 | 10 |
| Return to 50% production (yrs) | 6 | 12 | 6.0 | 8 | 10 | 20 |
| Return to 100% production (yrs) | 6 | 37 | 17.4 | 21 | 46 | 50 |
| Esperance | | | | | | |
| Use site again (yrs) | 5 | 15 | 5.1 | 10 | 13 | 20 |
| Return to 50% production (yrs) | 6 | 14 | 5.3 | 10 | 13 | 20 |
| Return to 100% production (yrs) | 5 | 29 | 19.5 | 15 | 20 | 50 |
| Murchison-Coolgardie | | | | | | |
| Use site again (yrs) | 7 | 15 | 11.7 | 4 | 10 | 30 |
| Return to 50% production (yrs) | 8 | 20 | 17.6 | 7 | 13 | 35 |
| Return to 100% production (yrs) | 6 | 26 | 19.7 | 14 | 18 | 50 |
| Northwest-Nullarbor-Deserts | | | | | | |
| Use site again (yrs) | 0 | | | | | |
| Return to 50% production (yrs) | 0 | | | | | |
| Return to 100% production (yrs) | 0 | | | | | |

Notes
25th PC i.e. 25th percentile, 25% of values are below this value.
50th PC i.e. 50th percentile, 50% of values are below this value.
75th PC i.e. 75th percentile, 75% of values are below this value.
\(^a\) Excludes zero values.

Table 10

| Logging impacted site | Yes | Unsure | No | Response total |
|-----------------------|-----|--------|----|----------------|
| **Hobbyist-Amateur** | | | | |
| Jarrah Forest | 10 | 5 | 73 | 88 |
| Warren | 1 | 4 | 30 | 35 |
| **Commercial** | | | | |
| Jarrah Forest | 15 | 2 | 14 | 31 |
| Warren | 9 | 2 | 5 | 16 |

Ever had site and surrounding 3 km logged, by beekeeper category and by region [Q85].
Table 11
Recovery after site and surrounding logged, expected number of years until use site again, production losses and years site impacted, by beekeeper category [Q88].

| Impact of logging¹ | Observations | Mean | Std Dev. | 25th PC | 50th PC | 75th PC |
|-------------------|--------------|------|----------|---------|---------|---------|
| **Hobbyist-Amateur** |              |      |          |         |         |         |
| Jarrah Forest     |              |      |          |         |         |         |
| Use site again (yrs) | 3          | 3    | 2.1      | 1       | 2       | 5       |
| Loss of production (%) | 5         | 30   | 40.4     | 3       | 20      | 25      |
| Years site impacted (yrs) | 6       | 20   | 23.5     | 3       | 12      | 30      |
| Warren            |              |      |          |         |         |         |
| Use site again (yrs) | 1          | 30   |          | 30      | 30      | 30      |
| Loss of production (%) | 1         | 100  |          | 100     | 100     | 100     |
| Years site impacted (yrs) | 1       | 30   |          | 30      | 30      | 30      |
| **Commercial**    |              |      |          |         |         |         |
| Jarrah Forest     |              |      |          |         |         |         |
| Use site again (yrs) | 11        | 24   | 31.1     | 2       | 7       | 40      |
| Loss of production (%) | 10        | 62   | 39.9     | 20      | 67      | 100     |
| Years site impacted (yrs) | 10      | 27   | 39.3     | 4       | 6       | 30      |
| Warren            |              |      |          |         |         |         |
| Use site again (yrs) | 8          | 36   | 32.1     | 11      | 33      | 51      |
| Loss of production (%) | 7         | 66   | 39.1     | 20      | 80      | 100     |
| Years site impacted (yrs) | 7       | 39   | 44.0     | 3       | 20      | 100     |

Notes
25th PC i.e. 25th percentile, 25% of values are below this value.
50th PC i.e. 50th percentile, 50% of values are below this value.
75th PC i.e. 75th percentile, 75% of values are below this value.

¹ Excludes zero values.

1.7. Honey Sales and Distribution (Tables 12 and 13)

Table 12
Volume of honey sold or distributed in season July 2019–June 2020, by flora type and beekeeper category [Q102].

| Honey flora type                      | Observations² | Mean | Std Dev. | 25th PC | 50th PC | 75th PC |
|--------------------------------------|---------------|------|----------|---------|---------|---------|
| **Backyard beekeepers**              |               |      |          |         |         |         |
| Mixed flora                          | 77            | 24   | 21.9     | 10      | 20      | 30      |
| Mono flora - not TA tested           | 6             | 27   | 13.8     | 15      | 25      | 35      |
| Organic mixed flora                  | 5             | 16   | 10.5     | 10      | 15      | 22      |
| Organic mono flora - not TA tested   | 2             | 55   | 63.6     | 10      | 55      | 100     |
| TA 10+ - tested                      | 0             |      |          |         |         |         |
| TA 20+ - tested                      | 0             |      |          |         |         |         |
| TA 30+ or more - tested              | 0             |      |          |         |         |         |
| Organic TA 10+ - tested              | 0             |      |          |         |         |         |
| Organic TA 20+ - tested              | 0             |      |          |         |         |         |
| Organic TA 30+ or more - tested      | 0             |      |          |         |         |         |
| Manuka - Leptospermum                | 0             |      |          |         |         |         |
| **Response total**                   | 87            |      |          |         |         |         |
| **Hobbyist-Amateur beekeepers**      |               |      |          |         |         |         |
| Mixed flora                          | 175           | 135  | 229.2    | 20      | 60      | 150     |
| Mono flora - not TA tested           | 34            | 83   | 70.5     | 30      | 60      | 100     |

(continued on next page)
Table 12 (continued)

| Honey flora type                                      | Observations | Mean  | Std Dev. | 25th PC | 50th PC | 75th PC |
|-------------------------------------------------------|--------------|-------|----------|---------|---------|---------|
| Organic mixed flora                                   | 11           | 72    | 89.8     | 15      | 35      | 135     |
| Organic mono flora - not TA tested                    | 5            | 211   | 273.4    | 10      | 45      | 400     |
| TA 10+ - tested                                       | 0            |       |          |         |         |         |
| TA 20+ - tested                                       | 2            | 26    | 34.6     | 1       | 26      | 50      |
| TA 30+ or more - tested                               | 2            | 190   | 240.4    | 20      | 190     | 360     |
| Organic TA 10+ - tested                               | 0            |       |          |         |         |         |
| Organic TA 20+ - tested                               | 0            |       |          |         |         |         |
| Organic TA 30+ or more – tested\(^a\)                 | n/a          |       |          |         |         |         |
| Manuka - Leptospermum                                 | 0            |       |          |         |         |         |
| **Response total**                                    | **196**      |       |          |         |         |         |

**Commercial beekeepers**

| Honey flora type                                      | Observations | Mean  | Std Dev. | 25th PC | 50th PC | 75th PC |
|-------------------------------------------------------|--------------|-------|----------|---------|---------|---------|
| Mixed flora                                           | 31           | 4,496 | 6,865.5  | 320     | 1,500   | 4,225   |
| Mono flora - not TA tested                            | 21           | 12,194| 20,038.9 | 620     | 2,500   | 17,000  |
| Organic mixed flora                                   | 3            | 70,667| 103,736.8| 2,000   | 20,000  | 190,000 |
| Organic mono flora - not TA tested                    | 2            | 3,500 | 2,121.3  | 2,000   | 3,500   | 5,000   |
| TA 10+ - tested                                       | 0            |       |          |         |         |         |
| TA 20+ - tested                                       | 2            | 6,050 | 8,414.6  | 100     | 6,050   | 12,000  |
| TA 30+ or more - tested                               | 5            | 6,740 | 5,868.4  | 1,700   | 6,000   | 10,000  |
| Organic TA 10+ - tested                               | 0            |       |          |         |         |         |
| Organic TA 20+ - tested\(^b\)                         | n/a          |       |          |         |         |         |
| Organic TA 30+ or more - tested\(^b\)                 | 3            | 10,333| 8,386.5  | 5,000   | 6,000   | 20,000  |
| Manuka - Leptospermum                                 | 2            | 3,500 | 2,828.4  | 1,500   | 3,500   | 5,500   |
| **Response total**                                    | **31**       |       |          |         |         |         |

Notes

25th PC i.e. 25th percentile, 25% of values are below this value.
50th PC i.e. 50th percentile, 50% of values are below this value.
75th PC i.e. 75th percentile, 75% of values are below this value.
Response total is the number of respondents who answered the question.
\(^a\) Excludes respondents whose values were less than 1.
\(^b\) - n/a - Not available for publication, too few observations.

Table 13

Price of honey sold or distributed in season July 2019–June 2020, by flora type and beekeeper category [Q103].

| Honey flora type                                      | Observations | Mean | Std Dev. | 25th PC | 50th PC | 75th PC |
|-------------------------------------------------------|--------------|------|----------|---------|---------|---------|
| Backyard beekeepers                                   |              |      |          |         |         |         |
| Mixed flora                                           | 39           | 13.1 | 5.62     | 10.0    | 13.0    | 16.0    |
| Mono flora - not TA tested                            | 2            | 10.0 | 7.07     | 5.0     | 10.0    | 15.0    |
| Organic mixed flora                                   | 2            | 14.5 | 0.71     | 14.0    | 14.5    | 15.0    |
| Organic mono flora - not TA tested                    | 2            | 12.0 | 2.83     | 10.0    | 12.0    | 14.0    |
| TA 10+ - tested                                       | 0            |      |          |         |         |         |
| TA 20+ - tested                                       | 0            |      |          |         |         |         |
| TA 30+ or more - tested                               | 0            |      |          |         |         |         |
| Organic TA 10+ - tested                               | 0            |      |          |         |         |         |
| Organic TA 20+ - tested                               | 0            |      |          |         |         |         |
| Organic TA 30+ or more - tested                       | 0            |      |          |         |         |         |
| Manuka - Leptospermum                                 | 0            |      |          |         |         |         |
| **Response total**                                    | **43**       |      |          |         |         |         |

| Hobbyist-Amateur beekeepers                           |              |      |          |         |         |         |
| Mixed flora                                           | 141          | 13.4 | 5.40     | 10.0    | 13.0    | 15.0    |
| Mono flora - not TA tested                            | 29           | 13.9 | 5.00     | 10.0    | 15.0    | 16.0    |
### Table 13 (continued)

| Honey flora type                                      | Observations | Honey price ($/kg) | Mean  | Std Dev. | 25th PC | 50th PC | 75th PC |
|------------------------------------------------------|--------------|--------------------|-------|----------|---------|---------|---------|
| Organic mixed flora                                   | 9            | 17.8               | 6.67  | 15.0     | 15.0    | 20.0    |
| Organic mono flora - not TA tested                   | 3            | 13.7               | 6.99  | 6.2      | 15.0    | 20.0    |
| TA 10+ - tested                                       | 0            | 25.0               | 25.0  | 25.0     | 25.0    |
| TA 20+ - tested                                       | n/a          |                    |       |          |         |         |
| TA 30+ or more - testedb                             | 1            | 20.0               | 20.0  | 20.0     | 20.0    |
| TA 10+ or more - testedb                             | 1            | 20.0               | 20.0  | 20.0     | 20.0    |
| Organic TA 20+ - tested                              | 0            | 25.0               | 25.0  | 25.0     | 25.0    |
| Organic TA 30+ or more - tested                      | 1            | 20.0               | 20.0  | 20.0     | 20.0    |
| Manuka - Leptospermum                                | n/a          |                    |       |          |         |         |
| Response total                                       | 159          |                    |       |          |         |         |
| Commercial beekeepers                                |              |                    |       |          |         |         |
| Mixed flora                                          | 30           | 10.1               | 5.38  | 6.0      | 9.3     | 14.0    |
| Mono flora - not TA tested                            | 20           | 10.3               | 5.88  | 6.0      | 8.5     | 13.0    |
| Organic mixed flora                                  | 3            | 8.3                | 3.21  | 6.0      | 7.0     | 12.0    |
| Organic mono flora - not TA tested                   | 2            | 11.0               | 7.07  | 6.0      | 11.0    | 16.0    |
| TA 10+ - tested                                      | 0            |                    |       |          |         |         |
| TA 20+ - tested                                      | n/a          |                    |       |          |         |         |
| TA 30+ or more - testedb                             | 4            | 38.8               | 11.09 | 30.0     | 40.0    | 47.5    |
| Organic TA 10+ - tested                              | 0            |                    |       |          |         |         |
| Organic TA 20+ - tested                              | 0            | 18.0               | 18.0  | 18.0     | 18.0    |
| Organic TA 30+ or more - tested                      | 2            | 30.0               | 7.07  | 25.0     | 30.0    | 35.0    |
| Manuka - Leptospermum                                | 2            | 13.5               | 9.19  | 7.0      | 13.5    | 20.0    |
| Response total                                       | 31           |                    |       |          |         |         |

**Notes**
- 25th PC i.e. 25th percentile, 25% of values are below this value.
- 50th PC i.e. 50th percentile, 50% of values are below this value.
- 75th PC i.e. 75th percentile, 75% of values are below this value.
- Response total is the number of respondents who answered the question.
- a Excludes respondents whose values were less than or equal to 1.
- b - n/a - Not available for publication, too few observations.

### 1.8. Operating Costs (Table 14)

| Unit cost                  | Total cost ($/unit) |
|----------------------------|---------------------|
|                           | Observations | Mean  | Std Dev. | 25th PC | 50th PC | 75th PC |
| **Hobbyist-Amateur**       |              |       |          |         |         |         |
| Cost per hive ($/hive)a    | 36          | 171.0 | 139.64   | 75.0    | 136.2   | 224.3   |
| Cost per kilogram of honey ($/kg)b | 35      | 14.2  | 12.97    | 4.0     | 10.1    | 22.0    |
| **Commercial**             |              |       |          |         |         |         |
| Cost per hive ($/hive)a    | 23          | 306.1 | 257.66   | 60.0    | 245.0   | 628.3   |
| Cost per kilogram of honey ($/kg)b | 22    | 12.7  | 14.60    | 3.8     | 7.1     | 16.8    |

**Notes**
- 25th PC i.e. 25th percentile, 25% of values are below this value.
- 50th PC i.e. 50th percentile, 50% of values are below this value.
- 75th PC i.e. 75th percentile, 75% of values are below this value.
- a Excludes values > 800.
- b Excludes values > 100.
1.9. Pollination Services to Agricultural Crops, Fees and Future Pollinators (Tables 15–17)

Table 15
Beekeepers pollinating crops, season July 2019–June 2020 [Q60].

| Crop                                      | Observations | Response total |
|-------------------------------------------|--------------|----------------|
| Avocado                                   | 13           | 20             |
| Canola                                    | 3            |                |
| Citrus, including orange, mandarin, grapefruit, lemons and limes | 3 |                |
| Gourds, including cucumber, squash, zucchini, pumpkin | 1 |                |
| Nuts, excluding almond                     | 2            |                |
| Pome fruit, including apple, pear, nashi  | 2            |                |
| Stone fruit, including apricot, cherry, nectarine, peach, mango | 6 |                |

Table 16
Pollination hive numbers and service fee, season July 2019–June 2020 [Q58, Q63].

| Response                              | Observations | Mean  | Std Dev. | 25th PC | 50th PC | 75th PC |
|---------------------------------------|--------------|-------|----------|---------|---------|---------|
| Number of hives a                      | 16           | 139   | 170.6    | 21      | 80      | 193     |
| Pollination service fee ($/hive) b     | 13           | 167.69| 41.312   | 150     | 168     | 200     |

Notes
25th PC i.e. 25th percentile, 25% of values are below this value.
50th PC i.e. 50th percentile, 50% of values are below this value.
75th PC i.e. 75th percentile, 75% of values are below this value.
a Excludes values < 5.
b Excludes values < 10.

Table 17
Beekeepers considering offering pollination services in next 5 years [Q175].

| Response | Backyard | Hobbyist-Amateur | Commercial | Total |
|----------|----------|------------------|------------|-------|
| Yes      | 4        | 16               | 12         | 32    |
| Maybe    | 12       | 31               | 6          | 49    |
| No       | 146      | 197              | 7          | 350   |
| Response total | 162      | 244              | 25         | 431   |

2. Experimental Design, Materials and Methods

The survey design was developed through semi-structured interviews with beekeepers and industry representatives to gain an understanding of the use of natural resources, the production system and challenges facing the industry with respect to apiary sites, bush fires and logging. This was followed by an extensive literature review of surveys and questionnaires conducted within the apiculture industry and on related topics. Manning’s [2] Natural Resource Questionnaire for Beekeepers targeted amateur and commercial beekeepers in Western Australia in 1990-91 and focused on honey production and geographical significance of apiary sites. This previous work was valuable and influenced the construction of the online survey to be inclusive of all beekeepers and registered apiary site holders in Western Australia. An apiculture monitoring programme in New Zealand that publishes annual reports and survey data was also reviewed [3].
The Natural Resources for Beekeepers Questionnaire (Western Australia) 2020-21 [4] was developed using Qualtrics software [5] using a range of question types such as multiple choice, multiple answer with graphics, number selection using slider bars and free text entry. Side-by-side type questions were best suited for displaying calendar months to ascertain region use throughout the year. Often selected choices were carried forward to gather more information about specific topics, for example the crops selected for pollination were later redisplayed in questions asking for the regions of these crops, hive stocking rate, crop area and service fee charged. To avoid unnecessary time spent on irrelevant questions, survey flow and question display logic were carefully constructed to generate a question pathway for respondents that was applicable to them and their situation.

The questionnaire accommodated all scales of production and use of natural resources. In total there were 180 questions, but the questions seen by the participant varied depending on previous responses. Statements and information sections such as regional maps, descriptive displays and links to more information were included throughout the questionnaire for clarity. The questions mostly focused on the season July 2019–June 2020, and there were options to provide historical information if respondents wanted to. Crop pollinators were included and retired full time/commercial beekeepers who had retired in the last ten years had the option to share their valuable knowledge and experience from their years of commercial beekeeping.

The beekeepers were concerned with privacy and sharing commercially sensitive knowledge via a survey. Therefore, to protect anonymity random sampling from the population was not possible, instead the sample was self-selected by those willing to participate in the survey. The online survey was open to all Western Australian beekeepers and registered apiary site licence holders during December 2020 to June 2021, and participation was voluntary and anonymous. Invitation to participate was delivered through industry networks and newsletters, websites, Facebook and direct email. All participants had the option to seek assistance if required.

Statistical analysis of survey results including data clean up, table and graph creation has been performed using Stata/SE 16.1 [6] and Microsoft Excel. Beekeepers were classified according to the number of hives, number and type of sites and honey harvested. Beekeeper categories were analyzed separately, and no all-encompassing single conclusion was attempted.

Ethics Statements

This research was conducted under the University of Western Australia ethics protocol RA/4/20/6491. All research participants provided informed consent.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability

A survey dataset to better understand the honey bee industry, use and value of natural resources and challenges for beekeepers in Western Australia: A beekeepers’ perspective (Original data) (Pure, The University of Western Australia Research Repository).

CRediT Author Statement

Cheryl Day: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization,
Project administration; **Benedict White**: Conceptualization, Methodology, Formal analysis, Writing – review & editing, Supervision, Project administration, Funding acquisition.

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