**Supplementary material, Table S1.** Literature values for female mating frequencies in solitary and social bee species. The social categories are listed as facultatively social, eusocial (also known as primitively eusocial), and hypersocial (also known as advanced eusocial). Note that in all social categories, at least some species have mating frequencies greater than 1. See the originating paper for reference information.

|  |  |  |  |
| --- | --- | --- | --- |
| Sociality | Species  | Female mating frequency | Reference |
| Solitary | *Andrena vaga* | 1 | Vleugel (1947) |
|  | *Anthidium manicatum* | > 1 | Lampert *et al.* (2014) |
|  | *Augochlora pura* | 1 | Barrows (1975) |
|  | *Calliopsis (Nomadopsis)* sp*.*  | > 1 | Rozen (1958) |
|  | *Centris pallida* | 1 | Alcock (1976) |
|  | *Ceratina chalybea* | 2.57 | Mikát *et al.* (2019) |
|  | *Ceratina cyanea* | 2.5 | Mikát *et al.* (2019) |
|  | *Ceratina nigrolabiata* | 3.25 | Mikát *et al.* (2019) |
|  | *Megachile rotundata* | 1 | Blanchetot (1992) |
| Facultatively social | *Ceratina calcarata* | > 1 | Shell and Rehan (2018) |
|  | *Euglossa hemichlora* | 1 | Zimmermann *et al.* (2009) |
|  | *Euglossa* sp. '2dentate' | 1 | Zimmermann *et al.* (2009) |
|  | *Euglossa viridissima* | 1 | Zimmermann *et al.* (2009) |
| Eusocial | *Augochlorella aurata* | 1 | Mueller *et al.* (1994) |
|  | *Halictus ligatus* | 2.9 | Richards and Packer (1995) |
|  | *Lasioglossum malachurum* | 1.0–1.2 | Paxton *et al.* (2002); Richards *et al.* (2005); Soro *et al.* (2009) |
|  | *Lasioglossum versatum*  | 1.16 | Barrows (1975) |
|  | *Lasioglossum zephyrum* | 1 | Barrows (1975) |
| Hypersocial | *Apis andreniformis* | 9.1–19.6 | Oldroyd *et al.* (1997); Tarpy *et al.* (2004); Takahashi *et al.* (2008) |
|  | *Apis cerana* | 14.2 | Tarpy *et al.* (2004) |
|  | *Apis dorsata* | 20.0–44.7 | Moritz *et al.* (1995); Oldroyd *et al.* (1996, 1997); Tarpy *et al.* (2004) |
|  | *Apis florea* | 7.9–10.1 | Oldroyd *et al.* (1995,1997); Palmer and Oldroyd (2001); Tarpy *et al.* (2004) |
|  | *Apis koschevnikovi* | 13.4 | Tarpy *et al.* (2004) |
|  | *Apis laboriosa* | 14.5–29.0 | Paar *et al.* (2004); Tarpy *et al.* (2004) |
|  | *Apis mellifera* | 10.4–20.8 | Estoup *et al* (1994); Oldroyd *et al.* (1997); Neumann *et al.* (1999); Tarpy *et al.* (2004, 2010, 2015); Delaney *et al.* (2011) |
|  | *Apis nigrocincta* | 17.8–73.6 | Palmer *et al.* (2001); Tarpy *et al.* (2004) |
|  | *Austroplebeia symei* | 1 | Palmer *et al.* (2002) |
|  | *Bombus affinis* | 1 | Payne *et al.* (2003) |
|  | *Bombus ardens* | 1 | Kokuvo *et al*. (2009) |
|  | *Bombus auricomus* | 1 | Payne *et al.* (2003) |
|  | *Bombus bimaculatus* | 1.05 | Payne *et al.* (2003) |
|  | *Bombus citrinus* | 1.76 | Payne *et al.* (2003) |
|  | *Bombus diversus* | 1 | Kokuvo *et al.* (2009) |
|  | *Bombus fervidus* | 1 | Payne *et al.* (2003) |
|  | *Bombus griseocollis* | 1 | Payne *et al.* (2003) |
|  | *Bombus honshuensis* | 1 | Kokuvo *et al.* (2009) |
|  | *Bombus hortorum* | 1 | Schmid-Hempel and Estoup *et al.* (1995); Schmid-Hempel (2000)  |
|  | *Bombus hypnorum* | 1.1–1.3 | Estoup *et al.* (1995); Schmid-Hempel and Schmid-Hempel (2000); Paxton *et al.* (2001) |
|  | *Bombus ignitus* | 1.00 | Takahashi et al. (2008) |
|  | *Bombus impatiens* | 1.05 | Payne *et al.* (2003) |
|  | *Bombus insularis* | 1 | Payne *et al.* (2003) |
|  | *Bombus lapidarius* | 1 | Estoup *et al.* (1995); Schmid-Hempel and Schmid-Hempel (2000)  |
|  | *Bombus lucorum* | 1 | Estoup *et al.* (1995); Schmid-Hempel and Schmid-Hempel (2000)  |
|  | *Bombus mixtus* | 3.57 | Payne *et al.* (2003) |
|  | *Bombus pascuorum* | 1 | Estoup *et al.* (1995); Schmid-Hempel and Schmid-Hempel (2000)  |
|  | *Bombus pratorum* | 1 | Estoup *et al.* (1995); Schmid-Hempel and Schmid-Hempel (2000) |
|  | *Bombus sicheli* | 1 | Estoup *et al.* (1995); Schmid-Hempel and Schmid-Hempel (2000) |
|  | *Bombus ternarius* | 2.04 | Payne *et al.* (2003) |
|  | *Bombus terrestris* | 1.0–2.1 | Estoup *et al.* (1995); Schmid-Hempel and Schmid-Hempel (2000); Inoue *et al.* (2012) |
|  | *Bombus vagans* | 1 | Payne *et al.* (2003) |
|  | *Bombus wilmattae* | 1.08 | Huth-Schwarz *et al.* (2011) |
|  |  |  |  |
|  | *Lestrimelitta limao* | 1.22 | Peters *et al.* (1999) |
|  | *Melipona beecheii* | 1.16 | Paxton *et al.* (1999); Peters *et al.* (1999)  |
|  | *Melipona marginata* | 1 | Tóth *et al.* (2002) |
|  | *Melipona mondury* | 1.84 | Viana *et al.* (2015) |
|  | *Melipona panamica* | 0.96 | Peters *et al.* (1999) |
|  | *Melipona quadrifasciata* | 0.9–1.0 | Peters *et al.* (1999); Tóth *et al.* (2002) |
|  | *Melipona scutellaris* | 1 | Tóth *et al.* (2002) |
|  | *Melipona seminigra* | 8.23 | Francini (2013) |
|  | *Nannotrigona perilampoides* | 1.19 | Peters *et al.* (1999) |
|  | *Paratrigona subnuda* | 1.35 | Peters *et al.* (1999) |
|  | *Partamona near cupria* | 0.91 | Peters *et al.* (1999) |
|  | *Plebeia doryana* | 1 | Tóth *et al.* (2002) |
|  | *Plebeia near minima* | 1.43 | Peters *et al.* (1999) |
|  | *Plebeia remota* | 1 | Tóth *et al.* (2002) |
|  | *Plebeia saiqui* | 1 | Tóth *et al.* (2002) |
|  | *Scaptotrigona barrocoloradensis* | 0.85 | Peters *et al.* (1999) |
|  | *Scaptotrigona mexicana* | 1.0–1.3 | Palmer *et al.* (2002); Solórzano-Gordillo *et al.* (2021) |
|  | *Scaptotrigona pectoralis* | 1 | Palmer *et al.* (2002) |
|  | *Scaptotrigona postica* | 0.8–1.4 | Paxton *et al.* (1999, 2003); Peters *et al.* (1999); Paxton (2000); Tóth *et al.* (2002) |
|  | *Schwarziana quadripunctata* | 0.93–1 | Peters *et al.* (1999); Tóth *et al.* (2003) |
|  | *Tetragona clavipes* | 1 | Peters *et al.* (1999); Tóth *et al.* (2002) |
|  | *Tetragonula carbonaria* | 1 | Green and Oldroyd (2002) |
|  | *Trigona clypearis* | 1 | Palmer *et al.* (2002) |
|  | *Trigona fulviventris* | 1.16 | Peters *et al.* (1999) |
|  | *Trigona hockingsi* | 1 | Palmer *et al.* (2002) |
|  | *Trigona mellipes* | 1 | Palmer *et al.* (2002) |
|  | *Trigona sapiens* | 1 | Palmer *et al.* (2002) |

**Supplementary material, Table S2.** A summary of the relative proportions of full-sister and maternal half-sister sibships inferred in individual runs of COLONY. Each run was based on a different starting seed. Data subsets are described in Table 2. Results are summarised in Table 5. N is the number of sibships inferred from the pairwise sibling relationships predicted by COLONY in each run. N thus represents the inferred number of monogamous versus polygamous mothers inferred from the genotypes.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Likelihood threshold | Data subset | Analysis number | Proportion of full-sister sibships (N) | Proportion of maternal half-sister sibships (N) |
| > 0.7 | 1 | 1 | **80.0%** (56) | **20.0%** (14) |
|  | 2 | **75.0%** (51) | **35.0%** (17) |
|  | 3 | **77.4%** (48) | **22.6%** (14) |
| 4 | **78.3%** (47) | **21.7%** (13) |
| 5 | **78.3%** (54) | **21.7%** (15) |
| 2 | 1 | **66.7%** (14) | **33.3%** (7) |
| 2 | **60.0%** (12) | **40.0%** (8) |
| 3 | **64.7%** (11) | **35.3%** (6) |
| 4 | **63.6%** (14) | **36.4%** (8) |
| 5 | **63.6%** (14) | **36.4%** (8) |
| 3 | 1 | **56.3%** (18) | **43.7%** (14) |
| 2 | **48.6%** (18) | **51.4%** (19) |
| 3 | **40.0%** (12) | **60.0%** (18) |
| 4 | **55.6%** (15) | **44.4%** (12) |
| 5 | **53.6%** (15) | **46.4%** (13) |
| > 0.8 | 1 | 1 | **93.4%** (57) | **6.6%** (4) |
|  | 2 | **94.4%** (51) | **5.6%** (3) |
|  | 3 | **94.4%** (51) | **5.6%** (3) |
|  | 4 | **94.1%** (48) | **5.9%** (3) |
|  | 5 | **100.0%** (53) | **0.0%** (0) |
| 2 | 1 | **100.0%** (14) | **0.0%** (0) |
|  | 2 | **100.0%** (13) | **0.0%** (0) |
|  | 3 | **92.3%** (12) | **7.7%** (1) |
|  | 4 | **88.2%** (15) | **11.8%** (2) |
|  | 5 | **88.9%** (8) | **11.1%** (1) |
| 3 | 1 | **66.7%** (18) | **33.3%** (9) |
|  | 2 | **69.7%** (23) | **30.3%** (10) |
|  | 3 | **75.0%** (21) | **35.0%** (7) |
|  | 4 | **70.8%** (17) | **29.2%** (7) |
|  | 5 | **80.8%** (21) | **19.2%** (5) |