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A scientific note on the mating frequency of *Apis dorsata*

Wandee WATTANACHAIYINGCHAROEN^{a,b,c}, Benjamin P. OLDROYD^{c*},
Siriwat WONGSIRI^a, Kellie PALMER^c, Jürgen PAAR^{c,d}

^a Bee Biology Research Unit, Department of Biology, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand

^b Present Address: Department of Biology, Naresuan University, Phitsanulok 65000, Thailand

^c School of Biological Sciences A12, University of Sydney NSW 2006, Australia

^d Institute of Zoology, Karl-Franzens University Graz, 8010 Graz, Austria

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Apis dorsata Fabricius has the highest level of polyandry recorded for any social insect (Tab. I, Moritz et al., 1995; Oldroyd et al., 1996). To improve the precision of current estimates, we re-examined paternity frequency using larger sample sizes and 4 microsatellite loci, including a new highly variable locus cloned from *A. dorsata* by Paar et al., unpublished data. We also compared mating frequency between colonies found in aggregations and colonies found singly.

Combs of *A. dorsata* were obtained from the wild during 1998–1999. Eight of these (colonies 1–8) were collected from a group of 14 aggregated colonies in the Pua district of Nan province. Another five solitary colonies (colonies 9–13) were collected from various parts of Thailand (Tab. I).

Workers were genetically analyzed using the microsatellite loci A14 (Estoup et al., 1993), A24 and A88 (Estoup et al., 1995) and Ad3 (Paar et al., 2003) as described in Oldroyd et al. (2000). Effective mating frequency (m_e) corrected for finite sample size (Pamilo, 1993; Boomsma and Ratnieks, 1996), average coefficient of relatedness (g) weighted according to the relative proportions of each subfamily (Boomsma and Ratnieks, 1996) and the expected frequency of non-detected patriline due to two or males in the mating having the same genotype (d_p) (Boomsma and Ratnieks, 1996) were calculated as described in Palmer et al. (2001).

The number of subfamilies found per colony in this investigation ranged from 47–102 and the effective mating frequency ranged between 26.9 and 88.5 (Tab. I). As a consequence of increased

sample size and the use of highly variable genetic markers, the number of subfamilies observed per colony are much higher in this study than those reported by Moritz et al. (1995) and Oldroyd et al. (1996). However, they are within the range estimated by Moritz et al. (1995) after they fitted the distribution of patriline to a binomial distribution. Our results confirm the widespread incidence of extreme mating frequencies in *A. dorsata*.

The mean number of patriline ($\bar{x} \pm \text{s.e.}$) per colony did not differ ($P = 0.2$ 2-tailed t -test) between colonies sampled from the aggregation (76.1 ± 4.4) and the single colonies (86.6 ± 5.6). The mean effective number of matings in the aggregated colonies (64.1 ± 7.6) was the same ($P = 0.82$) as the mean effective number of matings in the single colonies (61.2 ± 9.6). On the assumption that there are more drones present at drone congregation areas near colony aggregations, this may indicate that the availability of drones is not a factor in determining mating frequency.

The probability of non-detected patriline due to genetically identical inseminating drones (d_p) (Boomsma and Ratnieks, 1996) was 0.0003 for colonies from the aggregation, and 0.002 for the solitary colonies. This means that fewer than 3 fathering males were expected to be undetected in all 13 colonies.

Extreme multiple mating has now been demonstrated in at least 7 species of *Apis* (Palmer et al., 2001), and may be regarded as plesiomorphic for the genus (Palmer and Oldroyd, 2000). The

* Correspondence and reprints
E-mail: boldroyd@bio.usyd.edu.au

Table I. Sample size, N , per colony, number of patrines, k , detected, effective mating frequency, m_e , and average coefficient of relatedness, g , in *A. dorsata* colonies from several provinces of Thailand (this study), Malaysia (Moritz et al., 1995) and central Thailand (Oldroyd et al., 1996).

Colony	N	k	m_e	g	Province
A1	144	72	88.0	0.26	Nan ^a
A2	189	74	80.0	0.26	Nan
A3	111	47	37.7	0.26	Nan
A4	248	78	28.8	0.27	Nan
A5	204	92	77.6	0.26	Nan
A6	206	88	64.6	0.26	Nan
A7	235	87	62.1	0.26	Nan
A8	156	71	74.2	0.26	Nan
S9	176	83	88.5	0.26	Nakornratchsima ^b
S10	271	102	67.6	0.26	Lopburi ^c
S11	288	80	55.6	0.26	Nakornratchsima ^b
S12	276	83	26.9	0.27	Supanburi ^d
S13	192	85	67.7	0.26	Tak ^e
Mean \pm SE, this study	207.4 \pm 15.2	80.1 \pm 3.6	63.0 \pm 5.7	0.259 \pm 0.001	
Mean Moritz et al. (1995)	28.3 \pm 4.4	18.2 \pm 2.4	25.6 \pm 11.6	–	
Mean Oldroyd et al. (1996)	86 \pm 33.4	26.7 \pm 5.4	20.0 \pm 6.6	0.29 \pm 0.009	

^a Nan Province, northern Thailand.

^b Nakornratchsima Province, north-eastern Thailand.

^c Lopburi Province, central Thailand.

^d Supanburi Province, western Thailand.

^e Tak Province, north-western Thailand.

adaptive significance of the extraordinarily high mating frequency in this genus in general, and this species in particular, remains a mystery.

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Note scientifique sur la fréquence des accouplements chez *Apis dorsata*.

Eine wissenschaftliche Notiz über die Paarungshäufigkeit von *Apis dorsata*.

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