Electronic supplementary material

To leave or to stay: direct fitness through natural nest foundation in a primitively eusocial wasp

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Materials and methods

Quantitative behavioural observation

We used post-emergence colonies for our experiment. Post-emergence colonies refer to those from which at least one adult has eclosed. We collected quantitative behaviour data from nine post-emergence colonies, each transplanted inside separate walk-in cages. All behavioural observation sessions consisted of randomly intermingled instantenous scans and all occurrence sessions. Scans consists of snapshots of behaviours of all wasps present in the colony at that moment. During all occurrence sessions, every occurrence of the selected set of behaviours, by any individual, is recorded (Gadagkar 2001).

Data analysis

We used the 'lme4' package (Bates et al. 2015) in R-studio for all mixed models. For identifying the predictors that significantly affected the decision of staying or leaving the parent nest, we fitted a generalised linear mixed model with three fixed effects and one random effect. The fixed effects were proportion of time spent outside the parent nests and frequencies per hour of dominance behaviour shown by a wasp outside the parent nest and self-feeding on the parent nests; we used individual parent nest indentity as the random effect. In our dataset, we had 76 wasps that left their parent nests to become foundresses, and 529 wasps that stayed back in their parent nests. The *p*-values obtained for each of the predictor variables from the model were used to determine whether a predictor is significantly affecting the decision of a wasp to leave the parent nest or stay back. The model was as follows:

```
model1 = glmer(status ~ db_off + fe_on + tson + (1|nest), data=glm1, family=binomial(link="logit"))
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Here, db_off, fe_on and tson refer to frequecy of dominance behaviour in off-nest aggregation, frequency of self-feeding behaviour on parent nest and proportion of time spent outside parent nest respectively.

Similarly, we used linear models for comparing the solitary foundresses (N = 9) , queens of multiple foundress nests (N = 20) and cofoundresses (N = 47) of multiple foundress nests for frequencies per hour of dominance behaviour in off-nest aggregations (model 2) and self-feeding behaviour on parent nests (model 3).

model2 = lm(db_off ~ id, data=db_off)

model3 = lm(fe_on ~ id, data=fe_on)

In both the above models, "id" refers to the identity of the foundress i.e. whether it is a solitary foundress, or a queen of multiple foundress nest or a cofoundress. In model2 and model3, db_off and fe_on refer to frequnecies per hour of dominance behaviour in off-nest aggregations and self-feeding behaviour on parent nests respectively.

References

Bates D, Mächler M, Bolker B, Walker S (2015) Fitting Linear Mixed-Effects Models using lme4. J Stat Softw. doi: 10.18637/jss.v067.i01

Gadagkar R (2001) The Social Biology of *Ropalidia marginata*: Toward Understanding the Evolution of Eusociality. Harvard University Press, Cambridge,Massachusetts; London, England

Figures

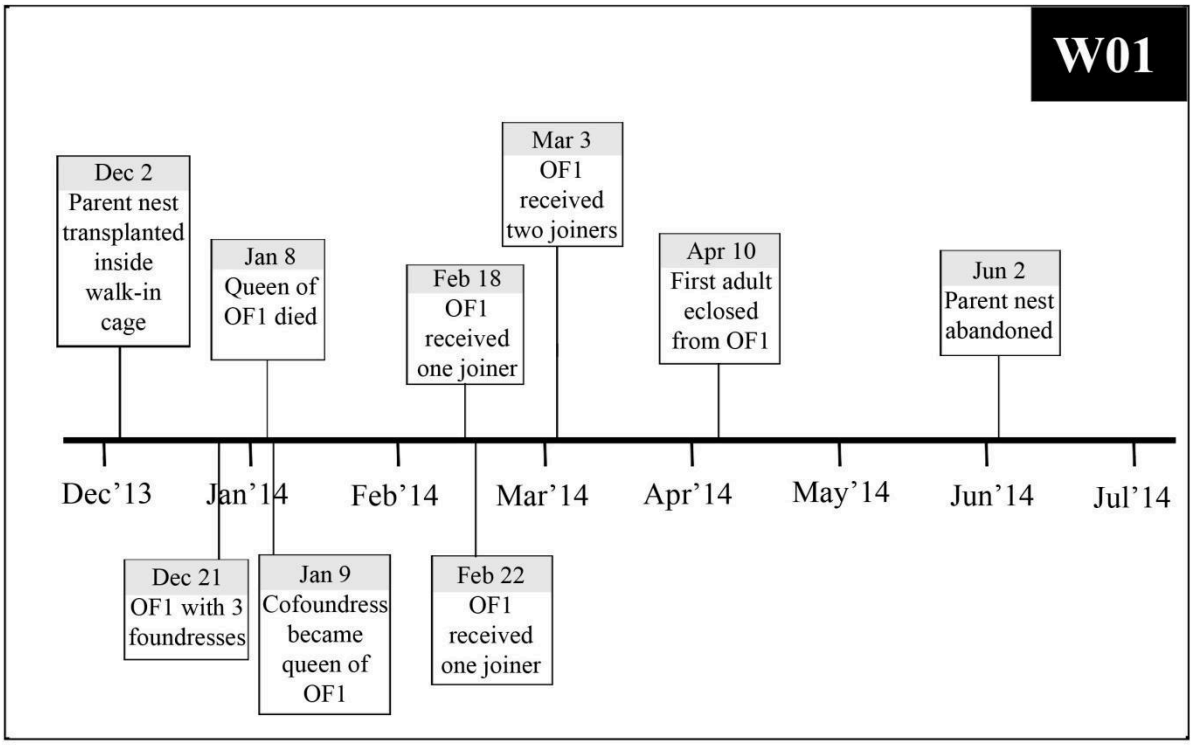

Fig S1 Timeline of parent nest W01. OF refers to offspring nests

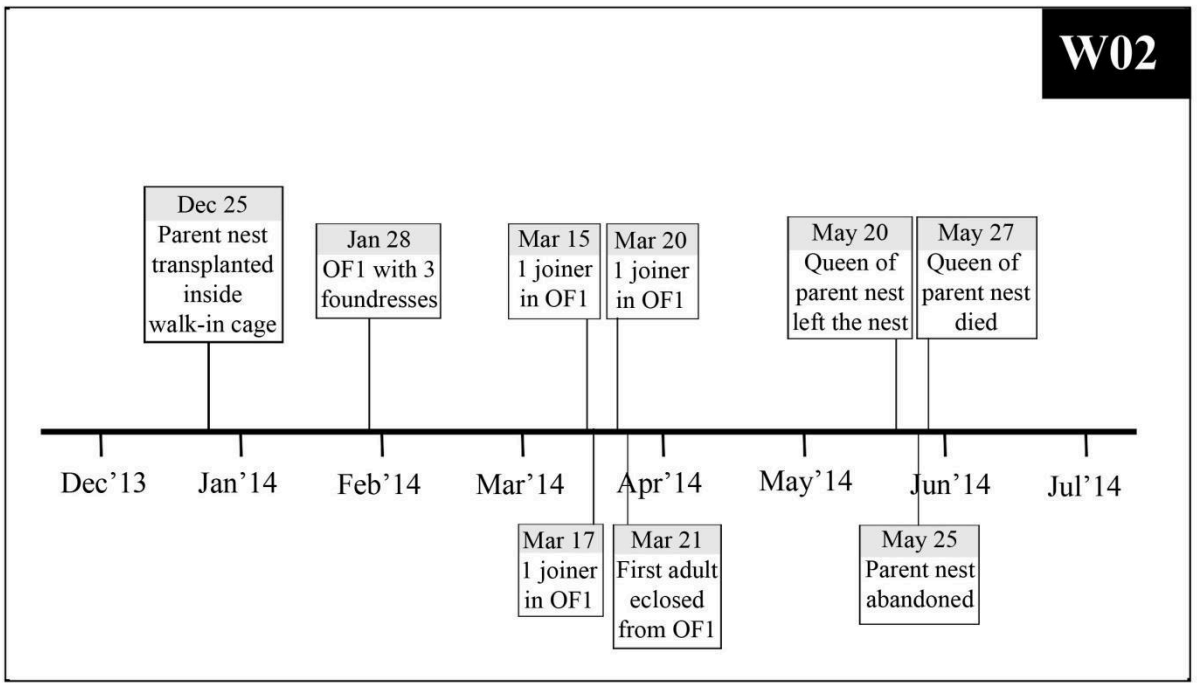

Fig S2 Timeline of parent nest W02. OF refers to offspring nests

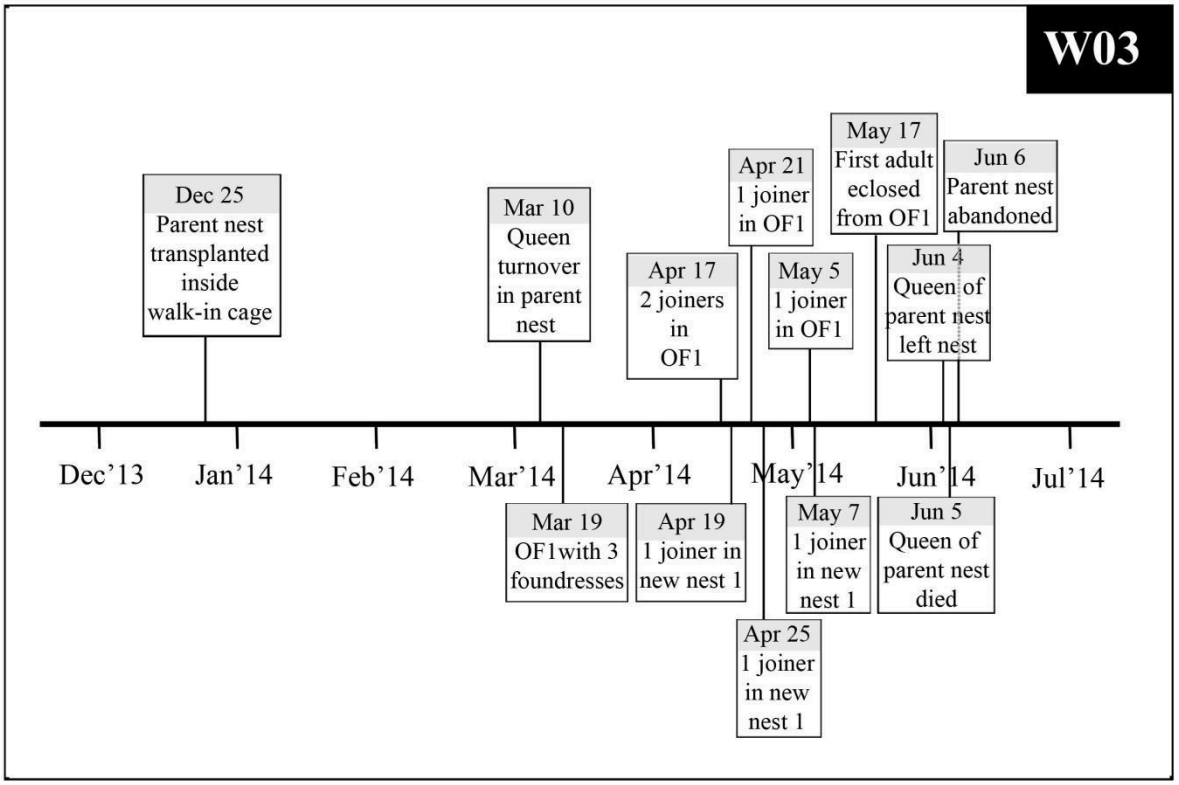

Fig S3 Timeline of parent nest W03. OF refers to offspring nests

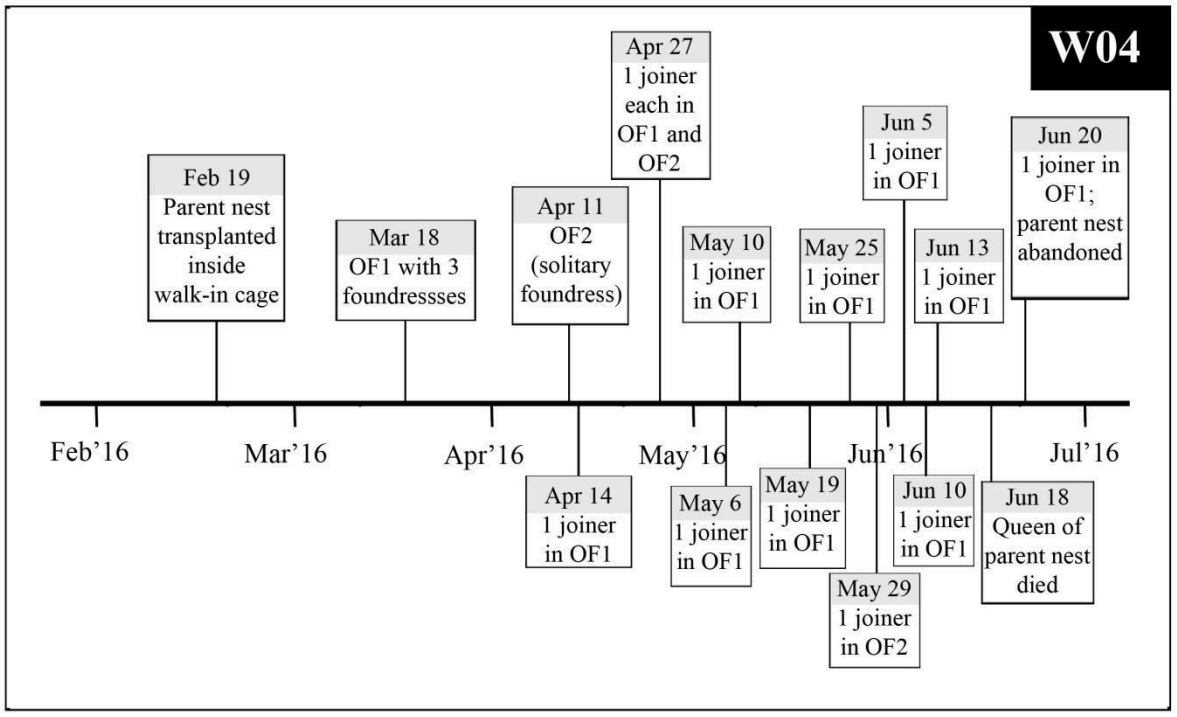

Fig S4 Timeline of parent nest W04. OF refers to offspring nests

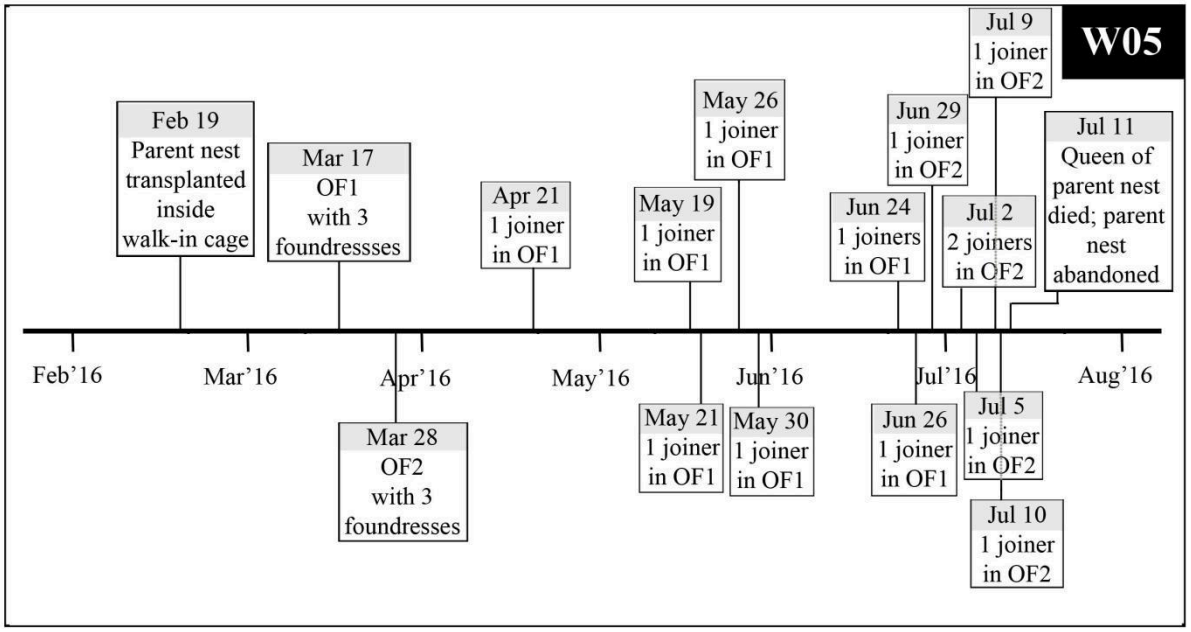

Fig S5 Timeline of parent nest W05. OF refers to offspring nests

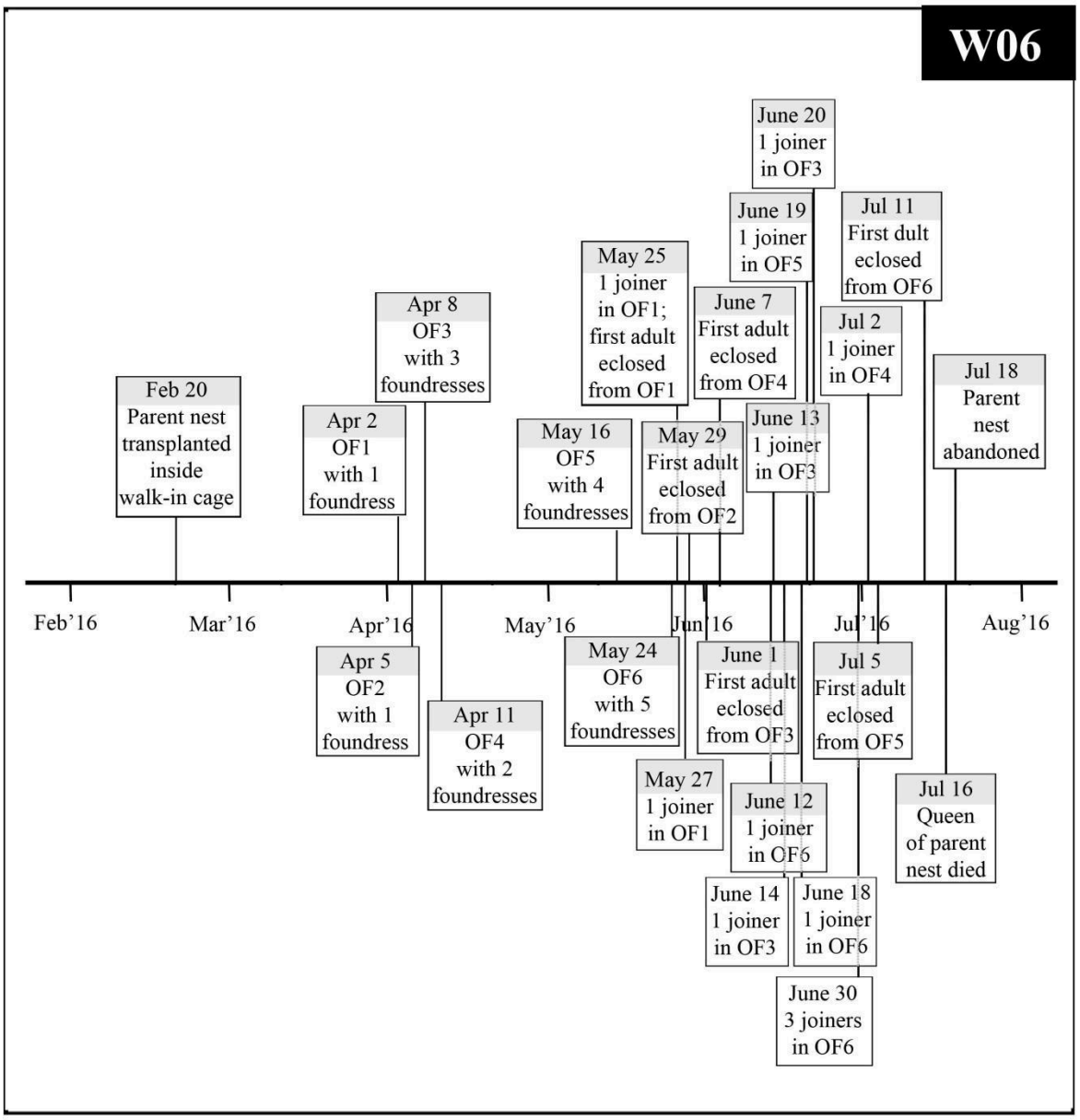

Fig S6 Timeline of parent nest W06. OF refers to offspring nests

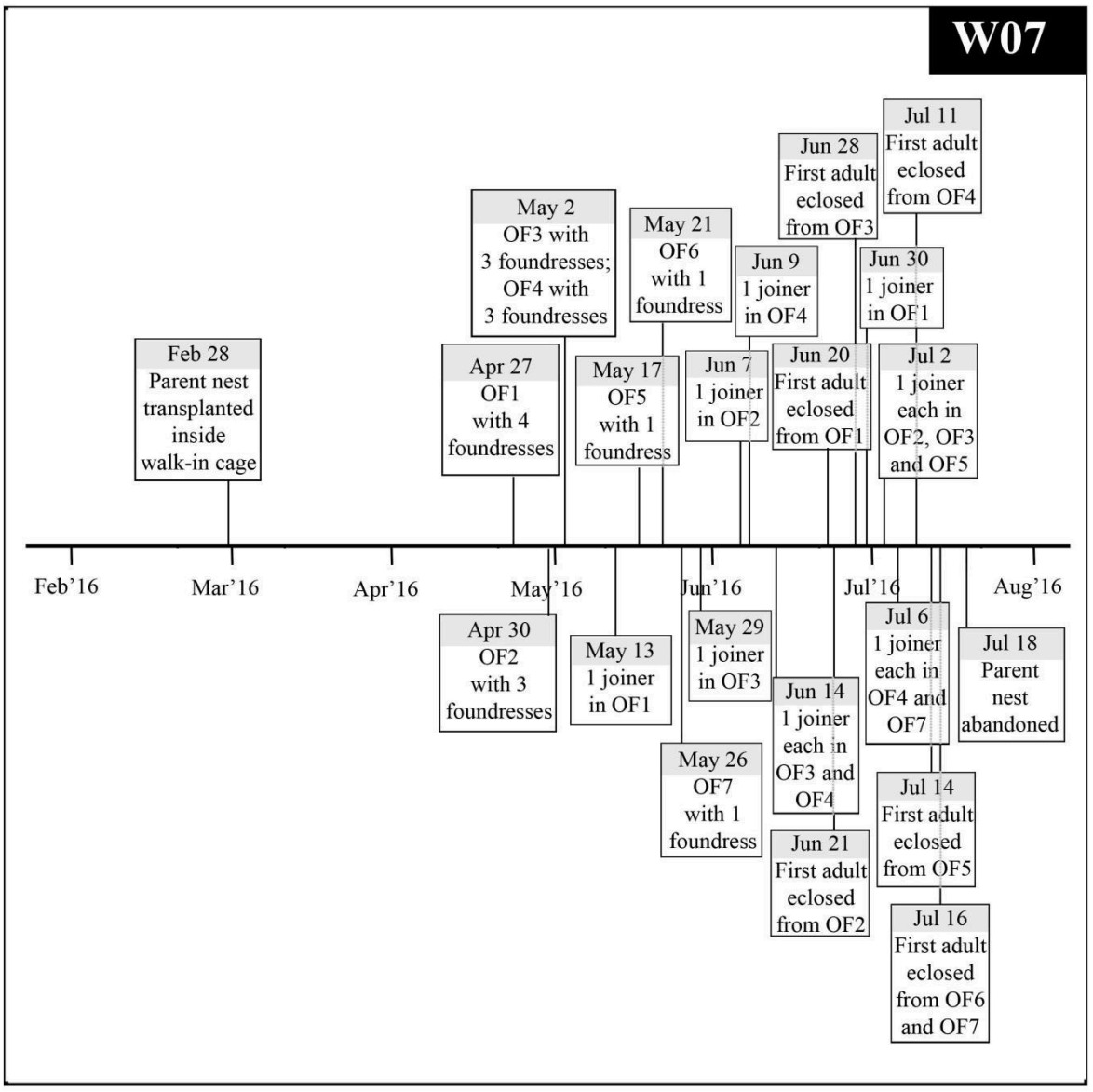

Fig S7 Timeline of parent nest W07. OF refers to offspring nests

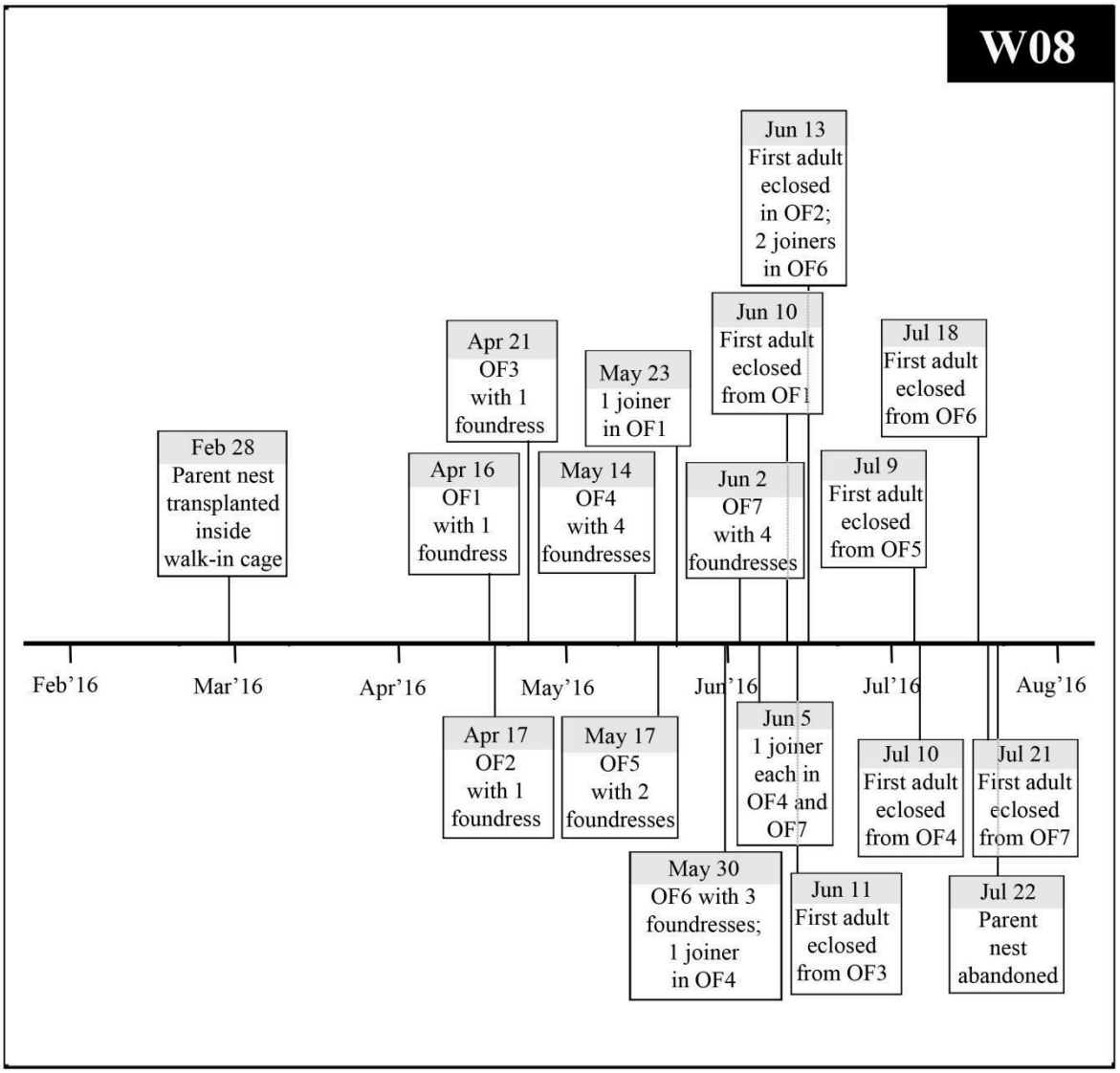

Fig S8 Timeline of parent nest W08. OF refers to offspring nests

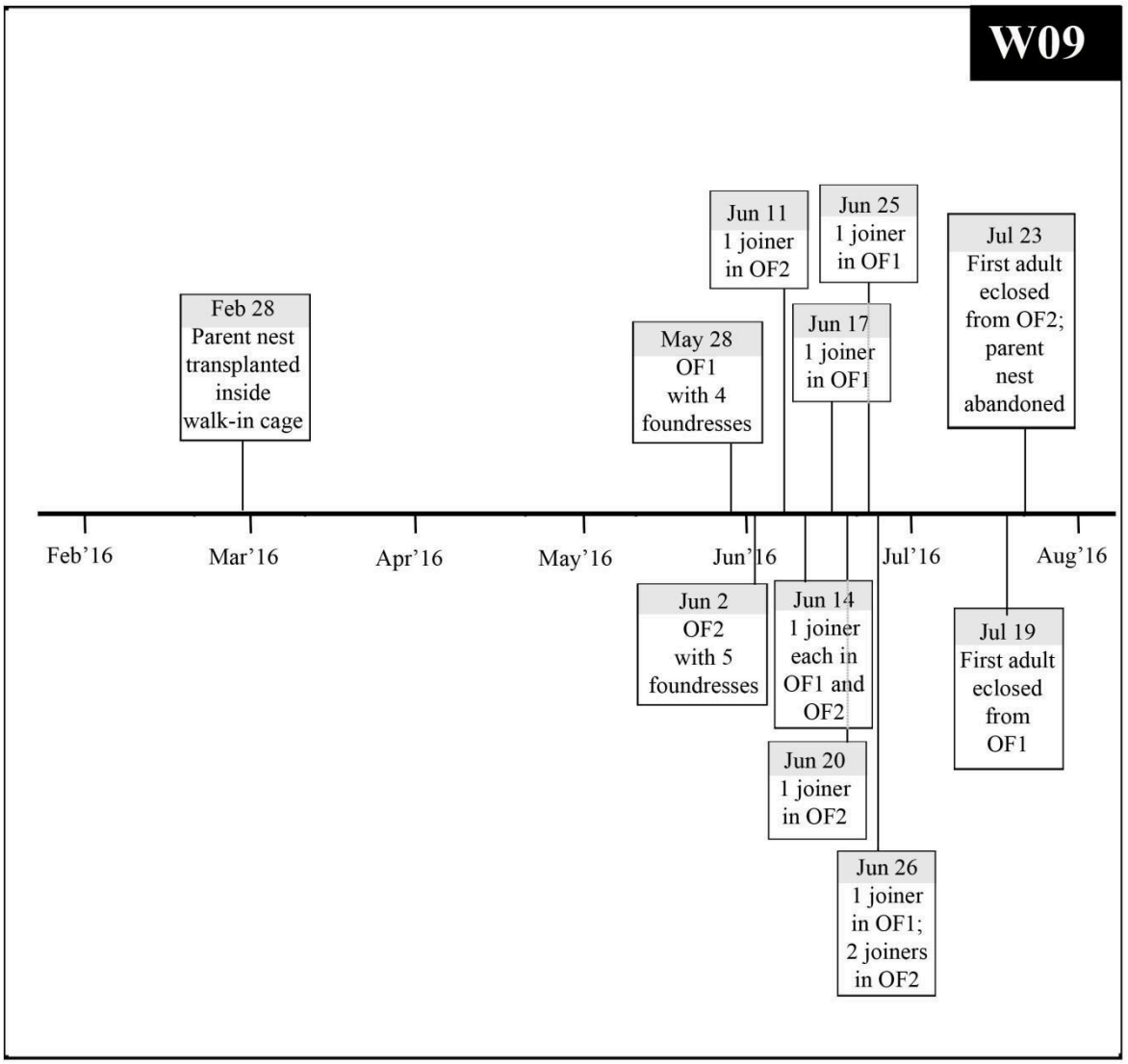

Fig S9 Timeline of parent nest W09. OF refers to offspring nests

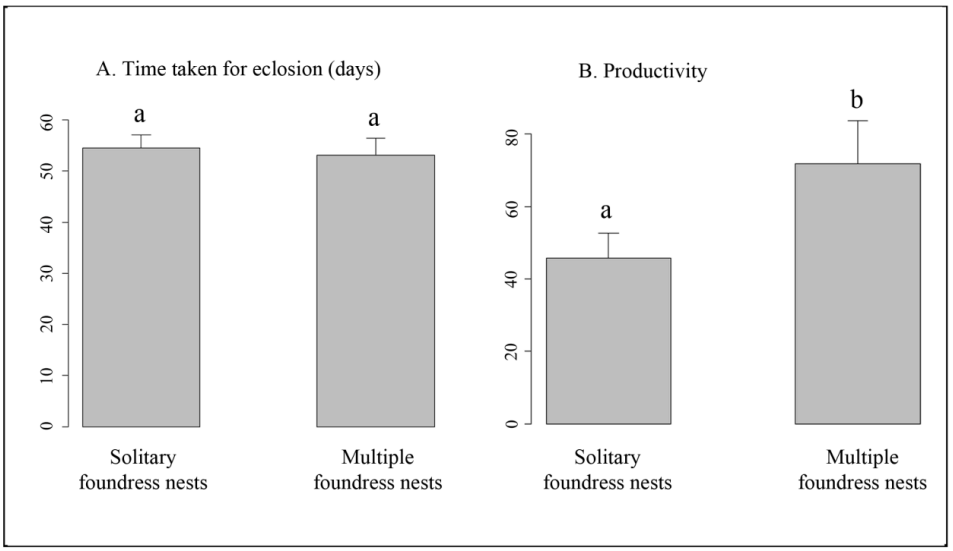

Fig S10 Comparisons between solitary foundress and multiple foundress nests for (A) time taken for eclosion of the first adult individual; and (B) productivity (total brood). Both comparisons made using Mann-Whitney U test at $\alpha = 0.05$. Bars carrying different alphabets are significantly different from each other

Tables

Table S1 Descriptive statistics of the characteristics of the 9 parent nests during transplantation inside their respective walk-in cages

Nest ID	#wasps	#cells	#eggs	#larvae	#pupae
W01	32	81	27	40	14
W02	114	156	31	98	27
W03	41	89	21	49	19
W04	64	103	15	72	16
W05	43	97	19	64	14
W06	116	178	33	111	34
W07	80	115	21	70	24
W08	77	103	23	59	21
W09	56	116	24	64	28

Table S2 Descriptive statistics of characteristics of the offspring nests

Parameters	Mean ± SD (days)	Range (days)
Age of solitary foundresses	41 ± 4.36	33 to 47
Age of multiple foundresses	47.11 ± 11.8	16 to 77
Age of foundress queens	44.9 ± 7.8	22 to 57
Age of cofoundresses	48.2 ± 13.0	16 to 77
Time taken for eclosion of first adult in solitary foundress nests	54.6 ± 2.6	51 to 58
Time taken for eclosion of first adult in multiple foundress nests	53.1 ± 3.4	48 to 59

Table S3 Descriptive statistics of the characteristics of joiners in newly initiated solitary and multiple foundress nests

Parameter	Mean ± SD	Range
Number of joiners in solitary foundress nests	1.7 ± 0.5	1 to 2
Number of joiners in multiple foundress nests	6.1 ± 1.9	3 to 10
Age of joiners (days)	14.1 ± 8.2	6 to 46
Age of joiners in solitary foundress nests (days)	17.3 ± 7.3	7 to 26
Age of joiners in multiple foundress nests (days)	13.7 ± 8.3	6 to 46

Photo S1 Comparison of dimensions of a regular experimental cage (dimensions: 45cmx 45 cm x 45 cm) and a walk-in-cage (dimensions: 2.13m x 2.13m x 2.13m)