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A scientific note on the natural merger of two honeybee colonies (*Apis mellifera capensis*)

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Natural mergers of honeybee colonies are commonplace in tropical Africa (Hepburn and Radloff, 1998), but their consequences on organizational structure are unknown. Here we determine the spatial distribution and division of labor of workers (Apis mellifera capensis Esch.) following a merger of two colonies. Two unrelated colonies (each ~3000 bees) were placed in threeframe observation hives. When workers emerged from the sealed brood of each colony, they were individually labeled and reintroduced into their respective mother hives. They are referred to as cohorts Aand B, each comprising 300 workers of the same age. The behaviors and positions of all labeled workers and queens were recorded twice daily for 24 days (Kolmes, 1989; Pirk et al., 2000). On day 14 colony B was dequeened, left its nest and merged with colony A on day 15.

4357 individual behavioral acts (48 different tasks) and 2263 queen-worker distances (1422 before and 841 after merger) were recorded for 360 labeled bees. Severe fighting initially occurred at the nest entrance when the merger began but no aggression occurred once the workers of colony B had entered the nest of colony A. No significant differences in total activity (all tasks/idleness) and mean queen-worker distances of individuals bees were observed between the cohorts A and B before and after merger (Tab. Ia). However, total activity decreased and queen-worker distances increased after merger for the individual bees of both cohorts (Tab. Ia). There were significant differences among and between tasks of cohorts A and B before and after merger (Tab. Ib). While some tasks increased and others decreased, the patterns of changes between cohorts differed (Tab. Ib). Daily counts of queen-worker distances were significantly different on four occasions before the merger but only once 24 hours after the merger (data not shown), demonstrating effective cohort integration. Also workers of both cohorts were similarly distributed throughout the nest after the merger.

On queen removal cohort B workers did not attempt to requeen but immediately merged with colony A. This may seem puzzling from an evolutionary perspective because the inclusive fitness of queenless workers is zero in the new unit. However, mergers are frequent in tropical honeybees (Hepburn and Radloff, 1998) and could be adaptive because workers may gain direct fitness. The lower levels of activity and the immediate increase in colony size after the merger probably reduce pro rata survival costs (Hepburn and Radloff, 1998). The origin of merging bees may matter, because task shifts differed in the two cohorts. This might be partially ascribed to age-related division of labor; however, this does not explain the substantial shifts observed both within and between the cohorts before and after the merger. Possibly, workers changed tasks as a result of different behavioral thresholds and task specialization (Moritz and Page, 1999). Thus, the possible acquisition of more efficient genetic specialists (Fuchs and Moritz, 1999) may also contribute to reducing pro rata costs in the new unit. The task shifts and worker distribution suggest that many bees responded to a different colony environment in the new unit, presumably necessary for social integration.

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Note scientifique sur la fusion naturelle de deux colonies d?abeilles (Apis mellifera capensis).

Eine wissenschaftliche Notiz zu der natürlichen Fusion zweier Honigbienenvölker (Apis mellifera capensis).

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Table 1

Proportional comparisons for (a) individual workers and (b) whole cohorts Aand B before and after the merger. Differences in total activity and mean queen-worker distances for individual bees were analyzed with Mann Whitney U-tests. Z-tests of proportions were used to test for significant differences in the task performances of the whole cohorts Aand B: (i) for each cohort and the new colony and; (ii) to assess frequency changes of performances before and after merger between cohorts Aand B. Only those behaviors are shown, where significant results have been obtained. Significant results are indicated with * for P < 0.01 and ** for P < 0.001 using Bonferroni adjustments (N = sample size, P = significance level, F = frequency, new colony = A + B combined).

(a) Individual bees	Before merger					After merger					Before vs. After	
											A	B
	Cohort A	N	Cohort B	N	P	Cohort A	N	Cohort B	N	P	P	P
Total activity	0.51 ± 0.33	170	0.51 ± 0.28	180		0.29 ± 0.30	143	0.33 ± 0.36	118		**	**
Mean queen-worker distance	30.1 ± 14.2	167	31.1 ± 11.9	175		43.3 ± 13.9	132	44.7 ± 16.4	106		**	**

(b) Whole cohorts	Cohort A			Cohort B			Changing patterns			New colony		
Task	Before F	After F	P	Before F	After F	P	A	B	P	vs. F	A P	B P
Walk	213	209	*	246	123	*	–4	–123	*	332	*	*
Idleness	478	903	*	612	681	*	+425	+69	*	1584	*	*
Groom self	49	15	*	78	14	*	–34	–64	*	29	*	*
Inspecting empty/egg cell	58	24	*	104	22	*	–34	–82	*	46	*	*
Inspecting honey cell	20	23		38	9	*	+3	–29	*	32		*
Build comb	1	8		3	7		+7	+4		15	*	
Groom other worker	24	8	*	27	4	*	–16	–23		12	*	*
Get groomed	4	0		10	0	*	–4	–10		0	*	*
Lateral shake	1	0		5	1		–1	–4		1		*
Dorsoventral abdominal vibration	5	0	*	2	0		–5	–2		0	*	
Begging for food	2	0		2	22	*	–2	+20	*	22	*	*
Attend queen	6	0	*	1	0		–6	–1		0	*	
Antennate with worker	52	26	*	61	12	*	–26	–49	*	38	*	*
Run (move faster ~3 cm/s)	4	0		12	1	*	–4	–11		1	*	*
Forage	1	1		0	4	*	0	+4		5		
Wax chain	0	15	*	0	10	*	+15	+10		25	*	*