This is an appendix to the paper by Kern Reeve *et al.* 2000 Genetic support

for the evolutionary theory of reproductive transactions in social wasps.

Proc. R. Soc. Lond. B **267**, 75–79.

Appendix A

Let $p_s(t)$ be the staying incentive expressed as the minimal fraction of

all present + future dyad reproduction required by the beta to stay and help

the alpha, this fraction being a function of the time t in the colony cycle.

Let T be the time at which workers emerge, and let $p(t)$ be the

'instantaneous' staying incentive, i.e. the fraction of the batch of new brood

at time t that the beta requires. These two staying incentives are related by

the equation

$$p_s(t) = \frac{\int_t^T p(x)\,dx}{T-t} \tag{1}$$

Differentiating both sides with respect to the time t, we obtain

$$\frac{\partial p_s(t)}{\partial t} = \frac{\frac{\int_t^T p(x)\,dx}{T-t} - p(t)}{(T-t)} \tag{2}$$

Thus, if the present + future staying incentive is always negative (i.e. the left-hand side of [2] is negative), then the numerator on the right-hand side expression must be negative, entailing that the instantaneous staying incentive $p(t)$ must, on average, decline with time (because the instantaneous staying incentive averaged across future times must be less than the current instantaneous staying incentive).