



The strength of selection on worker mortality predicts seasonal differences in honeybee worker senescence rate

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Honeybees have extraordinary phenotypic plasticity in their senescence rate, making them a fascinating model system for the evolution of aging. Seasonal variation in both senescence and extrinsic mortality result in up to a tenfold increase in worker life expectancy in winter as compared to summer. To understand the evolution of this remarkable pattern of aging, we must understand how changes in the longevity of individuals scale up to effects on the entire colony. Using methods from population demographic modelling, we develop a matrix model of colony demographics to ask how worker age-dependent and age-independent mortality affect colony fitness and how these effects differ by seasonal conditions. We find that there are seasonal differences in honeybee colony sensitivity to both senescent and extrinsic worker mortality. Colonies are most sensitive to extrinsic (age-independent) nurse and forager mortality during periods of higher extrinsic mortality and resource availability but most sensitive to age-dependent mortality during periods of lower extrinsic mortality and lower resource availability. These results suggest that seasonal changes in the strength of selection on worker senescence partly explain the observed pattern of seasonal differences in worker aging. As honeybees are an important pollinator, in addition to furthering our understanding of the evolution of senescence in social organisms, our results can better inform management practices for honeybees and other social organisms of economic or ecological significance.