WORKER MORTALITY AND THE EVOLUTION
OF CASTES IN THE SOCIAL WASP
POLISTES EXCLAMANS

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Summary

Workers of the primitively social wasp, Polistes exclamans, had very short average lifespans, averaging 14 days (S.D. = 11, N = 497) in 1977, 17 days (S.D. = 14, N = 503) in 1978 and 14 days (S.D. = 10, N = 222) in 1979; the oldest worker observed on a natural colony was 102 days old. Colony of origin explained more of the variance in worker longevity than did any other variable. Worker longevity decreased over the season, accompanied by an increase in larval development times and an increase in colony failure rates. In 1978 workers emerging in the presence of greater numbers of other workers lived longer which indicates that they may have performed risky tasks less often when many other females were present. Compared to 1977 and 1979, 1978 was characterized by greater numbers of workers per colony, shorter larva development times, longer average lifespans for workers, much higher probabilities of nest survival and greater average production of reproductives per colony.

Resume

Le taux de mortalité des ouvrières et l’évolution des castes chez la guêpe sociale Polistes exclamans

La durée de vie des ouvrières appartenant à l’espèce Polistes exclamans fut en moyenne de 14 jours (déviation standard égale à 11 pour 497 individus) en 1977, de 17 jours (déviation standard égale à 14 pour 503 individus) et de 14 jours (déviation standard égale à 10 pour 222 individus) en 1979. L’ouvrière la plus vieille que nous ayons observée avait 102 jours. La variance de longévité a été due à la colonie d’origine plutôt qu’à n’importe quelle autre variable. La diminution saisonnière de la longévité d’une ouvrière s’accompagne d’un accroissement de la durée du développement larvaire et d’un accroissement du nombre des colonies abortives. Ces observations suggèrent que la disponibilité de proies décroît tard dans la saison. En 1978, les ouvrières apparues en présence d’un grand nombre d’autres ouvrières vécurent plus longtemps. L’année 1978 comparée à celles de 1977 et de 1979 a été caractérisée par un plus grand nombre d’ouvrières par colonie, des durées du développement larvaire raccourcies et une durée de vie moyenne plus longue pour les ouvrières, des probabilités plus grandes pour la survie des nids et une plus grande moyenne de production de « reproductrices » par colonie.
Among social insects, worker longevity has been studied most extensively in the highly social bees, wasps, and ants (Brian, 1965; Wilson, 1971; Michener, 1974; Oster and Wilson, 1978). These species are characterized by large colonies, multiple castes, and workers that are unlikely or unable to become queens. Different castes of highly social insects often perform different functions, spending varying amounts of time within and outside the nest, and have different survivorship curves (Wilson, 1971). However, longevity has not been thoroughly investigated in social insects which lack morphological castes. Such species may be most interesting because small colony sizes mean that individual workers are much more critical to colony survival and because workers regularly become queens under certain circumstances (Strassmann and Meyer, 1983; Little, 1979).

The most pronounced dichotomy in behavior and longevity is usually between workers and the queen. The queen typically remains on the nest where she lays eggs, tends brood, and is aggressive towards other females. Workers not only defend the nest against predators and care for brood, but they also leave the nest to forage for paper, nectar, and prey. While they are off the nest, workers are most vulnerable to predators, particularly if they are weighted down by prey on a return trip to the nest. Worker life lengths are usually much shorter than queen life lengths (Wilson, 1971).

Variability in longevity among workers may indicate that there are differences in the type or frequency of work each performs. Individuals that remain on the nest and avoid risky foraging trips may increase the probability that they will become egg layers because the oldest remaining female replaces an original queen that has died (Strassmann and Meyer, 1983). However, colonies with workers that forage frequently will produce more reproductives and be less likely to fail through death of all workers.

The social wasp, Polistes exclamans, was chosen for this study because its colonies are small and abundant in central Texas, because death of all workers accounts for the demise of 13% to 76% of all colonies depending on the year, and because workers have several behavioral and reproductive options available to them which may influence their probability of dying at a given age (Strassmann, 1981a; 1981b; 1981c; Strassmann and Meyer, 1983; Strassmann et al., 1984). Workers may help on the main nest or a satellite nest, or they may become queen of either type of nest. Satellite nests are new nests started by the queen or a worker from about 30% of P. exclamans nests; they are near the main nest and are joined by additional workers which help to rear the brood. Original queens disappear from over half of all nests and are replaced by mated workers (Strassmann, 1981a).