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USE OF PHEROMONES BY MALES OF *PHIDIPPUS JOHNSONI* (ARANEAE, SALTICIDAE) TO DETECT SUBADULT FEMALES THAT ARE ABOUT TO MOLT

Courtship versatility and a complex display repertoire have been described for *Phidippus johnsoni* Peckham and Peckham, a common salticid species from western North America (Jackson 1977). The nests of *P. johnsoni* are built under rocks, under the bark of trees, and in similar places with low-intensity ambient light. Males that encounter adult females away from nests use vision-dependent displays (Type 1 courtship) similar to those traditionally associated with salticids, but adult females inside nests elicit vibratory courtship (Type 2) that is independent of vision. With a subadult (penultimate instar) female inside her nest, the male first uses Type 2 courtship and then constructs an adjacent silken chamber, cohabits with the female until she molts and mates when she matures.

Cohabitation durations, which were measured in nature and the laboratory (Jackson 1978a), tend to be only a few days in duration (mean: 7 days; maximum: 14 days), although the penultimate instar generally lasts much longer (mean: 83 days; maximum: 145 days; Jackson 1978b). Both male and female behavior may influence whether or not cohabitation will occur.

Males of *P. johnsoni* are known to begin vibratory courtship upon contacting vacant nests of adult or subadult females (Jackson 1976, 1981), and silk-associated, chemotactically-detected pheromones are probably involved. Previous studies did not ascertain the stage (days before molting) at which nests of subadults become attractive to males. This information was obtained for the present paper, because male responses to vacant nests can provide an indication of male sexual interest in subadult females without the subadult's behavior being a confounding factor.

MATERIALS AND METHODS

Juvenile *P. johnsoni* were collected in Berkeley, California in the spring of 1985 and taken to the laboratory in Christchurch. Maintenance, testing procedures, and terminology were essentially the same as in earlier studies (Jackson 1981), and only a few remarks will be provided here.

Tests were carried out by introducing males to cages with vacant nests. Vacant nests were obtained by removing the resident subadult females 2-8 min before introducing the males. The male's response was recorded for 30 min after he first contacted the nest. Only dense nests (4 or 5 on the scale provided elsewhere: Jackson 1979) were used.

Males and subadult females were taken at random from the laboratory stock for testing. A strictly random testing procedure, however, would have resulted in a disproportionate number of tests being carried out on nests of subadults nearing maturity, although this group was of lesser interest in this study. To minimize this problem, subadults suspected to be nearly ready to molt (because of their large abdomens, sedentary behavior, etc.: Jackson 1978b) were removed from the stock of spiders used in testing.

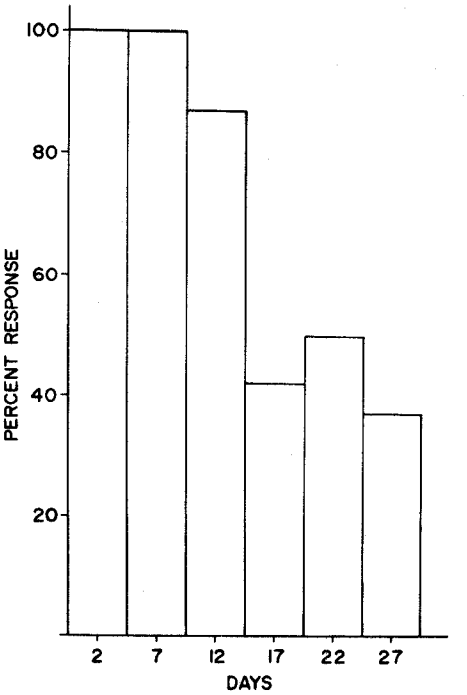

Fig. 1.—Sexual responses by males of *Phidippus johnsoni* tested with vacant nests of conspecific subadult females of differing proximity to molting. 2 days: midpoint for 0-4 days; etc. See text for numbers of tests. Response expressed as percentage of tests at each interval (0-4 days, etc.) in which nests elicited sexual responses.

Each nest was used in only one test. Each male was tested no more than once per day. After removal from their nests, subadults were given clean cages and the number of days elapsing before they molted to maturity was recorded. If they had not molted within 1 week of the last test, and if they had built a dense nest in the interval, subadults were used in additional tests.

The performance by the male of any of the following behaviors while on a nest was recorded as a sexual response: abdomen twitch (abdomen flicks up and down), probe (legs I move backward and forward on silk), vibrate (with legs on the nest, body flutters up and down). These behaviors normally occur only during intraspecific interactions, and they are described in detail elsewhere (Jackson 1977).

RESULTS AND DISCUSSION

The number of days elapsing between the end of tests and molting by females ranged from 0 to 47 days: 0-4 days, 10 tests; 5-9 days, 10, 10-14 days, 8; 15-19 days, 12; 20-24 days, 6; 25-29 days, 8; 30-34 days, 9; 35-39 days, 5; 40-44 days, 8; 45-49, 4. Nests of subadults more than 29 days from molting never elicited sexual responses (Fig. 1). Nests of subadults less than 10 days from molting always elicited sexual responses. The tendency for nests to elicit sexual responses seemed to gradually increase over the period between 29 and 10 days from molting.

These data suggest that females begin emitting a sex pheromone only late in their penultimate instar. Within 10 days of molting, all are emitting pheromones which make their nests highly attractive to males. For c. 3 weeks before this either there are fewer females emitting pheromones or pheromone emission by individual females is at a less effective level. Females apparently fail to make their nests attractive to males if they are a month or more away from molting.

Peak nest attractiveness and cohabitation initiation apparently coincide: most cohabitation durations observed in the laboratory and in nature were less than 10 days in duration, and none were more than 14 days. However, one-third to one-half of nests tested when females were 2-4 weeks away from molting elicited sexual responses from males. Whether these females would have cohabited is not known but seems unlikely given the failure to observe cohabitation durations of greater than 2 weeks in previous studies. Females probably begin to emit pheromones before they are ready to cohabit. Whether this has any adaptive significance for the female can not be inferred from exiting data.

In conclusion, cohabitation durations are the results of the combined influence of male and female behavior as well as female pheromones. There is a limited period near the end of the female's penultimate instar during which males are interested in cohabitation, but this period may be longer than the female is willing to cohabit.

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Robert R. Jackson, Department of Zoology, University of Canterbury, Christchurch 1, New Zealand.

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