A HUGE NEST OF THE COMMON YELLOWJACKET, *PARAVESPULA VULGARIS* (HYMENOPTERA: VESPIDAE), IN CALIFORNIA[1]

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ABSTRACT: A large, perennial colony of *Paravespula vulgaris* was collected in California in July 1992. The envelope was ca 97 diam and had multiple entrances. The colony consisted of 220 nonfunctional queens, 2 developing queens, 10 functional queens, ca 84,000 workers, and ca 32,000 males. The 22 combs consisted of ca 220,000 worker and 9,000 reproductive cells; 64% were empty. The colony was estimated to be 2-3 years old.

Yellowjackets typically have a one year life cycle, and the only members of the colony to overwinter are inseminated queens. They start new colonies in the spring. However, some colonies continue for more than one season (Akre and Reed 1981) and these colonies are always polygynous (Carpenter 1989). Large, perennial colonies have previously been reported for *Paravespula germanica* (F.) in New Zealand (Thomas 1960, Plunkett *et al.* 1989, Clapperton *et al.* 1989), Tasmania (Spradbery 1973a), Algeria and Morocco (Vuillaume *et al.* 1969), and Chile (Jeanne 1980, Chiappa *et al.* 1987). Perennial colonies are unusually large, and Spradbery (1973a) estimated one nest weighed 1,000 pounds. *Vespula squamosa* (Drury), the southern yellowjacket, has perennial colonies in the southern United States, especially in Florida (Tissot and Robinson 1954, Akre *et al.* 1981, Ross and Matthews 1982) and in Texas. Perennial colonies of the common wasp occur in New Zealand (Plunkett *et al.* 1989) and a perennial colony of *P. vulgaris* (L.) was recorded in California years ago (Duncan 1939). Unconfirmed reports indicate many more perennial colonies are being found in southern California where winter temperatures are mild, and prey populations are high enough to sustain a colony through the winter months. One *P. vulgaris* colony persisted from its discovery in 1984 until at least 1986 in Berkeley, CA (Alameda Co.) (Gambino 1986). A two year colony of *P. pensylvanica* (Saussure) was reported in British Columbia (Spencer 1960), and Nakahara (1980) recorded a huge perennial colony of *P. pensylvanica* (Saussure) in Hawaii (see also Gambino *et al.* 1990). The purpose of this paper is to present a detailed analysis of a nest of *P. vulgaris* collected in Burlingame (San Mateo Co.), California.

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MATERIALS AND METHODS

A large nest of *Paravespula vulgaris* was discovered in Burlingame, California, and a local pest control firm was called to kill the colony (Fig. 1). The nest was built into a dense mass of vines hanging 1.2 to 1.5 m

Fig. 1. The nest was suspended in a large mass of vines. Although the entrance holes are not readily apparent from this angle, several were at least 4 cm diam (R. Schoeppner photograph).

above a creek bank. The nest was ca 62 cm wide X 76 cm tall X 35 cm thick, with a circumference of 244 cm, a diameter of 97 cm (measurements were estimated from a photograph), somewhat heart-shaped, and had multiple entrances (ca 120 on each side). The colony was killed the week of 12 July 1992, and all nest material and occupants were shipped to Washington State University at Pullman for study. The nest, as collected, complete with severed vines, weighed ca 64 kg. The nest was stored in a freezer at —5.0° F until the occupants and combs were counted and analyzed. Males were individually counted first, and it was determined that 1,385 fit into a 250 ml graduate cylinder when it was vigorously tapped on the substrate to settle and compact them. The count was stopped when they no longer settled. Similarly, 2,011 workers were needed to fill a 250 ml cylinder. All remaining individuals, except queens, were measured volumetrically to estimate number of workers and males in the colony. Queens were individually tallied, injected with Kahle's to preserve them, and placed into 70% ETOH until they were dissected for ovarian development.

All combs of the nest were analyzed for the presence of pupal caps, larvae, and eggs. A 12 in grid divided into 1 in squares facilitated the count (MacDonald *et al.* 1974). In some sections the cells were individually counted. The nest was sectioned in California to fit into the shipping containers, and we tried to reconstruct comb placement before the analysis began. Sections were numbered and flagged as they were unpacked to aid us in this endeavor.

RESULTS

The colony consisted of ca 84,000 workers, 32,000 males, and 232 queens (Table 1). The total number of cells in the 22 comb layers of the

Table 1. Numbers and types of adults collected with the colony. Functional, developing, and nonfunctional queens (parens) add up to "Queens."

Adult Type	Number Counted
Queens	232
Functional	(10)
Developing	(2)
Nonfunctional	(220)
Males	31,811
Workers	83,784
Total Adults	115,827

nest was ca 230,000, but 146,000 of these cells were empty (Table 2). Dissections of the queens revealed that 10 had fully functional ovaries that filled the gaster (eggs are 1.0-1.5 mm when ready to lay). Two had a slight development of the ovarioles but no eggs were >1 mm. All functional queens had multiple age spots or dark discolorations on the gaster (Ross 1984). The remaining 220 queens showed no ovarian development.

DISCUSSION

Although large, this colony was probably entering a period of decline as evidenced by the great number of empty cells. Ten functional queens should have been able to lay eggs in many of these empty cells unless there was conflict and fighting among workers and/or queens in the nest. We could not determine any spheres of influence for any of the queens because of the state of the nest when received.

The large number of males in the colony suggests that workers were laying eggs and producing at least some or perhaps most of these males.

Questions asked of neighbors suggested that this nest was observed for 30 years. We have no evidence to support this claim and indeed, the nest analysis, including the construction of reproductive cells on the periphery of some combs, suggested that the nest was probably 2 years old, at most.

Photoperiod is probably the stimulus that allows new queens to circumvent reproductive diapause and to start egg development after they are inseminated (Spradbery 1973b, Ross and Matthews 1982). Queens frequently rejoin the parent colony if the photoperiod is still increasing

Table 2. Occupants of cells from the 22 combs. Small, medium, and large larval counts (parens) add up to "Larvae."

	Worker	Reproductive	Total
Eggs	2,884	82	2,966
Larvae	26,938	437	27,375
Small	(4,089)	(93)	(4,182)
Medium	(11,925)	(170)	(12,095)
Large	(10,924)	(174)	(11,098)
Pupae	51,553	972	52,525
Empty cells	138,954	7,779	146,733
Total	220,329	9,270	229,599

(up to 21 June) in that geographical area, and if the winter temperatures are mild. They can also rejoin the colony as nondiapausing, functional queens when the daylight is very short as the "window" of receptiveness seems to be 10-14 hrs (Spradbery 1973b). Photoperiods longer or shorter do not induce reproductive diapause, and the ovaries in these new queens are able to develop.

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