

NESTS OF *DOLICHOVESPULA NORWEGICA* AND *D. NORVEGICOIDES* IN NORTH AMERICA (HYMENOPTERA: VESPIDAE)^{1, 2}

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ABSTRACT: This study reports on nests of rarely found Boreal species of yellowjackets. Nests of both species were either supraterrrestrial (half buried in the soil) or were suspended from vegetation very near to the ground. Both species produce envelope paper of a very loose, coarsely woven texture, suggesting that colonies usually build their nests in protected locations. Colony sizes were much smaller than that reported for other *Dolichovespula* species.

In February 1978 a compendium of data on the biology of yellowjackets of North America was submitted to USDA for publication as a handbook (Akre et al. 1981). Included was information on identification and nesting biology of the 18 species of yellowjackets occurring in North America. However, there was little to report concerning the biology of *Dolichovespula norwegica* (F.) [= *D. albida* (Sladen), see Eck, 1981] and *D. norvegicoides* (Sladen). *D. norwegica* in North America is restricted almost entirely to the Hudsonian Zone of the Boreal Region, while *D. norvegicoides* occurs in the Hudsonian and Canadian Zones (see figs. 34 and 41, Akre et al. 1981). Thus, both species occur in areas where there have been few investigations or collections of yellowjacket colonies. Indeed, only two nests of *D. norwegica* had ever been found; one was reported as being subterranean, the other "partly subterranean" (Bequaert 1931). Recently, two additional colonies of *D. norwegica* were collected in the Canadian arctic (Yamane et al. 1980). Both nests were "supraterrrestrial" (half buried in the soil, see Wagner 1978), and each contained about 170 cells. Similarly, only two nests of *D. norvegicoides* have been collected, and the single nest analyzed had two empty combs with a total of 234 cells (Akre et al. 1981). Unfortunately, only 23 dead workers were present when it was collected in October long after the colony had died. Both nests were attached to shrubs 10-15 cm above the ground.

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The purpose of this paper is to describe one additional nest of *D. norwegica* and three of *D. norvegicoides*.

Dolichovespula norwegica

The nest of *Dolichovespula norwegica* was collected 21 August 1983 on Fern Mine Road, 0.8 km southeast of Fern Mine, in Hatcher Pass, Talkeetna Mountains, near Palmer, Alaska. The collection site is approximately 975m (3200 ft) elevation. This elevation is above tree line at those high latitudes, and the vegetation consisted mainly of dense willow (*Salix* sp.) cover about 1.2 m tall. The nest was fastened to a 1.9 cm diam willow branch with the main attachment at the top. It also had a 1 cm diam attachment to a side branch just below the top of the nest. The nest was suspended 15 cm above ground.

The nest was nearly spherical, 10.5 cm high by 10.5 cm diam at its widest point. The nest entrance was located 3 cm from the bottom of the nest and measured 1.75 by 2.5 cm. There were 11 envelope layers completely enclosing the combs, while several additional layers extended from the attachment point to the edge of the top comb, where they were fastened to cells along the edge. In addition, several cells along the edge of comb two were papered over, a characteristic of colony decline.

The envelope paper was coarse in texture, with frequent holes left in the weaving (see Yamane et al. 1980). A number of sources were obviously used for the fibers. Some were finely ground grey fibers, others varied from black to rust to occasional, very coarse, straw-colored fibers. Pieces of leaves from a broadleaf plant 2 to 10 mm diam were incorporated into the outer envelope.

The nest was devoid of brood, but 4 workers were present. A single fly maggot (either a sphaerocerid or an anthomyiid) was collected from the inner surface of the envelope.

The nest was composed of 3 combs. The attachment fastening the nest to the branch obscured any suspensoria between the top comb and the envelope, and in this area the envelope was broadly joined to the comb in an area 1 by 2.5 cm. Suspensoria on combs two and three were buttresslike. Comb two had a 2 cm long Y-shaped suspensorium in the center, and a 1 cm long suspensorium on one side nearly extending to the edge of the comb. Twelve measurements of height taken at 2-4 mm intervals showed the center suspensorium averaged 6 mm tall (range 4-8 mm, S.D.=1.35), while that to the side averaged 4.6 mm (n=5, S.D.=2.01). Comb three had a single T-shaped suspensorium 1.2 by 0.5 cm, 6.2 mm average height (n=5, S.D.=1.84).

There was a total of 357 cells in the 3 combs (Table 1). Cell sizes were also measured so they could be compared to values given for other species.

Since the cells were not all even hexagonals (especially along the edge of the comb), each cell was measured in two directions across the opening and the figures averaged. Worker cells from comb 1 averaged 5.17 mm ($n=12$, S.D.=0.59), while the reproductive cells of combs 2 and 3 averaged 6.33 mm ($n=24$, S.D.=0.36, 12 from each comb).

Unfortunately the colony was too far into decline when discovered to make any meaningful assessment of productivity (total workers, production of new males and queens).

Dolichovespula norvegicoides

Colony 1 was found 10 August 1979 in the St. Joe National Forest, 9 miles northeast of Harvard, Latah County, Idaho, adjacent to the Palouse River Road. The nest site was located in a mature, closed-canopy forest of grand fir, Douglas-fir, and western red cedar (*Thuja plicata*-*Pachistima myrsinites* habitat type, Daubenmire and Daubenmire 1968). The nest was inside a decayed log of about 10 cm diam in a shaded area of the forest. The colony had been attacked by an animal, and all combs of the nest were gone. The nest had probably been initiated within the log in a cavity that was expanded as the nest was enlarged. The envelope that remained fastened to the top of the cavity showed the nest was 7.5 cm diam at its upper attachment to the log. In addition, there was a smooth depression in the log duff, where the base of the nest had been, 6 by 6.5 by 3 cm deep. Thus, the nest had been approximately 10 cm tall. The workers had obviously excavated into the rotten log to expand the nest downward since the depression was so smooth and cone-shaped. An entrance tunnel 5 cm long went from near the base of the log directly through the log and into the nest cavity.

Although all the combs were gone, 18 workers and the foundress queen (age spots on abdominal terga, frayed wings) were collected inside the nest remnants. Since neither construction of new combs nor repair of the envelope was evident, it was assumed that the animal attack was very recent.

Several abdominal terga of a *D. norvegicoides* queen were found in the nest cavity. This suggests that a conspecific fight for the nest occurred, and that the loser was killed (see Akre et al. 1976). Several dipterous maggots were also present in the nest cavity, but since it was impossible to positively verify them as associates, they were discarded.

Colony 2 was collected 14 August 1982 near Weld, Maine. The nest was built into the side of a hillock, with half the nest underground (supraterrrestrial). Thirty-one workers and 21 males were present when the nest was collected, but no queen.

The nest was composed of 3 combs with a total of 263 cells (Table 2). The roof of the nest was a dense mat of envelope layers (15-20) 20 mm thick, into which were woven multiple strands of moss gametophytes. Unfortunately, the suspensoria were crushed when the nest was received for analysis, so no information is available on them, nor on cell diameters except for a notation that all were $\cong 5$ mm.

Colony 3 was collected 28 July 1983 at the University of Alaska Agricultural Experiment Station, Matanuska-Susitna Borough, Palmer, Alaska. The nest was attached to the underside of a 45 cm square, 3/4 in. plywood sheet supported off the ground by 1 in. angle iron. The nest was fastened to the plywood by a 2 by 2.5 cm attachment area and extended down into a shallow depression. This depression did not appear to be excavated by workers but was cleared of leaves and debris. An entrance hole 7 mm diam was located laterally near the bottom of the nest. Probably because space for expansion under the plywood was limited, the nest was flat on the top and bottom, and shaped much like a doughnut or tire viewed from the side. The nest was 85 mm diam by 35 mm deep. Cottonwood leaves were abundant at the nest site, and two leaves were woven into the envelope layers, as was a small pebble. The envelope layers were not continuous under the combs. An area 25 by 35 mm at the bottom of the nest, directly in contact with the soil, was left open. The envelope was comprised of 9 more or less distinct layers, each ending further down the side of the nest. Inside the nest the envelope layers at the top of the petiole returned to the edge of the comb where it was fastened in 4 places.

Collected with the nest were 5 workers, one male, and 3 queens. An additional 4-6 workers were flying around the nest site but not collected, and 6 workers were found under cottonwood leaves adjacent to the nest. No foundress was present, as would be expected from the empty cells present in the combs.

The nest was composed of 2 combs with 122 cells (Table 2). The top comb was connected to the substrate with a single pedicel 5 mm wide by 7 mm tall. It was highly glazed with secretions and very flexible (see Yamane et al. 1980). Comb 2 had a single pedicel off-center so it was 5 mm from the edge of the comb. The pedicel was 1 mm thick, with no glazing.

The cells in the center of comb 1 were 5 mm diam ($n=5$, S.D.=0.12). However, there were large cells added to the periphery of the comb of 6.0 to 6.5 mm diam ($n=5$, S.D.=0.21). A section of 25 cells on one edge of the comb was tilted upward at a 45 degree angle from the main plane of the comb, perhaps indicating that the nest was damaged at one time, or that the available space under the plywood severely limited expansion. Eleven of the capped cells of comb 1 contained males, and the new queens must also have emerged from the large cells on the edge of this comb.

Two muscoid fly larvae were present in a cell of comb 1. These were identified as Piophilidae, cheese skippers, a family of general scavengers.

The envelope paper of all three nests had a very loose weave, with many small holes, and was comprised of very small fibers. It would appear that the workers malaxate the fibers very little before they are applied to the envelope. The only notable difference between these envelopes and that of *D. norwegica* is that the latter used much larger fibers.

DISCUSSION

Worker cell size in *D. norwegica* averaged 5.17 mm and reproductive cells averaged 6.33 mm diam, while in *D. norvegicoides* these values were 5 mm, and 6.0 to 6.5 mm. These are comparable to the values given for *D. arenaria* (F.) of 4.5 to 5 mm (worker) and 6.0 to 7.0 mm (reproductive or queen cells) (Greene et al. 1976). However, colony sizes of both species are much smaller than reported for other *Dolichovespula* species. For example, Greene et al. (1976) reported that 60% of *D. arenaria* colonies investigated in Washington and Idaho had nests of over 2,000 cells. Similarly, *D. norwegica* nests in Europe have a reported maximum cell number of approximately 1,400 (Spradbery 1973).

D. arenaria has a strong tendency to use the upper combs for reproductives (Greene et al. 1976). This may also be true of *D. norvegicoides* since 11 capped cells on comb one of colony 3 contained males. Other cells probably also contained males, but these were indistinguishable as larvae and eggs. Obviously the 3 new queens found with the nest also emerged from cells on comb 1, as comb 2 was so small it did not have any capped cells.

None of the 4 colonies investigated contained parasites such as *Sphecophaga vesparum burra* (Cresson) (Hymenoptera: Ichneumonidae) even though Greene et al. (1976) reported that 7 of 20 *D. arenaria* colonies collected in 1974 in Washington harbored this parasite. However, even in *D. arenaria* colonies the rate of parasitism was very low. It is surprising that few scavengers were found, especially in nests of colonies in decline. Perhaps this is related to the relatively short period of colony existence, since both *D. norwegica* and *D. norvegicoides* peak early in the season with their very small colonies, then rapidly decline.

The loose, coarsely woven texture of the envelopes produced by both *D. norwegica* and *D. norvegicoides* in North America suggests that most colonies of these species are probably supraterrrestrial or in some sort of protected location. Indeed, perhaps this is the reason so few colonies have been found. Even nests of *D. arenaria* in mountainous situations are probably very commonly supraterrrestrial or subterranean (Greene et al.

1976, Roush and Akre 1978). The nest envelopes of these species are certainly much less durable than envelope produced by either *D. arenaria* or *D. maculata* (L.) and would certainly sustain major damage in exposed locations. In addition, they would appear to be much less efficient at thermoregulation since they are so coarsely woven, with numerous holes.

Table 1. Size and composition of combs of the *Dolichovespula norwegica* nest.

Comb	Size in mm	type	empty	CELLS		Total
				larvae	capped	
1	60 x 75	worker	91	0	0	91
2	75 x 75	reprod.	146	5	3	154
3	50 x 50	reprod.	102	4	6	112
Total	—	—	339	9	9	357

Table 2. Nests of *D. norvegicoides*

Colony	Nest Site	Comb	Size mm	type	empty	eggs	larvae	capped	Total
1									
Harvard, ID	"Subterranean" decayed log	a/	—	—	—	—	—	—	—
2									
Weld, ME	Supraterrrestrial	1	68 x 57	worker	b/	—	—	—	141
		2	55 x 75	reprod.	—	—	—	—	106
		3	17 x 18	reprod.	—	—	—	—	16
3									
Palmer, AK	Supraterrrestrial	1	47 x 38	mixed	29	14	15	25	83
		2	21 x 27	reprod.	32	0	7	0	39

a/ eaten by animal, possibly bear
b/ unavailable

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