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ECONOMICS OF CELL PARTITIONS AND CLOSURES PRODUCED BY
PASSALOECCUS CUSPIDATUS (HYMENOPTERA: SPHECIDAE)John M. Fricke¹

ABSTRACT

Sphecid wasps, *Passaloeccus cuspidatus* were observed gathering fresh pine resin (*Pinus strobus*) which they used for creating partitions and closures in their nests. Based upon measurements taken of the cells, and an estimate of the load carried by the wasps, the number of collecting trips made by the wasps was correlated with the quantity of resin contained within the nest partitions and closures.

Passaloeccus cuspidatus Smith is a small pemphredonine sphecid wasp that utilizes pre-existing tunnels and trap nests for its nests, which have cells within arranged linearly, each separated by a thin partition of pine resin. A final closure of the nest is also constructed of resin. Female wasps, therefore, must collect the resin from recently-oozing wounds on coniferous trees. This study examines the relationship between the amount of resin contained within the nest and the number of trips required to collect the resin.

Resin gathering activity of *P. cuspidatus* was observed at resin flows on *Pinus strobus* on 17 June 1987 in Ann Arbor, Michigan (see Fricke, 1992). Large fence staples (1.5 in) had been used to secure trap nest bundle carriers (described previously in Fricke, 1991) to trunks of trees selected as trap-nesting stations. Resin flows were produced in response to fence-staple wounds. *Passaloeccus cuspidatus* selected resin flows with dimensions 9 by 4 mm. The wasp's mandibles were used in a scissors-like fashion to excise a drop of resin with a diameter the width of the wasp's head. When separation of a resin drop was nearly complete, the wasp backed directly away from the resin flow. A thin strand of resin, connecting the resin drop to the flow, was drawn into the excised drop by lateral and circular motions of the wasp's head. Any remaining remnant of the resin strand was cut off by a continued backward movement combined with an abrupt turning to the left or right. Twenty-two resin gathering trips were observed between 0947 and 1142 hr. Resin drops were carried on the ventral surface of the mandibles.

Three separate resin flows were used during these resin gathering activities. Resin flow (I) was visited repeatedly and the wasp returned directly to the resin flow, landing within a few cm of the flow and approaching it directly. After a number of resin gathering trips, the remaining portion of the resin flow was too small, or of improper consistency, and was abandoned as a resin source.

The pine trunk was searched for another appropriate resin flow and resin gathering resumed. Resin flow (II) was then used repeatedly as a resin source.

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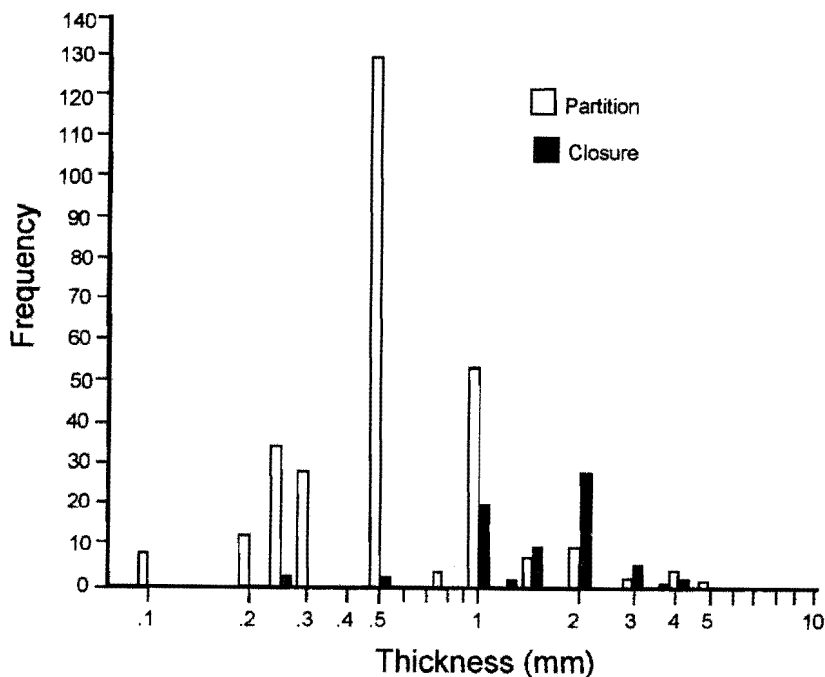


Figure 1. Thickness of resin partitions and closures in *Passaloecus cuspidatus* trap nests.

After three or four trips to resin flow (II) the wasp made a trip to resin flow (I), explored the resin mass, and returned to resin gathering at flow (II). Resin gathering was again observed 18 June (eight trips, 1631–1713 hr) and 24 July (11 trips between 0900 and 1000 hr, with no elapsed time recorded).

Ring of trap nest bore openings was also observed and the following action pattern was noted. *Passaloecus cuspidatus* landed at or within a few centimeters of the trap nest opening, entered head first, exited and re-entered gaster first. The wasp then appeared at the nest opening and with her mandibles spread a thin layer of resin on the face of trap nest at the margin of the opening.

Krombein (1967) noted that resin partitions were usually 0.25 and occasionally 4.0 mm thick, while closures, ranging from 0.25 to 4.0 mm, were usually 1.0 mm thick. Vincent (1978) noted that 4 drops of resin were used for nest closures. Data from my studies of 1987 were examined to determine the variability of partition and closure dimensions, their volumes, and the energetics of resin gathering. It was noted during resin gathering described above that an excised drop of resin had a diameter approximately equal to the width of the wasp's head. Given a diameter of 1.5 mm, a resin drop carried by *P. cuspidatus* has a volume of 1.77 mm³. The thickness of resin partitions of 295 provisioned cells ranged from 0.1 to 5.0 mm in trap nests with bore diameters 2.4

to 6.4 mm. Median and modal partition thicknesses were 0.5 mm; the mean partition thickness was 0.66 mm. Seventy-one closures had thicknesses ranging from 0.25 to 4.0 mm with a mean of 1.69 mm.

Based upon the bore diameters and thicknesses indicated above, the volume of resin required for partitions and closures ranged from 1.13 mm³ to 62.83 mm³. The volumes of resin required for partitions and closures in bores most frequently used by *P. cuspidatus* are respectively: 3.2 mm - 5.31 and 13.59; 4.0 mm - 8.29 and 21.24; and 4.8 mm - 11.94 and 30.58 mm³. Given a volume of 1.77 mm³ per resin drop, the numbers of resin gathering trips for partitions and closures for these respective bores are: 3.2 mm - 3 and 7.68 (8); 4.0 mm - 4.68 (5) and 12.0; 4.8 mm - 6.75 (7) and 17.28 (18).

These data are rather conservative since they have not taken into consideration the foundations for closures or partitions. Foundations, consisting of a resin ring on the wall of the trap nest bore, have base widths greater than that of their respective partition or closure. Resin partitions, closures, and their respective foundations, represent a significant energy investment. Resin volumes and bore diameters across which resin must be drawn possibly contribute to the upper limits of the bore diameters used by *P. cuspidatus*. The distribution of partition and closure thicknesses from *P. cuspidatus* trap nests are given in Figure 1.

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