Ant Engineering Across Scales: Linking Species Diagnosis to Nest Architecture and Validating Gel Substrate for High-Throughput Excavation Experiments

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An unusual population of Camponotus (Mayr, 1861) was investigated, initially suspected to belong to the complex Camponotus sansabeanus (Buckley, 1866). Worker and gyne specimens were used in a provisional taxonomic treatment along with standardized imaging and morphometrics before being compared with reference material. A consultant clarified that while morphologically similar, they were phylogenetically closest to Camponotus maccooki (Forel, 1879) and an undescribed species from San Clemente Island. To test whether nest architecture, an extended phenotype determined by digging behavior, produces an additional quantifiable line of evidence for comparative biology, a pilot experiment quantifying the effect of different digging media on nest architecture and digging behavior was performed using harvester ants (Pogonomyrmex; Mayr, 1868), which are keystone ecosystem engineers. The digging behavior of worker cohorts of Pogonomyrmex rugosus (Emery, 1895) and Pogonomyrmex occidentalis (Cresson, 1865) in standardized dirt and gel substrates were compared, with measurements taken of latency to dig, branching, and excavated volume. Digging was delayed in gel versus dirt, but volumes excavated were comparable across substrates, suggesting that gel can recover key architectural output metrics despite differences in behavioral initiation. A three-stage progression of novel captive-rearing methodology emphasizing modularity, ease-of-observation, and humidity control were developed and tested. Together, the results propel gel-based systems as a scalable platform for high-throughput, continuously monitored experiments on ant architecture while clarifying which behavior metrics may be substrate-sensitive.

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