Studying House-Hunting in the *Temnothorax* Ants Using Distributed Computing Theory

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DC results

Bio insights
The House-Hunting Problem

There is, however, another dimension to quorum attainment: it marks the last in a series of increasing levels of commitment to a site. A scout enters the first level when she decides to search for a new nest, spurred by the inadequacy of her current home. The second level begins when she finds a candidate and assesses its quality. If she judges it good enough, she advances to the third level in which she recruits fellow scouts to evaluate the site. The final level comes only when quorum attainment indicates that these others have confirmed her judgment by continuing to visit or recruit to the site. From that point on, she pays no further attention to population, and will continue to transport even if the site is experimentally emptied of nestmates.

This series of steps constitutes a decision algorithm that guides scout behavior (Figure 2). The algorithm clarifies two otherwise puzzling observations. First, a scout that has found the new site but not yet sensed a quorum will sometimes retrieve isolated brood items. She carries these not to the safety of the intact new site, but to the destroyed old nest. Second, after sensing quorum attainment, many scouts lead 'reverse' tandem runs from the new nest back to the old. Both behaviors make sense if we assume that recruitment behavior is described by two simple rules: tandem runs are only led away from home to a place where work needs to be done, and transports are made only toward home to repatriate lost or misplaced nestmates. Before a scout senses a quorum at a new site, the old nest is still her home, despite being heavily damaged. She transports lost ants there, and she leads tandem runs away from there to summon help in assessing a candidate site. Her allegiance switches to the new site only when it attains a quorum. From then on, she transports ants only to her new home and she leads tandem runs away from there to summon help in retrieving misplaced ants.
Model (Platform)

- \( n \) ants
- \( k \) nests

Connections:
- **tandem**
- **transport**
- **search**

\( \# \) ants
Tandem Transport ~ log n

Lower Bounds

Together at least log n

Search ~ k log n

n ants

k nests

n/k + (n - n/k) / k
Algorithm

$\log k + \log n$
Conclusions

DC results:
well-known DC problems (gossip, consensus)

Bio insights:
computational evidence that quorums are useful

What Next?

better lower bounds (artifact of consensus)

more realistic models
more insights

robust algorithms

algorithms that match real ant behavior?