

The fitness consequences of bearing domatia and having the right partner: experiments with protective and non-protective ants in a semi-myrmecophyte. Gaume *et al.*

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Definitions

- **Myrmecophyte** - A plant that affords shelter and food to certain species of ants which live in symbiotic relations with it (e.g. *Humboldtia brunonis*)
- **Extrafloral nectary (EFN)** - a gland-like organ outside of the plant that secretes nectar
- **Caulinary domatia** - swollen internodes with excavated piths and self-opening entrance holes that are inhabited by microfauna such as ants
- **Polymorphic** - The occurrence of different forms, types, or stages in individual organisms or in organisms of the same species (independent of sexual variation)
- **Mutualism** - An association between organisms of two different species in which each member benefits



Main Questions

- Do caulinary domatia provide a selective advantage to *Humboldtia brunonis*? If so, does the selective advantage vary with the type of ant species occupying the plant? What is the nature of benefits mediated by the domatia? Furthermore, is the mutualistic nature of the ant-plant relationship necessary for myrmecophytism to spread?

Motivation for the Questions

- The selective advantage provided by caulinary domatia to their host has been shown in other plant-arthropod systems, but it is only assumed in ant-plant systems
- Comparing the fitness parameters of plants with and without domatia amongst the same species has never been done before – *Humboldtia brunonis* provides this opportunity
- To gain a better understanding of how selection on the plant partner has shaped myrmecophytism
- To understand the role played by mutualistic ant-plant interactions in the evolution of myrmecophytism

Summary of Paper

Location: Western Ghats, India

Methods: measured:

- presence of domatia and ant identity on total fruit production
- ant exclusion effects
- activity of ants, herbivores, and nectar production
- reaction of ants to caterpillars

Results:

- several ant species present
- fruit production enhanced in domatia bearing trees
- fruit production highest in trees occupied by *Technomyrex albipes* (white-footed ant)
- *T. albipes* only ant that provided anti-herbivore protection to plant
- *T. albipes* had higher patrolling density and shorter lag time for attacking caterpillars



Summary of Paper

Discussion:

- plants associated with domatia produce more fruit
- anti-herbivory provided only by *T. albipes* likely the greatest benefit mediated by domatia
- other non-protective microfauna inhabiting domatia may also provide benefits through nutrient exchange
- there are costs & benefits of domatia
- effectiveness of *T. albipes* due to high patrolling densities, aggressiveness, and extrafloral nectaries
- ant densities highest on new growth because of increased nectar
- selection for myrmecophytism could be maintained by *T. albipes* at a larger scale because of its nomadic lifestyle



The Authors



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Focus: insects and their operation, ecology, and evolution (mechanisms of plant-ant interactions, adaptations, and role in the ecosystem)

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Trees and Ants

- The Relationship between the ants and the tree is mutualistic
- *H. brunonis* has domatia that provide shelter for the ants, as well as extra floral nectaries that provide the ants with food
- The waste of *T. albipes* is rich in nitrogen, which is absorbed by the plant
- The ants attack caterpillars and other insects, thus protecting the tree from herbivory



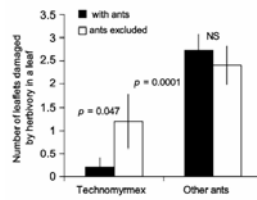
Mutualism in General

- Many plants and animals have relationships that are beneficial for both species
- Many types of flowers and bees
- Plants with berries and birds
- Moths and orchids
- Ants and acacia
- Organisms that have this type of relationship generally fair better



Why Have Domatia?

- *H. brunonis* is a legume, and not all of them have domatia
- Also, it was found that trees with domatia didn't grow taller than those without, and with some species of ants the trees fared worse than without them
- However, trees that were inhabited by *T. albipes* had greater fruit production, and suffered much less herbivory



Why Do We Care?

- The fact that the presence of ants increases fruit production means that a species has more opportunities to reproduce
- Also, the ants in question act as a natural pesticide against predators and provide fertilizer for growing trees
- Some plants that we use for domestic products, coffee plants for example, have domatia
- If it were possible to introduce a proper species of ant, we could have a natural form of pesticide and increase crop yield if the plant responds the same way as *H. brunonis*

T. albipes Behavior

- Feed at night
 - When predators are about (especially caterpillars)
 - Also when EFN activities are enhanced
- Migrate from tree to tree
 - Do not live on one tree for long
 - Individual trees could not support the ant colonies
 - Concentrated on young leaves

Case for Co-evolution

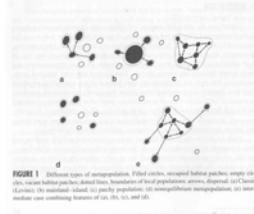
- *T. albipes* is found in India's early fossil record
- *H. brunonis* may or may not have domatia – polymorphic
 - probably an inherited trait
 - there may be a structural cost
- EFN only active on growing organs, where predators are likely to be found
- Other examples of *Humboldtia* and *T. albipes*
 - *H. decurrens* – Southern India
 - *H. lauriflora* – Sri Lanka



(www.fossilmuseum.net)

Meta-Population Dynamics

- Meta-population is a set of local populations within some larger area, where typically migration from one local population to at least some other patches is possible (ESC 450 Winter 04)
- *T. albipes* is a mutualistic partner at the meta-population scale
- *H. brunonis* population more successful as a whole



(Harrison and Taylor 1997)

Conclusions

- Domatia confer a selective advantage
- There is a mutualistic relationship between *H. brunonis* and *T. albipes* in which both species benefit
- *H. brunonis* and *T. albipes* likely co-evolved
- *T. albipes* migration plays a pivotal role in success of *H. brunonis* at both the local and meta-population scale