



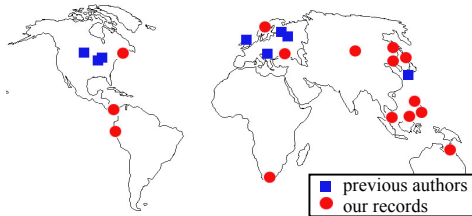
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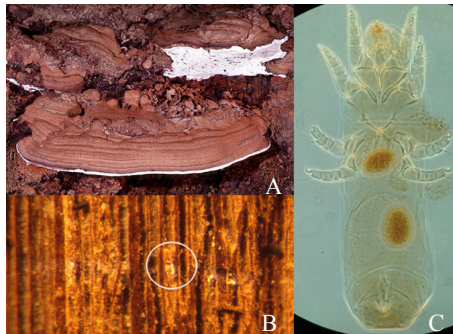
Phylogeny, biogeography and host associations of the genus *Boletoglyphus* (Acari: Acaridae) associated with polypore fungi

Context: The genus *Boletoglyphus* had been previously known from only four species in the Holarctic region. We have found twelve new species from the Oriental, Australian, Afrotropical, and Neotropical regions. Species known from feeding stages all inhabit fruiting bodies of polypore fungi. Heteromorphic deutonymphs are phoretically associated mainly with tenebrionid beetles of the tribe Bolitophagini (Coleoptera: Tenebrionidae), although a single species from South Africa has been found on a millipede. Parsimony analysis based on morphological characters of the deutonymphs yielded a single tree which is used to test biogeographic and coevolutionary hypotheses with respect to the insect hosts of these mites.

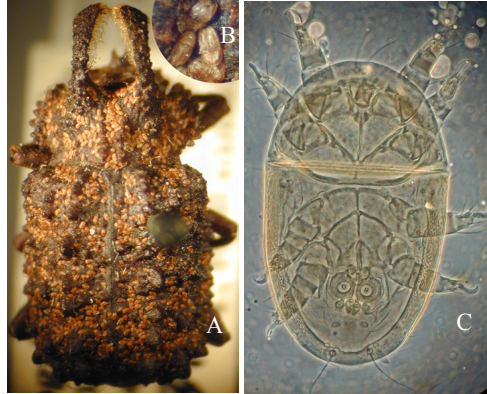
1. DISTRIBUTION



2. HOST ASSOCIATIONS



Tubes (B) of perennial fruiting bodies of the Artist's Conk, *Ganoderma applanatum* (A), are a common habitat for feeding stages of *Boletoglyphus ornatus* (C) in eastern North America. The feeding stages of 3 other previously known species and 6 new species have been found only in polypore fungi.



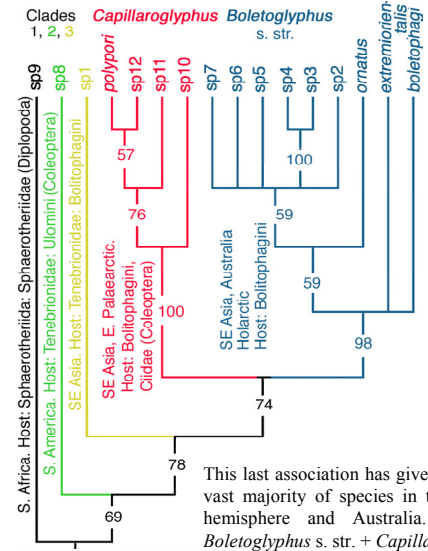
Heteromorphic deutonymphs (B-C) of *Boletoglyphus ornatus* dispersing on the mycophagous beetle *Bolitotherus cornutus* (A). Our study revealed 23 new host associations for 14 mite and 18 insect species. Main hosts for the mites are tenebrionid beetles of the tribe Bolitophagini.

3. PHYLOGENY

We performed phylogenetic analyses on heteromorphic deutonymphs only since few species of this genus are known from adults. Sixty-six morphological characters of sixteen species were analyzed with PAUP* v.4.0b8a using the brand and bound approach. A hypothetical ancestor was used to polarize characters. The analyses yielded a single most parsimonious tree (length 224, CI 0.638, RI 0.618). The tree suggests that the genus *Boletoglyphus* s. lat. consists of 5 clades (see figure on the right, ancestor is not shown). Three basal clades represented by a single species each have been found in tropical Central and South America, Africa, and SE Asia. Two other clades, *Boletoglyphus* s. str. (Holarctic, SE Asia, Australia) and *Capillaroglyphus* (SE Asia and Palaeartic) are represented by 9 and 4 species, respectively. The single known North American species, *Boletoglyphus ornatus*, probably originated from a northern Palaeartic species that had a Southeast Asian ancestor.

4. EVOLUTION OF HOST ASSOCIATIONS

Several shifts in host associations have occurred during the evolution of the group (see the cladogram on the right). The three most basal lineages are associated with a millipede (*B. sp9*), tenebrionid beetle of the tribe Ulomini (*B. sp8*) and tenebrionid beetles of the tribe Bolitophagini (*sp1*).



This last association has given rise to the vast majority of species in the northern hemisphere and Australia. (clade 1, *Boletoglyphus* s. str. + *Capillaroglyphus*).

Another shift has occurred within the *Capillaroglyphus* clade. A single species of this clade, *C. polypori*, was found phoretic on beetles of the family Ciidae and occasionally on tenebrionids. Fungal associations still remain poorly studied. Known associations include *Ganoderma applanatum* and *Fomes fomentarius* and many unidentified polypore fungi.

Results

- The genus *Boletoglyphus* is known from 16 species from all parts of the world (except Antarctica).
- All known feeding stages of the genus are associated with perennial fruiting bodies of polypore fungi.
- Heteromorphic deutonymphs are phoretic on millipedes, tenebrionid (Ulomini, Bolitophagini) and cid beetles, although they may occasionally utilize other arthropods as hosts.
- The genus consists of 5 clades. It appears to have originated in the southern hemisphere, then dispersed to Oriental, Australian, Palaeartic, and Nearctic regions.

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