Amber cockroaches, wood decomposers, dinosaur dung, clean Mesozoic ground and eusociality

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Among unresolved enigmas of ancient terrestrial ecosystems functioning, the origin of social life, wood decomposition, provisioning of dinosaur dung and cleanness of Mesozoic ground belong to most important ones (Zherikhin 2002).

Sample from dinosaur-aged (125-million-year old) amber of Lebanon provided partial answer for all these questions (Vršanský et al. 2013).

An immature individual of the cockroach family Blattulidae was preserved with coprolites partially extruded from the body and containing particles of wood indicating external pre-digestion. Based on distribution curves (obtained using ST) a hypothesised was advanced that source of the wood particles were dinosaur feces. Additionally, identical particles of wood were discovered in dung of Mesozoic dinosaurs and lystrosaurs (Fiorelli et al. 2013, unpublished), supporting the present claims in unrequiring chewing of wood by cockroaches.

The presence of processed wood with smooth edges is important in providing evidence for the occurrence of lignolytic endosymbionts in ancient cockroaches, which are transferred only in multigenerational organisation of population structure (e.g. in termites).

In contrast to intuition, masses of dinosaur dung did not decay automatically as they contain too much nitrogen (as in birds) and normally would be deposited analogically to guano (high proportion of phosphorus). Nevertheless, after the extraction of nitrogen, dung is further exploited by plants, microorganisms and animal decomposers. This is in sharp contrast to exploitation of mammal dung and its fixed rapid exploiters. Nevertheless, also mammal dung can prevent growth of plants including grasses (see example from present-day Australia, where introduction of dung beetles was necessary – Bornemissza 1960).

Huge amounts of dinosaur dung would cover surface and prevent growth of the lowest levels of plants, which would allow the significant erosion. Thus, thanks to an amber cockroach we now know that Mesozoic forests were rather clean due to clean-up services provided by cockroaches (no other dung-provisioning insects are known from the beginning of the Mesozoic).

REFERENCES

Bornemissza G.F., 1960. Could dung eating insects improve our pastures? *Journal od Australian Institute of Agricultural Science*, 26, 54–56.

Fiorelli L.E., Ezcurra M.D., Hechenleitner E.M., Arganaraz E., Taborda J.R.A., Trotteyn M.J., Belén von Baczko M. & Desojo J.B., 2013. The oldest known communal latrines provide evidence of gregarism in Triassic megaherbivores. *Scientific Reports*, 3, 3348.

Vršanský P., Van de Kamp T., Azar D., Prokin A., Vidlička L. & Vagovič P., 2013. *Cockroaches probably cleaned up after dinosaurs*. PLOS ONE 0080560.

Zherikhin V.V., 2002. Ecological History of the Terrestrial Insects. [in:] Rasnitsyn A.P. & Quicke D.L.J. (eds), *History of Insects*, Kluwer, Dodrecht, 331–388.