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Fossil insects may provide unique information on structures and disturbances in past forest ecosystems – examples from Holocene studies in southern Sweden

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Insects are complex organisms that play an important role in all types of forest ecosystems. Insect remains are often abundant in waterlogged sediments and peat, and the majority of the fossils may be identified to species level, thus contributing with specific information. The occurrence of species feeding or confined to one or a few species of herbaceous plants, shrubs and trees may confirm or improve/refine the interpretations based on pollen and plant macrofossil analyses. Many insects, particularly ground living animals, select open, sun exposed habitats or closed shaded areas. Such indicators are valuable for reconstructions of forest/landscape openness. However, unique information can be provided by fossil insect assemblages.

Insect studies carried out at two natural sites in southern Sweden with complete Holocene peat stratigraphies (Olsson and Lemdahl 2009) and a number of sites covering parts of the Holocene (e.g. Gaillard and Lemdahl 1994, Gustavsson et al. 2009) provide strong evidence on changes in forest structure and the occurrence and nature of disturbances. Studies in Britain have yielded similar results (e.g. Whitehouse 2006). Saproxylic beetles indicate the presence of dead wood, which clearly was a more prominent component in ancient woodlands than in present forests, and beetles confined to wood mould suggest the presence of large hollow trees.

Finds of pyrophilic species, of which some are very rare in European woodlands today, together with layers of charcoal, suggest that fire was a major disturbance factor during most of the Holocene in southern Sweden. Whereas macroscopic charcoal fragments indicate local fires, the presence of pyrophilic insects is an indication of continuous fire activity at the regional spatial scale. Remains of dung beetles indicate extensive grazing by megaherbivores during early Holocene, and more intensive grazing during late Holocene, whereas such indicators are absent from mid Holocene records, which correlates well with the data of Holocene megaherbivores bone finds in southern Sweden. Obligate insects on heather-covered heath confirm the interpretation of Calluna pollen during the Bronze Age as representing heath land rather than bog vegetation. Changes in the abundance of aquatic and hydrophilic species exhibit trends that correlate with regional lake-level fluctuations.

These results suggest that the forests of the early Holocene were more open than often proposed by palynologists, grazing by megaherbivores and fire being two very important disturbances in these ecosystems. In contrast, there is no indication of grazing during Mid-Holocene, while fire is still frequent at sites dominated by pine (see Cui et al. BG 6.2). Late Holocene is characterized by human-induced fire and grazing.

References:
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