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Holocene local forest history at two sites in Småland, southern Sweden – insights from quantitative reconstructions using the Landscape Reconstruction Algorithm

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Quantitative reconstruction of past vegetation using fossil pollen was long very problematic. It is well known that pollen percentages and pollen accumulation rates do not represent vegetation abundance properly because pollen values are influenced by many factors of which inter-taxonomic differences in pollen productivity and vegetation structure are the most important ones. It is also recognized that pollen assemblages from large sites (lakes or bogs) record the characteristics of the regional vegetation, while pollen assemblages from small sites record local features. Based on the theoretical understanding of the factors and mechanisms that affect pollen representation of vegetation, Sugita (2007a and b) proposed the Landscape Reconstruction Algorithm (LRA) to estimate vegetation abundance in percentage cover for well defined spatial scales. The LRA includes two models, REVEALS and LOVE. REVEALS estimates regional vegetation abundance at a spatial scale of 100 km x 100 km. LOVE estimates local vegetation abundance at the spatial scale of the relevant source area of pollen (RSAP sensu Sugita 1993) of the pollen site. REVEALS estimates are needed to apply LOVE in order to calculate the RSAP and the vegetation cover within the RSAP. The two models were validated theoretically and empirically.

Two small bogs in southern Sweden were studied for pollen, plant macrofossil, charcoal, and coleoptera in order to reconstruct the local Holocene forest and fire history (e.g. Greisman and Gaillard 2009; Olsson et al. 2009). We applied the LOVE model in order to 1) compare the LOVE estimates with pollen percentages for a better understanding of the local forest history; 2) obtain more precise information on the local vegetation to explain between-sites differences in fire history.

We used pollen records from two large lakes in Småland to obtain REVEALS estimates for twelve continuous 500-yrs time windows. Following the strategy of the Swedish VR LANDCLIM project (see Gaillard et al.; Trondman et al., CL 1.22; Mazier et al. CL 1.21) we used 3 sets of pollen taxa (20, 22, 31) and 3 sets of pollen productivity estimates (PPEs) (1. southern Sweden; 2. southern Sweden except for cereals, Calluna, Plantago and Rumex, Denmark; 3. the mean of all PPEs available in NW Europe). The Spearman rank correlation test shows that there are no significant differences between the 9 runs. LOVE was applied on the pollen records from the two small bogs following the same strategy. We also compared the LOVE estimates (20 taxa, PPEs dataset 2) with the records of plant macro-remains and coleoptera species that are indicators of the local occurrence of conifers (Pinus and Picea), Betula, and deciduous trees.

The results show large discrepancies between the LOVE estimates and pollen percentages. The LOVE estimates are higher than pollen percentages for Cyperaceae, Gramineae and Filipendula, and the broaded-leaved trees Corylus, Fraxinus, and Tilia. In contrast, the LOVE estimates for Pinus and Betula are generally much lower than their pollen percentages. LOVE estimates and pollen percentages are relatively similar for Alnus, Quercus, and Calluna. The LOVE reconstruction confirms the assumed difference between the sites in terms of the abundance of birch and pine, which was not clearly demonstrated by the pollen percentages and accumulation rates. The Pinus LOVE estimates are significantly higher at one of the sites, which explains the differences in fire history between the sites. The comparison of the LOVE estimates with plant macro-remains and coleoptera species shows a good correspondence.

References:

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