Photosynthetic capacity peaks at intermediate size in temperate deciduous trees
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Studies of age-related changes in leaf functional biology have generally been based on dichotomous comparisons of young and mature individuals with little data available to describe changes through the entire ontogeny of trees. Leaf-level gas-exchange and morphological parameters were quantified in trees acclimated to high light conditions spanning a wide range of ontogenetic stages from saplings (~1 cm in stem diameter) to senescent trees nearing their maximum lifespan in three temperate deciduous tree species in central Ontario Canada. Leaf mass per area (LMA) and related morphological parameters (leaf thickness leaf tissue density and leaf structural allocation) increased monotonically with tree size with maximum values observed in trees showing signs of senescence. In contrast leaf photosynthetic capacity (expressed on either an area (Amax-area) or mass (Amax-mass) basis) stomatal conductance (gs) and leaf size showed peak values at an intermediate ontogenetic stage. While qualitatively similar humped relationships with of Amax-area vs. size were found in each species examined quantitative differences were apparent: species that attained higher photosynthetic rates (Betula alleghaniensis and Tilia americana) showed a greater amplitude of change than a more shade-tolerant species with lower average rates (Acer saccharum). In all three species the peak in Aarea corresponds to a peak in leaf size and approximately to the size at reproductive onset. These results thus suggest that tree reproduction plays a critical role in driving changes in leaf morphology and leaf-level gas-exchange processes late in tree ontogeny.