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Roadblocked monotonic paths and the enumeration of coalescent histories for non-matching caterpillar gene trees and species trees.

For a given gene tree topology and species tree topology, a coalescent history represents a mapping of the list of gene tree coalescences to branches of the species tree. Enumerative properties of coalescent histories have been of interest in the analysis of relationships between gene trees and species trees. One such enumerative result identifies a bijection between coalescent histories for a matching caterpillar gene tree and species tree with a class of monotonic paths on a lattice, producing a result that the number of coalescent histories for n -taxon matching caterpillar trees ($n \geq 2$) is the Catalan number C_{n-1} . We show a similar result for non-matching caterpillars, connecting coalescent histories for a non-matching caterpillar gene tree and species tree to “roadblocked” monotonic paths. The result enables a rapid proof of the result that given a caterpillar species tree, no non-matching caterpillar gene tree has more coalescent histories than the matching gene tree. We study the number of coalescent histories for non-matching caterpillar gene trees that differ by nearest-neighbor interchange, cyclic permutation of the taxa, and subtree-prune-and-regraft moves, characterizing the non-matching caterpillar with the largest number of coalescent histories. (Received January 18, 2018)