Given a set $R$ of natural numbers let $S(n,k,R)$ be the restricted Stirling number of the second kind: the number of ways of partitioning a set of size $n$ into $k$ non-empty subsets with the sizes of these subsets restricted to lie in $R$. Let $S(R)$ be the matrix with $S(n,k,R)$ in its $(n,k)$ entry. If $R$ contains 1, $S(R)$ has an inverse $T(R)$ with integer entries. We find that for many $R$ the entries $T(n,k,R)$ of $T(R)$ are expressible (up to sign) as the cardinalities of explicitly defined sets of trees and forests. For example this is the case when $R$ has no exposed odds, i.e. $R$ contains 1 and 2 and $R$ never contains an odd number $n$ greater than 1 without also containing $n+1$ and $n-1$. We have similar results for restricted Stirling numbers of the first kind (partitions into cycles) and Lah numbers (partitions into ordered lists). Our proofs depend in part on a combinatorial formula for the coefficients of the compositional inverse of a power series that expresses each coefficient as a sum of weighted trees. (Received August 21, 2018)