We can reduce the problem to 2D LIS. Let $r[i]$ denote the rank of $a[i]$ in array b (a minor issue is when $\exists\ j$ s.t. $a[i] = b[j]$), then the problem is equivalent to find the longest increasing subsequence in a, where $a[i]$ can be followed by $a[j]$ if $a[i] < a[j]$ and we can change $a[i+1, \ldots, j-1]$ to elements in b, which is equivalent to $r[j] - r[i] \geq j - i - 1$, i.e. $r[j] - j \geq r[i] - i - 1$ (the -1 shouldn't affect much). cite?

References