We say that a permutation $\pi = \pi_1 \pi_2 \cdots \pi_n \in S_n$ has a peak at index $i$ if $\pi_{i-1} < \pi_i > \pi_{i+1}$. Let $P(\pi)$ denote the set of indices where $\pi$ has a peak. Given a set $S$ of positive integers, we define $P(S;n) = \{ \pi \in S_n : P(\pi) = S \}$. In 2013 Billey, Burdzy, and Sagan showed that for subsets of positive integers $S$ and sufficiently large $n$, $|P(S;n)| = p_S(n)2^{n-|S|-1}$ where $p_S(x)$ is a polynomial depending on $S$. They gave a recursive formula for $p_S(x)$ involving an alternating sum, and they conjectured that the coefficients of $p_S(x)$ expanded in a binomial coefficient basis centered at max($S$) are all nonnegative. In this paper we introduce a new recursive formula for $|P(S;n)|$ without alternating sums and we use this recursion to prove that their conjecture is true. (Received March 10, 2017)