Timely detection of surface damages on wind turbine blades is imperative for minimizing downtime and avoiding possible catastrophic structural failures. With recent advances in drone technology, a large number of high-resolution images of wind turbines are routinely acquired and subsequently analyzed by experts to identify imminent damages. Automated analysis of these inspection images with the help of machine learning algorithms can reduce the inspection cost. In this work, we develop a deep learning-based automated damage suggestion system for subsequent analysis of drone inspection images. Experimental results demonstrate that the proposed approach can achieve almost human-level precision in terms of suggested damage location and types on wind turbine blades. We further demonstrate that for relatively small training sets, advanced data augmentation during deep learning training can better generalize the trained model, providing a significant gain in precision.