Abstract

The influence of hemispherical photographs acquisition and analysis modes on light conditions modeling under forest canopy

Jakub Badelek

Investigating light conditions under forest canopies is fundamental for defining methods of forest renewal. An indirect method of light condition investigation, that is gaining high popularity, is the analysis of hemispherical photographs imaging forest canopy structures, which are created by using a photographic camera and a “fish-eye” lens. Newer research suggests that hemispherical images should be taken with manual exposure based on an external photometer indication with a correction of + 2Ev. Some researchers indicate superiority of automatic thresholding over manual threshholding. Also an important issue that is rarely taken into account is the application of a calibrated function of a lens projection in software that analyses images.

The aim of this paper is investigating the influence of different elements of the acquisition and analysis of hemispherical photographs methodology on the results of light condition modeling under the canopy of forest stands of different densities. Those elements are: optical properties of the lens (projection function), photographic exposure and image thresholding.

In order to test those recommendations, photographs were taken with a camera in two forest stands with different densities. Together 16 scenarios representing different combinations of variants of three tested recommendations were created (8 for each forest stand). Projection function calibration was done by placing points of known real positions on the hemispherical image. Difference between observed positions and positions expected on the basis of the theoretical projection function of a Sigma 8mm F:3.5 lens allowed calculation of the calibrated projection function of this lens.

With the use of the Kruskal-Wallis test the influence of 16 different combinations of methodology of acquisition and analysis of photographs (taking into account such factors like forest stand type, exposure type, thresholding method and application of calibrated projection function) on the calculated value of the site factor has been compared. The test confirmed a strong influence of the photographic exposure method on the obtained results and accordingly to recommendations from newer literature a manual exposure measurement with correction of +2Ev is advisable. Automatic thresholding significantly accelerated the analysis process however detailed inspection of thresholded photographs showed in extraordinary cases errors

of automatic algorithms. As a result, it was decided that the best method is a supervised automatic thresholding method and performing manual thresholding in extraordinary cases.

Keywords: hemispherical photography, site factor, photographic exposure, thresholding, projection calibration