REMOTE SENSING OF MANGROVES IN GAZI BAY (KENYA) WITH VERY HIGH RESOLUTION QUICKBIRD SATELLITE IMAGERY: AUTOMATED METHODS FOR SPECIES AND ASSEMBLAGE IDENTIFICATION

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Mangrove degradation is occurring worldwide at a fast rate. This degradation necessitates a rational management at a local, national and global level. Satellite imagery is a valuable tool in the early detection of mangrove degradation in which floristic composition as well as areal extent are important indicators. This thesis work focuses on a tropical bay in Kenya, Gazi Bay, on which very high resolution QuickBird satellite imagery (acquired in October 2002) is available. A field mission for ground-truthing the satellite image was done in July-August 2003.

The aim of this thesis work is three fold. Firstly, to spectrally and spatially enhance the satellite image to ease visual interpretation. Different techniques were used and the most visual-interpretable images were found to be the contrast-stretched pansharpened multispectral false colour composite and the first three principal components of its principal component transformation. The former was used for visual assemblage delineation done by 3 naïve interpreters.

Secondly, to classify the mangroves of Gazi Bay at species level using unsupervised and supervised (hard and soft) per-pixel classification techniques. Incorporation of texture and normalized difference vegetation index (NDVI) measures in image classification both increased the spectral separability between the image classes, but this was not indicative for the accuracy of the classification. On the contrary, the supervised fuzzy classification of the contrast-stretched multispectral image using a 3x3 pixels convolution window appeared to be the most accurate one (based on visual image interpretation and field knowledge). The accuracy of the supervised classification (using the maximum likelihood decision rule) of the contrast-stretched multispectral image was assessed using the Point-Centred-Quarter-Method (PCQM) transect data. The overall accuracy was found to be 68%.

Thirdly, to develop automated methods for vegetation assemblage delineation, which were obtained based on fuzzy convolution techniques of an appropriate convolution window size. The automated delineation was compared with the visual delineation done by 3 naïve interpreters. Results showed that there were two possible disagreements between automated assemblages and visual assemblages: more than one automated assemblage could be included in a visual assemblage and vice versa, but overall the boundaries of the automated assemblages corresponded quite well with the visually delineated polygons. The correspondence between these delineations could however not be quantified.

Also an important methodological improvement was proposed for future mangrove remote sensing research. My suggestion is to add a canopy layer to the PCQM, describing the remotely sensed canopy, which can be used in classification accuracy assessment instead of the adult tree layer (which was used previously and does not always correspond to the remotely sensed canopy). In such a way, PCQM can still be used to determine structural forest parameters (such as absolute density, basal area, relative density, dominance, frequency, *etc*.) and at the same for classification accuracy.

We can conclude that it is possible to create a mangrove species map of adequate accuracy through supervised classification of the QuickBird satellite image and to automatically identify assemblages using fuzzy convolution techniques of an appropriate window size. Therefore QuickBird satellite imagery has proven to be a valuable tool in the early detection of mangrove degradation in which floristic composition is as important as areal extent.