Application of remote sensing for monitoring fish spawning sites of a large hydropower plant reservoir in a lowland region

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ABSTRACT: The main objective of a large hydropower plant (HPP) is to produce electricity, stabilize electrical grid and provide protection from floods at some level. Typically, operation of these large HPPs that use dams to store water in reservoirs is not an easy task, because at the same time it has ensure environmental protection requirements and fulfil other water users needs. Many studies had shown that peaking hydropower plants, play an important role for aquatic organisms and ecosystem. Reservoirs with shallow and gently-sloping littoral slopes as well as small shallow reservoirs can experience a greater magnitude of change of water quality due to water level fluctuations. Also, reduction in water level is likely to accelerate eutrophication processes and involves a higher risk of cyanobacteria blooms. Ecologically sustainable management of such reservoirs is especially difficult, because it has to combine a lot of different decisions that are opposing of each other and usually it is very hard to estimate the effects of ecological mitigation measures.

This paper is a short presentation of a research conducted in the reservoir of Kaunas hydropower plant (HPP) in Lithuania. It is a large, relatively shallow reservoir located in the Eastern European lowland (area 63.5 km^2, average depth about 7 m. The reservoir has two operating hydropower plants – Kaunas HPP and Kruonis pumped storage hydropower plant (PSP). To mitigate the impact on various aquatic organisms the Reservoir operation rules are in force that limit the operation of the HPPs. The main concern is to protect the fish spawning sites during spawning period. There is a lack of knowledge where those spawning areas are and how is their area affected when the water level fluctuates. A detailed survey of a small (about 5 ha) area containing several potential spawning grounds was carried out using Unmanned Aerial Vehicles (UAV) and traditional field survey methods to gather information and to track changes of the spawning grounds (drawdown areas). High resolution multispectral images were used to analyse the spectral footprint of aquatic macrophytes and the possibility to use the results to identify and map potential spawning sites in the entire reservoir was evaluated.

The aim of the study was to implement modern remote sensing techniques to investigate dewatering areas in the fish spawning sites. Surveying fish spawning sites that are containing aquatic macrophytes is typically a difficult task that is usually carried out by performing manual bathymetric measurements due to the limitations of sonars. Our hypothesis is that RS can be used to assist in surveying difficult and vulnerable areas, where the current and accurate data are needed. This knowledge could assist in making decisions for better use of reservoir storage while increasing power generation.