Mactaquac Aquatic Ecosystem Study
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METHODS PAPER:
Downstream Bathymetry and BioBase Analyses of Substrate and Macrophytes

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DISCLAIMER

Intended use and technical limitations of the report, “Downstream Bathymetry and BioBase Analyses of Substrate and Macrophytes”. This report describes the methods for the bathymetry and substrate interpretations for the Saint John River. The CRI does not assume liability for any use of the included information outside the stated scope.
INTRODUCTION

As part of the Mactaquac Aquatic Ecosystem Study (MAES), downstream bathymetry was completed to characterize the current flow patterns and conditions that exist downstream of the Mactaquac Generating Station. The surveyed area was the Saint John River, New Brunswick between the Mactaquac Generating Station (N 45.95443 W -66.86804) and the Westmorland St. Bridge in the city of Fredericton (N 45.96839 W -66.64290). Downstream bathymetry surveys were completed between September and October, 2014 and May and December 2015.

METHODS

Bathymetry surveys were conducted using Lowrance HDS7 Gen2 Touch Fishfinder/Chartplotters with StructureScan HD (www.lowrance.com) mounted to a small motorboat. Fishfinders use sonar to relay depth information and the presence of fish for recreational anglers; however, newer units may also be used to log sonar data for the purpose of creating detailed bathymetry. The sonar logs can also be used to produce detailed maps of macrophyte extent and coverage (expressed as bio-volume; the % of the water column occupied by macrophytes) and bottom hardness. Sonar log processing is required to generate formats compatible with Geographical Information Systems (GIS); this processing was completed by CIBioBase (www.cibiobase.com).

Concurrent with the downstream bathymetry, seven temperature and water level loggers (Onset HOBO U20 Water Level Data Logger; www.onsetcomp.com) were deployed along the study section to monitor changes in water levels (Figure 1). In addition, the water level data from the Fredericton WSC gauge were downloaded for the survey period. A separate logger was deployed at Hartt Island to monitor air pressure during the survey period. Air pressure information as well as water depth at known times (i.e., control points) were used to create a regression to convert pressure to water depth for each logger file. First air pressure was subtracted from water pressure and tied to known depths and the relationship between depth and corrected pressure and depth was established by regressing Known Depth vs. Corrected Pressure and applying the conversion to the whole file. The variation in water levels throughout different parts of the study area over the course of the surveys were needed in order to apply water level corrections to standardize the final bathymetry maps.

Downstream bathymetry surveys were completed following suggested methodologies for bathymetry mapping using Lowrance sonar units (Navico, 2014). Surveys were conducted by motoring to the survey area and mounting the sonar sensors to the stern of the boat. As the depth below the waterline varied from day to day and between different boats used for collecting bathymetry it was necessary to record the depth of the sensors in order to correct for these differences (actual depth = recorded depth + depth of sonar sensor from the water line +/- water level correction). Once logging was started the shoreline was surveyed by making 2 to 3 passes along the shoreline on each side of the reach. This created a “box” to bound each survey, which was filled in by running parallel transects in either the upstream/downstream direction or across the river depending on the conditions (Figure 2). Ideally, each “box” was completed within 1 hour, which is nearing the maximum sonar log file size that can be quickly uploaded to the BioBase servers.
Figure 1. Location of Onset HOBO U20 temperature and pressure loggers used to apply water level corrections to acquired bathymetric data

Transect spacing varied throughout the surveys depending on the complexity of the bottom in each area; however, transect spacing did not exceed 50 meters. In areas where rapid changes in depth or interesting features existed (e.g., holes, sand bars, macrophyte beds, etc.) transect spacing was reduced to between 5 to 20 meters to better capture these features. Similarly, in areas where the bottom was consistent such resolution was not required and transect spacing was increased to cover a greater area in a given amount of time. While logging sonar data the speed of the boat was kept between 5 and 8 km/h SOG (Speed Over Ground) in order to achieve good resolution from the surveys. While it is possible to travel at greater speeds and still produce quality bathymetry, the resolution of macrophyte bio-volume and bottom hardness mapping is reduced.
Figure 2. Example sonar log and corresponding BioBase bathymetry map output for an area of the Saint John River below the Mactaquac Generating Station (MGS) surveyed in October 2014.

Data from the bathymetry surveys (.sl2 sonar log files) was uploaded to the CIBioBase servers using the BioBase upload tool (Navico, 2014). Bathymetry, macrophyte biovolume, and substrate hardness maps were merged to create a single file for each and were exported from BioBase. These files, which contain latitude and longitude data as well as a value for each attribute, were then imported and projected in ArcMap.

Bathymetry sounding points were imported into ArcMap (v. 10.2) and plotted. The date/time of each sounding point was used to create a “temporal id” field consisting of “day of year”_“minute of day (in 10 minute intervals)”. The (x,y) location of each sounding were spatially tied to the nearest two water level loggers. A temporal id for each water level logger was created and used to identify the water level at the time the bathy soundings were acquired. Using the XY of the nearest water level logger, a “virtual” identical logger on the parallel stream bank, and the XY of the next closest logger, a “water level plane” was created for the time of each bathy sounding acquisition. Solving the “water level plane” for the plane location (z) of the bathy sounding, the resulting offset was applied along with a constant 14cm offset (average draft of the acquisition vessel), to cover the relative bathy depths to absolute elevation (m ASL). After death normalization, bathymetry soundings were interpolated to create a bathymetry layer, with the exception of areas with missing bathymetry surveys using “normal” kriging, with all default parameters proposed by the ArcGIS software following examination of errors.
REFERENCES