Mapping and interpretation of macrophytes within a 200 km reach to inform environmental flow management decisions

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Key Points

- Macrophytes were assessed and mapped in detail along both banks of a creek-line, averaging 20 km per day using relatively simple field equipment and GIS post-processing.
- Key macrophytes have been identified, assigned to water plant functional groups, and mapped.
- Key macrophyte summary sheets and distribution mapping clearly informs future management decisions.

Keywords

Macrophytes, aquatic habitat, Water Plant Functional Groups, Broken Creek, Nine Mile Creek, environmental flows, flow regulation, vegetation mapping

Introduction

The lower Broken Creek and Nine Mile Creek (hereafter referred to as the lower Broken Creek system) lies within the Broken River Basin in the Goulburn Broken catchment in northern Victoria. The flow regime of lower Broken Creek system is highly modified, with irrigation development dating back over 100 years. The system (below Katamatite) now carries irrigation water from the Shepparton and Murray Valley Irrigation Areas. The lower Broken Creek system has been altered from intermittent creeks, commonly ceasing to flow during summer and autumn, to perennial creeks. These now have significant and consistent flows through summer and autumn to supply water for inter-valley transfers, irrigation, stock and domestic use. This modified system has numerous weirs (incorporating fish ladders), weir pools, free flowing narrow channels and connected wetlands with a diverse range of habitats and aquatic vegetation. Management of aquatic fauna habitats, particularly for native fish, has become a high priority and, therefore, understanding the composition (species richness and abundance) and distribution of aquatic vegetation is paramount. This technical note describes the unique methods adopted during field assessment and mapping aquatic vegetation along 200 km of creek-line. The resultant mapping clearly represents the distribution of aquatic vegetation and provides a guide to the location of key habitats and areas where habitat improvement intervention is recommended. These results will be used to inform future flow recommendations that aim to enhance macrophytes and habitats they provide.

Methods

Prior to this project, the Goulburn Broken CMA had a limited understanding of the aquatic vegetation present in the lower Broken Creek system. Identifying and mapping aquatic vegetation throughout this 200 km of creek system was to be a principal output of this project. Two fundamental decisions were to be made prior to commencing fieldwork. How was the entire system to be assessed with 11 days of allocated field time (i.e. needed to assess approximately 20 km per day), and how were we to map aquatic vegetation on both banks and instream concurrently? Although road access is relatively good along about half of the project area, it was decided that the assessment should be undertaken by boat if possible so that both banks could be observed closely enough for identification of species. Throughout the system, the channel dimensions vary considerably from 5 m width in the upper reaches, to some 50 m width in the weir pools at the downstream end. Although originally considered improbable, a 3 m long aluminium boat with a 2hp outboard motor was able to navigate all reaches, with numerous portages, during high irrigation flows in December.

Field recording of plant distribution

Two field assessors travelled downstream by boat, assessing one bank each, identifying and recording the location of aquatic vegetation using a hand held Garmin eTrex™ GPS (positional error estimated at +/- 5m) and a data recording sheet. A small (i.e. less than 20m long) aquatic vegetation patch was recorded as a waypoint. Larger patches were mapped by recording waypoints at the start and end of these patches. Patches were also recorded as being either fringing (i.e. on the bank and mostly out of the water), instream (i.e. growing mostly in the water at the time of assessment) or instream abundant (i.e. extending well off the bank, or growing throughout the bed of the creek). To further document an understanding of the creek system, more than 800 geo-referenced photographs were taken during field assessment for display on the GIS.

Assigning Water Plant Functional Groups (WPFG's)

Water is one of the main drivers of plant community zonation in wetlands. Brock & Casanova (1997) developed a way to classify wetland plant species into WPFG's based on their response to the presence of water and duration / frequency of wetting. This is possible because the plants responded differently to water depths, durations and frequency of flooding. Therefore, by defining a water plant functional group to each species, sites with different suites of species, levels of biodiversity and overall water regimes are able to be compared. WPFG's were assigned to each recorded aquatic plant species so that these groups could later be mapped.

GIS post fieldwork processing

Following completion of the fieldwork the GPS waypoint data was downloaded and Right and Left Bank GIS layers were developed using the following method:

- Import Waypoints from GPS1 and GPS2 into ArcMap and plot/convert to GIS points layer
- Use the Index of Stream Condition (ISC) Top-of-Bank polyline layer – generalise vertices (2.5m) for quicker processing/display (using Generalize tool)
- Snap GPS1 points to closest location on Right Bank; snap GPS2 points to closest location on Left Bank (using ArcGIS Snap tool)
- Split banklines with GPS points and attribute each line section with the 'From<>To' Waypoint IDs and Date (using ArcGIS Spatial Join tool)
- Buffer GPS points by 5m and split banklines with the buffer circles to create additional 10m-long line sections at each point, with waypoint ID and Date (using ArcGIS Buffer tool and ET Geowizards Split tool)
- Append the additional 10m line sections into the 2x master line layers, and sort the features into correct Section ID order (1, 1-2, 2, 2-3, 3, 3-4, …etc.)
- Export each line layer (Left & Right) to a table with Section ID and Date columns, for data entry. Separate columns were added to the tables for each individual species.
- The data was manually entered from fieldsheets to the relevant tables (spreadsheets), assigning a code (1 = fringing, 2 = instream, 3 = instream abundant) to each section or waypoint where a particular species was present.
- Once data entry was performed, the two tables were imported back into GIS and joined to the two line layers.

The GIS layers produced contain all vegetation data separated for the left and right bank, while vegetation in the middle of the channel was captured by one or other of the layers.

Mapping

The mapping layers can be viewed on the GIS at any desired scale and at a large scale if differentiation between banks was required. A series of whole of project area scale maps were produced at A3 size to provide an indication of the distribution of the desired taxon. Larger scale representation would be useful for tasks such as developing a Sagittaria weed control program where infestations may need to be sprayed from the correct bank.

Four of the main WPFGs were mapped to not only identify where particular groups existed, but to identify where different habitat zones may be found.

Project findings

Forty taxa were identified and mapped during field assessment. The lengths of occurrences were calculated for each reach and for the entire project area. Twenty of the key taxon were mapped independently as shown in Figure 1, with this figure showing the distribution of the invasive weed species Sagittaria. The data showed that the weed Sagittaria was present along 25.7 km or 6.8 % of bankline (i.e. one bank) within the project area.

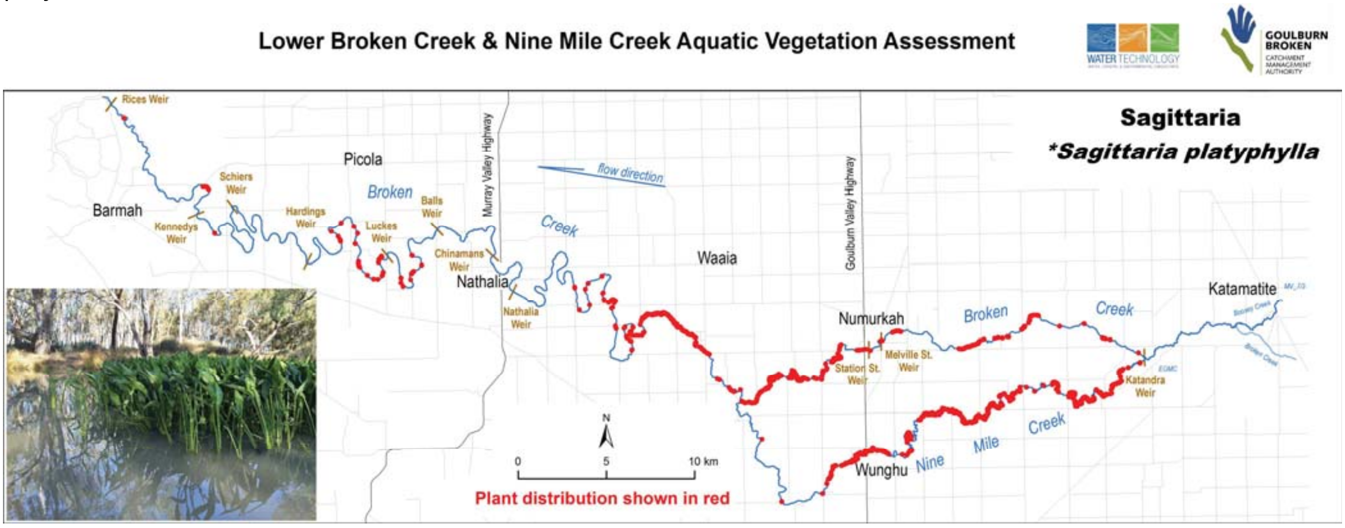

Figure 1. Distribution of the weed Sagittaria within the project area

Mapping of individual taxa provides an indication of the distribution and, to some extent, the abundance of macrophytes within the project area. The GIS mapping of individual taxa can be interrogated and mapped at a larger scale to show specific locations, bank origin and length of infestation.

The WPFG mapping did not reveal unexpected zonation. The weir pools provide a very static water level and low velocities throughout most of the year. Therefore, certain plant groupings were found in those locations as expected. The WPFG mapping did tend to reveal the areas of shallow water and also highlight areas with near permanent water.

Conclusions

This project successfully used an innovative method of mapping aquatic vegetation along both banks of 200km of long-term regulated creekline using relatively simple field equipment and GIS post processing. The mapping of a comprehensive suite of aquatic vegetation was achieved using precision assessment at site level. The outputs provide a detailed understanding of the location, type and characteristics, including water regime requirements, of aquatic plants within the project area. These outputs provide a high level of vegetation detail that will inform future environmental flow determination within the lower Broken Creek system.

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