THE UNIVERSITY OF MELBOURNE

Commonwealth Environmental Water Office
Monitoring, Evaluation and Research Program

Turf Mat Monitoring - SOP v1.0

Standard Operating Procedures
Turf Mats for Sediment and Seed Propagules v 1.0

7 October 2019

1. Objective and Hypotheses

Propagule dispersal by flow (hydrochory) is an important process supporting vegetation recruitment and ecosystem diversity of riparian zones (Nilsson, Gardfjell, and Grelsson 1991), and may be the most important source of propagules to riparian zones and wetlands. In rivers propagules are dispersed by water in two ways:

1. Dispersal of non-buoyant propagules entrained with sediment movement.

2. Dispersal of buoyant propagules. These maybe more likely to be deposited at the water/land boundary as flows recede.

Hydrochorous dispersal is supported by hydrological and sediment connectivity in rivers, and influenced by flow patterns and seasonality, landscape position and geomorphology. Dispersal associated with sediment movement may be influenced by the properties of the sediment (amount, organic content and particle size). In addition, propagules that are deposited with sediment may have better recruitment success.

Flow regulation affects both longitudinal connectivity of sediment/propagules (by physical barriers such as dams) and flow patterns which drive transport and deposition. The extent to which environmental flows can restore these processes depends on both appropriate flow regimes (both magnitude and seasonality) being delivered, and hydrochorous propagule sources being available. The links between flow magnitude (elevation of inundation), seasonality and sediment/propagule deposition on different types of in-channel features (bars, benches, and banks) needs to be better quantified. Additionally, the link between sediment properties and propagule assemblages needs to be determined.

Winter monitoring in 2018 showed that Environmental flows (the winter and spring freshes) provided around half of the sediment and seeds deposited on inundated features at sites in the lower Goulburn River. The environmental flows were the primary contributor of sediment and seeds to riverbanks, providing three-quarters of sediment and seed deposition on banks. Seed diversity on banks was higher in the environmental flows with 12 species represented on each mat on average (compared to 8 species in the tributary flow event and 9 in the IVT). This supports the hypothesis that environmental flow events provide mud drapes and seeds to assist river bank repair, assisting to patch the erosional damage caused by some river operations or natural disturbance events.

The monitoring also showed that large amounts of sediment and seeds were transported and deposited during the 2018/19 IVT event. However, smaller amounts of sediment and seed were transported and deposited under a natural tributary event in 2018. This was surprising because it was hypothesised that natural high flow events would transport more sediment and seed than events delivered from clear water storages (like Lake Eildon). However, the tributary event did deliver a large number of river red gum seeds compared to released events. This is important because it suggests that, at least for some species, natural events may be critical for dispersal because of associated climate condition that precipitate seed drop.

Given the variable outcomes in response to different types of events, it is prudent to continue the monitoring and evaluation to further understand and verify the patterns observed over the 2018/19 period and with specific reference to the different types of delivery events (i.e. environmental water delivery, natural high flow events and IVT events) and for more than just the winter period.

Evaluation questions

- What does Commonwealth environmental water contribute to sediment transport and deposition in the lower Goulburn River relative to IVT events and natural high flows generated via tributary inflows?

- What does Commonwealth environmental water contribute to plant propagule transport and subsequent deposition in the lower Goulburn River relative to IVT events and natural high flows generated via tributary inflows?

2. Indicators

The use of turf mats to assess sediment transport and propagule assemblages can be considered a Category III indicator for the MER project. This protocol provides quantitative data tracking of plant propagule dispersal by flow (hydrochory) and quantitative data tracking the change in transiting sediment properties.
Plant propagule dispersal by flow (hydrochory) is an important process supporting vegetation recruitment and ecosystem diversity of riparian zones and may be the most important source of propagules to riparian zones and wetlands. Hydrochory can be associated with sediment movement (non-buoyant propagules), or independent of sediment (buoyant propagules). Flow regulation affects both longitudinal connectivity of sediment and propagules (by physical barriers such as dams) and flow patterns which drive transport and deposition. The extent to which environmental water can restore hydrochory needs to be determined.

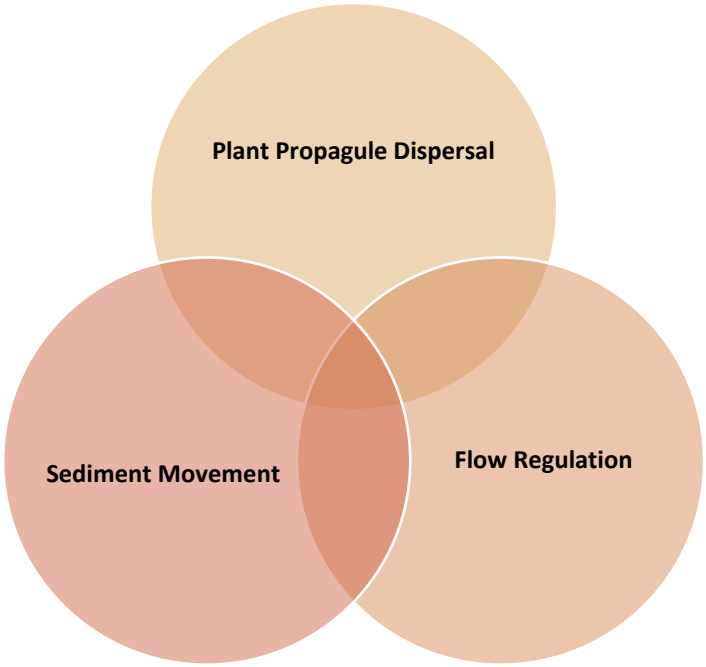

Figure 1 Inter-relationship between plant propagule dispersal, sediment movement and flow regulation, as assessed by category III indicators in the MER project.

Complementary Monitoring and Data

Water level gauging at sites and hydraulic models developed for other monitoring programs are valuable tools to demonstrate levels of inundation arising from certain flows (e.g. models developed for the LTIM Physical Habitat Monitoring and Victorian Environmental Flow Monitoring and Assessment Program).

3. Locations for Monitoring

Locations for turf mats will be based on: sites directly influenced by Commonwealth environmental water flow deliveries, existing transects so that cross sectional data can be incorporated into the assessment, sites where nearby gauging stations exist, sites with appropriate access, but limited public access

The following three sites have been selected for monitoring in 2019/20:

- Darcys Track
- Loch Garry
- McCoys Bridge

4. Timing and frequency of sampling

Sediment and propagule deposition assessments should be undertaken at least six times over an eighteen-month period targeting different flow types (winter fresh, spring fresh, variable baseflow, IVT). Deployment, removal and replacement of sampling equipment (turf mats) should be undertaken at low flows.

5. Responsibilities and identifying key staff

Field Program

The field program will be undertaken by two field staff each visit with the retrieval of the turf mats. The turf mats will then be transported to a laboratory for seed and sediment preparations. The field staff will be Streamology staff members with occasional assistance from vegetation ecologist.

Laboratory Requirements

The laboratory work will be undertaken by both Streamology staff to process and analyse the sediment and a vegetation ecologist to grow out and analyse the seed samples.

Procedure for transferring knowledge to new team members

Methods and field notes will be communicated and stored as to transfer knowledge to new team members. Subsequent field visits will allow opportunities to train up new team members and explain the processes involved.

6. Monitoring Methods

6.1.1. Equipment

Equipment required includes:

- Field equipment:
  - Synthetic turf mats (360 mm x 240 mm, 19 mm pile)
  - Pegs (heavy-duty tent pegs or similar)
  - Survey equipment (total station) for survey of mat elevations
  - Large resealable bags
- Laboratory equipment (sediment):
  - Drying oven (55°C)
  - Foil trays
  - Balance
  - Furnace (550°C)
  - Crucibles
  - Sieves – including, at a minimum, 2 mm and 0.5 mm aperture
  - Laser diffraction particle sizer, or alternative equipment for sizing of fine (<0.5 mm) particles
  - Reagents
    - Sodium hexametaphosphate (Calgon)
- Nursery equipment:
  - Drying oven (40°C)
  - 125 µm sieve
  - Standard seedling trays (1 per sample)
  - Sterile seed raising media
  - Temperature controlled glasshouse (with TCs maintained between 15-25C) with automatic misting system.

6.1.2. Protocol

Based on the method of (Goodson et al. 2003) the following will be undertaken:

Deployment:

- Paired turf mats (for sediment and propagule monitoring) are deployed in groups of three replicates per feature with four features per site
- Mats are secured at four corners with pegs
- Feature selection is based on site geomorphology but aims to capture the diversity of features, particularly depositional features, on site. Ideally, features should include a bar, bench and bank.
- One additional set of 3 mats (unpaired, for propagule monitoring only) is deployed above the expected top water level for monitoring of aerial seed dispersal
- Mats are deployed at levels to target different flow types
    - Bar mats are inundated in low flows
    - Bench and bank mats are inundated in freshes and possibly IVTs
- Mat locations and levels are surveyed by total station

Retrieval:

- Turf mats are retrieved at low flow
- The bottom surface of each turf mats is wiped clean of any adhering soil or organic material before being placed in large resealable bags
- Leaves and small twigs (but not logs) on the surface of the turf mats are collected for processing
- Large litter that extends outside the mats should be broken off and discarded
- Lost mats are recorded
- Mats are replaced in same location by new mats

Laboratory analysis of sediment:

- Mats are dried for 48 hours at 55°C
- Sediment is brushed/tapped off each mat into a tray and weighed
- Large leaves and twigs are removed and weighed
- A subsample of known dry mass (20-50 g) is taken and placed in furnace at 550°C for 3 hours, then reweighed to obtain loss-on-ignition estimate of organic content
- A further subsample of 300 g (or remainder of sample if less than 300 g) is taken for particle size analysis:
    - Sample is dispersed by addition of water and sodium hexametaphosphate (around 10 ml of 25% solution per 100 ml of water)
    - Sample is washed through a 0.5 mm sieve with a low-pressure water jet. The effluent is reserved for laser particle sizing. The captured material is dried, weighed, and then dry-sieved through a 2 mm sieve (and other sieves if further resolution of particle size distribution is required). The retained and passing fractions are weighed.
    - The material finer than 0.5 mm is analysed using a laser diffraction particle sizer using standard procedure.

Propagule germination

Processing of turf mats

- Large leaves and twigs are removed and rinsed thoroughly over a 125 µm sieve to collect attached seeds before being discarded.
- Mats are agitated in buckets of tap water to dislodge propagules. The wash water is then filtered through 125 µm sieve to recover propagules. This mesh size ensures very small seeds (e.g. Juncus spp) are collected.

- The presence of the floating plants Lemna spp and Azolla spp should be recorded and removed. Counts of Lemna and Azolla are unreliable as they form colonies of vegetatively produced individuals which are prone to fragmenting during sampling and multiply rapidly.
- Viable vegetative fragments (e.g. green or turgid buds) are recorded and placed in separate trays if they cannot be identified immediately.
- All other material retained by the sieve is placed in paper bags and dried at 40°C for 1 week.
- The dried material is then spread evenly over soil trays. If there is a large amount of material it should be spread over several trays.

Preparation of soil trays and set up

- Germinations trays are filled to a depth of c. 5 cm with soil
- Seeds are germinated under moist soil conditions (Williams et al. 2008; Casanova and Brock 2000).
- Germination trays are kept moist using an automatic misting system operated 3-4 times per day
- Trays are placed in a glasshouse to provide a favourable temperature range for germination and to avoid contamination with wind dispersed propagules.
- For each sampling event ten "blank" soil trays should be distributed among the samples to detect contamination of trays.

Monitoring germination

- Species identification and counts of germinants are carried out weekly progressing to fortnightly as germination slows.
- Germinants are monitored for 4-6 months depending on the amount of continuing germination
- Seedlings are removed once identified and once they flower.
- If new germinants are observed at 4 months monitoring may need to continue for longer.

Plants that cannot be identified at the end of the germination period are transplanted and grown on.

7. Quality assurance/ quality control

Quality control and quality assurance protocols are documented in the Quality Plan developed as part of the MER for all Selected Areas. To ensure quality assurance and quality control, the protocol outlined in the monitoring methods should be followed precisely in each retrieval and each round of laboratory processing. Field notes and Laboratory notes should be kept and documented, outlining all conditions, observations and measurements.

8. Data analysis and Reporting

The main analysis of data collected for the turf mat monitoring will be undertaken at the University of Melbourne to ensure greater consistency in methods used for analysis and reporting of results. Processed monitoring data will be uploaded to the Monitoring Data Management System in accordance with data management protocols. All new results will be presented in the annual report as per other monitoring matters.

It is impossible to be completely prescriptive of the specific model structures that will be used to analyse the turf mat monitoring data at this stage, but the programs for sediment deposition and propagule transport will use comparisons among different periods of the year (winter to warmer season) and between different types of flow events (e.g. CEW, IVT and natural high flows) to make inferences about the effect of particular types of events. Analyses will also build upon those used for the 'winter' turf mat monitoring undertaken as part of the final year of the Long-Term Intervention Monitoring Project.

The results of the monitoring will be incorporated into the 2019 and 2020 annual MERP reports.

References

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