**Hydrological data analysis**

Hydrological data pertaining to each field site were collated from the PINNNENA CW 10.1 database (NSW Office of Water, Department of Primary Industries) and the NSW Office of Water Continuous Water Monitoring network website (<http://realtimedata.water.nsw.gov.au/water.stm>) (for NSW sites), and the Victoria State Government’s Water Measurement Information System website (<http://data.water.vic.gov.au/monitoring.htm>). Daily discharge rate data arrives as timestamped average daily flow datapoints in units of megalitres per day. Where possible 30 year time series were obtained, spanning years 1983 – 2012. Records were truncated for three sites, spanning 15, 19 and 28 years. Missing data were approximated using the Time Series Manager module in River Analysis Package (REF). Consistency of the resulting outputs were checked by visual inspection of hydrographs. For Mammy Johnson’s River, Mann River, Sportsman’s Creek and Wallagaraugh River, multiple linear regression was chosen as the most appropriate method. Linear interpolation was used for Jilliby Creek data.

A minimal set of hydrological metrics was pared from the full set described by Kennard et al. (2010). These metrics were chosen to be representative of variability in high flow magnitude and frequency as well as predictability and consistency of water availability in the riparian environment (see Table 1 for a description). We used the Time Series Analysis module in River Analysis Package to generate these metrics. Means and coefficients of variation were calculated for most metrics to indicate central tendency as well as spread within the data. Low and high spell metrics were thresholded at the 5th and 95th percentiles, respectively, with a flood independence criterion of 7 days between peaks events 20 year average return interval (ARI) flood magnitude was also calculated with a flood independence value of 7 days between peaks. Colwell’s Indices were calculated using mean values over monthly time periods and a class distribution of 11 flow classes. Metrics of flow magnitude were normalised by mean daily flow to allow for comparison between different sizes of river.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | **Abbreviation** | | **Units** | **Description** |
| *Flood frequency and magnitude* | | | | |
| Mean magnitude of high spells\* | HSPeaknorm | dimensionless | | High spells are periods of flow above the 95th percentile on the flow duration curve. We were interested in how frequently these conditions occurred over the time series as well as the mean magnitude of peak flows during these periods. 20 year average return interval (ARI) floods are extreme flow events that have the potential to resculpt the fluvial landscape. Together, these metrics indicate the intensity and frequency with which mechanical stress is applied to plants in the riparian zone. |
| CV of all years’ mean high spell magnitude | CVAnnHSPeak | dimensionless | |
| 20 year ARI flood magnitude\* | AS20YrARInorm | dimensionless | |
| Mean of all years’ number of high spells | MDFAnnHSNum | year-1 | |
| CV of all years’ number of high spells | CVAnnHSNum | dimensionless | |
| *Rise and fall rates* | | | | |
| Mean rate of rise \* | MRateRisenorm | dimensionless | | Rise and fall rates represent flow flashiness. Fast rise rates are associated with flood waves and intense mechanical stress to plant stems. Slow fall rates keep exposed substrate moist for longer periods, which may produce favourable conditions for germination. Historical discharge records are unfortunately limited to daily resolution, so are unable to fully capture flood discharge shapes. High variability between years indicates the occurrence of extreme events which may not have been captured by the mean value. |
| Mean rate of fall \* | MRateFallnorm | dimensionless | |
| CV of all years mean rate of rise | CVAnnMRateRise | dimensionless | |
| CV of all years mean rate of rise | CVAnnMRateFall | dimensionless | |
| *Baseflow index* | | | | |
| Baseflow index | BFI | dimensionless | | Baseflow index is calculated using the ratio of flow during average conditions to total flow. It is a useful metric of consistency of water availability, in that it is maximised when average flow conditions dominate, and minimised when total flow is dominated by above average flow events. Intra-annual variability in baseflow index measures how predictable baseflow index is between years. |
| CV of all years Baseflow Index | CVAnnBFI | dimensionless | |
| *Low flow magnitude, frequency and duration* | | | | |
| CV of all years’ mean low spell magnitude | LSPeaknorm | dimensionless | | Low spells are periods of flow below the 5th percentile on the flow duration curve. We were interested in how frequently these conditions occurred over the time series as well as the mean and interannual variability in magnitude and duration of low flows. |
| CV of all years mean of low spell magnitude | CVAnnLSPeak | dimensionless | |
| Mean of all years number of low spells | MDFAnnLSNum | year-1 | |
| CV of all years’ number of low spells | CVAnnLSNum | dimensionless | |
| Mean duration of low spells | LSMeanDur | days | |
| CV of all years’ low spell mean duration | CVAnnLSMeanDur | dimensionless | |
| Mean flow during driest week\* | MA.7daysMinMeannorm | dimensionless | |
| Mean days per year under 0.1ML/day flow | MDFAnnUnder0.1 | days/year | |
| CV of all year’s days per year under 0.1ML/day flow | CVAnnMDFAnnUnder0.1 | dimensionless | |
| *Colwell’s indices* | | | | |
| Constancy based on monthly mean daily flow | C\_MDFM | dimensionless | | Colwell’s indices provide a measure of the seasonal predictability of flow events and therefore water availability within the riparian zone. Constancy (M) measures uniformity of flow across seasons, and is maximised when flow conditions do not differ between seasons. Contingency (M) is a measure of interannual uniformity in seasonal flow patterns, and is maximized when seasonal patterns of flow are consistent between years.  We generated Colwells indices for both average flow conditions and minimum flows conditions. |
| Contingency based on monthly mean daily flow | M\_MDFM | dimensionless | |
| Constancy based on monthly minimum daily flow | C\_MinM | dimensionless | |
| Contingency based on monthly minimum daily flow | M\_MinM | dimensionless | |

Table . Hydrological parameters used as metrics of variability in high flow magnitude and frequency and predictability and consistency of water availability in the riparian environment. \* - normalised by mean daily flow (ML/day)

Finally, we performed permutational multivariate analysis of variance using distance matrices (using the vegan package in R) across these chosen metrics to confirm that our field sites did indeed comprise three significantly different hydrological categories.

**Abundance weighted site means of wood density**

To investigate variation in wood density across hydrological gradients at the community level, abundance weighted means of wood density were generated for each site. Species relative abundance was compiled from records of % cover at the shrub (1-4m), subcanopy (4-8m) and canopy (8+) strata. Wood density values were then weighted according to species relative abundance and then summed to produce the abundance weighted site mean. This method integrates particular trait values with their real world abundance as a measure of ‘performance’, while providing a useful reduction in data dimensionality. Wood density varies only over one order of magnitude, while exhibiting relatively high intra-species plasticity. As such, abundance weighted site means work well for environmental gradient studies because the focus is maintained on the functional characteristics of the community, rather than on species *per se*.

**Comparing wood density between hydrological classes**

Raw species trait values were lumped according to the hydrological class membership and differences between classes tested for using a post-hoc Tukey’s HSD test. This test was repeated using class-lumped abundance weighted site means.

**Testing relationships between mean wood density and hydrological conditions**

Ordinary least-squares regression models were generated for selected metrics to determine relationships between hydrological gradients and abundance weighted site mean values. Wood density data was normally distributed and did not require transformation. To reduce the occurrence of Type 1 statistical error, we adjusted the resulting p values using the Benjamini and Hochberg (BH) procedure for controlling family-wise error rate (stats package in R). Although sound ecological rationale underlay inclusion of each subgroup of hydrological metrics, these metrics were highly autocorrelated. The BH procedure has been shown to control the false discovery rate for positively dependent test statistics (Benjamini and Yekutieli, 2001). We then identified the most ecologically relevant axes of variation in hydrological conditions by running a principal components analysis over hydrological metrics showing significant relationships with site mean wood density values.