RESULTS

HYDROLOGICAL ANALYSIS

Below we describe patterns of variation functional dispersion as they relate to the two groups of hydrological variables described in Table X: those describing frequency and magnitude of flood disturbance, and those describing variability in water availability in the riparian zone. Statistics for all univariate regression models are shown in Table X.

Table 1. Statistics for univariate linear regression models comparing FDis with hydrological metrics. p.adj represents p values which have been adjusted to control the false discovery rate. Relationships which remained significant following adjustment are shown in bold typeface. \* All models are linear apart from M\_MinM for which a quadratic model (df = 2,12) provided a substantially better fit.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| metric | p | p.adj | R2 | F(1,13) |
| CVAnnHSPeak | **0.0010** | **0.0152** | **0.5773** | **17.7500** |
| M\_MinM | **0.0094** | **0.0278** | **0.5404** | **\*7.0560** |
| MDFMDFSummer | **0.0031** | **0.0230** | **0.5032** | **13.1700** |
| CVMDFSummer | **0.0218** | **0.0325** | **0.4716** | **\*5.3560** |
| CVMDFWinter | **0.0096** | **0.0278** | **0.4143** | **9.1940** |
| CVAnnMRateRise | **0.0110** | **0.0278** | **0.4031** | **8.7810** |
| CVAnnMRateFall | **0.0129** | **0.0278** | **0.3896** | **8.2990** |
| MDFMDFSpring | **0.0134** | **0.0278** | **0.3862** | **8.1800** |
| AS20YrARI | **0.0148** | **0.0278** | **0.3774** | **7.8790** |
| M\_MDFM | **0.0209** | **0.0325** | **0.3470** | **6.9080** |
| M\_MaxM | **0.0258** | **0.0325** | **0.3275** | **6.3300** |
| CVMDFSpring | **0.0260** | **0.0325** | **0.3269** | **6.3130** |
| CVMDFAutumn | **0.0342** | **0.0386** | **0.3009** | **5.5950** |
| CVAnnHSNum | **0.0360** | **0.0386** | **0.2961** | **5.4680** |
| HSPeak | 0.0648 | 0.0648 | 0.2384 | 4.0690 |
| MDFMDFWinter | 0.0881 | 0.0780 | 0.2073 | 3.4010 |
| C\_MaxM | 0.0885 | 0.0780 | 0.2069 | 3.3920 |
| C\_MDFM | 0.1086 | 0.0861 | 0.1859 | 2.9680 |
| MDFMDFAutumn | 0.1091 | 0.0861 | 0.1854 | 2.9590 |
| C\_MinM | 0.1361 | 0.1021 | 0.1626 | 2.5240 |
| MRateRise | 0.1556 | 0.1072 | 0.1488 | 2.2720 |
| MRateFall | 0.1572 | 0.1072 | 0.1477 | 2.2530 |
| MDFAnnHSNum | 0.7270 | 0.4741 | 0.0097 | 0.1273 |

COMPARISONS WITH GLOBAL ENVIRONMENTAL VARIABLES

No significant relationships were identified between FDis and latitude (p = 0.717, F(1,13) = 0.137), elevation above sea level (p = 0.518, F(1,13) = 0.441) and a weak, non-significant relationship was found between FDis and catchment area (p = 0.069, F(1,13) = 3.925).

IS FUNCTIONAL DIVERSITY RELATED TO THE FREQUENCY AND MAGNITUDE OF FLOODING DISTURBANCE?

Functional dispersion was positively associated with metrics describing intense but rare episodes of flooding disturbance. FDis was significantly explained by the magnitude of the 20 year average return interval flood (AS20YrARI, Fig Xa.). FDis was significantly explained by interannual variability in high flow magnitude (CVAnnHSPeak, Fig. Xb) and rates of flow rise (CVAnnMRateRise, Fig. Xc) and fall (CVannMRateFall, Fig. Xd), whereas relationships with metrics describing average conditions (mean high flow magnitude, HSPeak; mean flood rise rate, MRateRise; mean flood fall rate, MRateFall) were not significant. Likewise, while interannual variability in flood frequency bore some relationship with FDis, mean annual flood frequency did not. These results indicate that functional diversity is elevated at sites which experience extreme flooding events and patterns of flow which diverge strongly from average conditions.



Figure 1 Relationships between FDis and hydrological metrics describing a) magnitude of the 20 year average return interval flood (AS20YrARI), b) interannual variability in high flow magnitude (CVAnnHSPeak), c) interannual variability in flood rise rate (CVAnnMRateRise), d) interannual variability in flood fall rate (CVAnnMRateFall), e) interannual variability in high flow frequency.

IS FUNCTIONAL DIVERSITY RELATED TO SEASONAL VARIABILITY IN WATER AVAILABILITY IN THE RIPARIAN ZONE?

Higher functional diversity was positively associated with variability in seasonal flow patterns throughout the hydrological record. Functional dispersion was increased when seasonal patterns of minimum (M\_MinM, Fig. Xa), maximum (M\_MaxM, Fig. Xb) and average (M\_MDFM, Fig. Xc) flows became less uniform (smaller values of M) between years. In other words, at high FDis, the season which these flows were associated with was not consistent through the record. FDis was not significantly explained by interseasonal uniformity of minimum (Fig. Xd, C\_MinM) or average (Fig. Xe, C\_MDFM) flows, although visual inspection of the scatterplots for these relationships indicates two sites at the lower bound of the x axis (i.e. strongly seasonal patterns of flow), with substantially lower FDis than predicted by the regression model. If we consider this trend, we can infer that functional dispersion was increased when discharge patterns differed strongly between seasons, but the season with which those patterns were associated was not consistent between years.

This finding was corroborated by positive relationships between FDis and variability in mean daily flows for autumn (CVMDFAutumn, Fig. Xa), winter (CVMDFWinter, Fig. Xb), spring (CVMDFSpring, Fig. Xc). Summer flow variability (CVMDFSummer, Fig. Xd) exhibited a humped relationship with FDis. Mean daily flows for both summer and spring were associated with FDis, however. This relationship was positive for summer (MDFMDF Summer, Fig. Xe) and negative for spring (MDFMDFSpring, Fig. Xf). Note that this metric actually represents the ratio of seasonal mean daily flow to the general mean of daily flow for a given river, since metrics describing discharge were normalised by mean daily flow. Even though FDis was highest at sites where average flow is not associated with any particular season (low M\_MDFM), these sites still had high values for mean daily flow in summer. Pearson correlation confirms a significant negative relationship between M\_MDFM and MDFMDFSummer (r = -0.657, p = 0.008) but not C\_MDFM and MDFMDFSummer (r = -0.423, p = 0.1164). Summer mean daily flow may have been inflated by exceptional periods where very high average flows occurred during summer. Mean daily flow in spring, conversely, was strongly positively correlated with M\_MDFM (r = 0.8357, p = 0.0001) and C\_MDFM (r =0.7839, p = 0.0005), indicating that where mean daily flows in spring are high, this pattern is stable and consistent between years.

MDFMDFSpring strongly positively correlated with M\_MDFM and C\_MDFM

MDFMDFSummer strongly negatively correlated with M\_MDFM but not so much C\_MDFM

* How can that be? Usually flows are not associated with any season in particular but it is possible that MDFMDFSummer is inflated by exceptional years – i.e. occasionally, very high mean daily flows occur in summer. MDFMDFSummer is in fact correlated positively with CVMDFSummer… Must be a strong skewing effect from exceptional years (perhaps some tropical current?)



1. M\_MinM
2. M\_MaxM
3. M\_MDFM
4. C\_MinM
5. C\_MaxM
6. C\_MDFM
7. CVMDFWinter