Dear Dr Townsend,

Thank you for your invitation to review and resubmit our manuscript. The reviewers provided detailed and insightful comments and we hope that we have satisfactorily incorporated their suggestions and addressed their concerns. The major change to the draft manuscript is the addition of an additional analysis to tease apart the contributions of hydrology, climate and edaphic conditions to explaining functional dispersion. We believe this analysis lends further weight to our conclusion that functional dispersion is strongly associated with hydrological variability. You may note that the word count has increased somewhat. Individual references for each of the 12 variables were requested by the authors of the edaphic dataset. While we have added some text to describe the new analysis, these new references make up a large proportion of the increased word count.

We have also split the Supporting Information into three separate files to better accommodate the addition of further material associated with this analysis.

As previously, we had difficulty uploading the trait data spreadsheet file (Supporting Information S4) - this file can be accessed at: https://github.com/jamesrlawson/functional-diversity/blob/master/docs/to%20resubmit/Supporting%20Information%20S4.xlsx

We look forward to your assessment of the revised manuscript.

Kind regards,

J Lawson, on behalf of K Fryirs, T Lenz and M Leishman

**REVIWER 1**

General Comments  
This is a very interesting article that uses a selection of riparian plant morphological and phenological traits to describe the relationship with the river flow regime.  The manuscript is generally well written and provides some novel information and approaches to describe the importance of aspects of river flow regimes to the riparian plant functional diversity.  
  
The main points where I think the manuscript could be improved include a need early on in the article to provide a definition of and give examples of what is meant by functional traits and functional diversity.  This lead to some confusion in this reader for quite a way into the article before I worked out what functional traits were used and what was meant by functional diversity in this context.  These should be clarified in the Introduction and Methods.

We acknowledge the need to provide a solid theoretical foundation on functional diversity in the manuscript, but the reviewer’s comments are somewhat confusing. We provide substantial description of the concept of functional diversity in the introduction, particularly in the sections that the reviewer describes as superfluous.

For example

* (Lines X): “Quantitative functional traits can form the basis for mechanistic assessments of diversity that describe the range and distribution of ecological strategies within a community and their associated environmental effects.”
* (Lines X): “Numerous metrics of functional diversity have been described in the literature (Schleuter & Daufresne 2010; Mouillot *et al.* 2013). These metrics aim to quantify "the distribution of species and their abundances in the functional space of a given community” (Mouillot *et al.* 2013, p. 167) and typically process multidimensional trait data to output a single value describing various properties of these data.”
* (Lines X): “Functional dispersion (FDis), defined as the abundance-weighted mean distance in multivariate trait space of individual species to the centroid of all species in the communit”

We have clarified the text in the last case to explicitly refer to distance in multivariate trait space.

Further definition of functional dispersion is provided in the methods:

* (Lines X): “We used the *dbFD* function from the FD package for R (Laliberté & Legendre 2010) to calculate abundance-weighted functional dispersion (FDis). This package implements the method for distance-based tests for homogeneity of multivariate dispersions described by Anderson (2006).”

We did reconsider the placement of the trait description table, but decided that it should remain in the Methods section.

Also to me the Introduction is too long.  There are a couple of paragraphs of information that are peripheral to the research presented and could easily be removed and summed up in a sentence or two (with reference to the literature). Similarly the methods can be reduced in length by the removal of some information that is interesting but peripheral to the analysis done, as the reader does not need the detail of why one method was chosen over another, only provide a reference so the interested reader can chase it up.

As mentioned previously, we believe these paragraphs provide important information on functional diversity.

We have made the requested alterations to the Methods section.

Changes to text:

Lines X, Lines X

Abstract  
P2 L27 –Not sure I agree with this statement.  Could be said that hydrology is key for all plants in all environments, if you are talking hydrology broadly.  If you mean river flow regimes then perhaps it is an important variable but not overriding.

We are actually referring to the prevalence of this assertion in the literature, most notably by Poff et al., rather than making this claim ourselves.

(Poff, N.L., Allan, J.D., Bain, M.B., Karr, J.R., Prestergaard, K.L., Richter, B.D., Sparks, R.E., Stromberg, J.C., 1997. The natural flow regime. Bioscience 47, 769–781)

P2 L29 – Does this study look at functional traits of species rather than functional types? There are many studies in Aust and elsewhere that have looked at functional composition of riparian veg and river flows.  E.g.  
Capon S. (2005) Flood variability and spatial variation in plant community composition and structure on a large arid floodplain. Journal of Arid Environments 60, 283-302.  
Capon S. (2003) Plant community responses to wetting and drying in a large arid floodplain. River Research and Applications 19, 509-520.  
Campbell et al. (2014) The value of plant functional groups in demonstrating and communicating vegetation responses to environmental flows. Freshwater Biology doi:10.1111/fwb.12309.  
Greet et al. (2011) Flow variability maintains the structure and composition of in-channel riparian vegetation. Freshwater Biology, 56, 2514-2528.  
Pettit N.E. and Froend R.H. (2001)  Variability in flood disturbance and the impact on riparian tree recruitment in two contrasting river systems.  Wetland Ecology and Management 9: 13-25.  
Kominoski et al. (2013) Forecasting functional implications of global changes in riparian plant communities. Frontiers of Ecology and the Environment 11, 423-432.

We acknowledge that functional classification is a commonly used method in riparian plant ecology. In answer to the reviewer’s question, our study specifically uses quantitative, continuous plant functional traits to estimate functional diversity.   
  
P2 L35 – What is meant by functional diversity in the context of this study?

We are explicitly referring to functional trait diversity (rather than diversity of plant functional types).

Changes to text:

Clarified the text such that ‘functional diversity’ is defined as ‘functional trait diversity’ (Line X)   
  
Introduction  
P3 L61– Do you mean flow regime?  To me hydrology implies also ground & soil water as well as overland flow, etc.

We do mean river flow regime, and have added a clarification to the text to this end.

Changes to text:

Added clarification, (Line X)

P3 L68 – Perhaps delete this sentence.

Suggestion actioned.

Changes to text:

Sentences has been deleted and paragraphing has been altered (Lines X)

P4 L82- 112 – These two paragraphs while they contain a lot of interesting information much seems peripheral to the topic being studied.  Perhaps consider revising to reduce to the core information.

We have retained these paragraphs, as they contain important information rationalising functional trait diversity as an interesting property of plant communities, defining functional trait diversity, and demonstrating that functional dispersion as the most suitable of the available metrics for this study.

P4 L84 – Need to define what functional traits you mean?

Definitions and rationales for inclusion of functional traits are provided in the Methods (Table X).

P4 L93 - What do you mean by functional diversity?

We believe we adequately describe functional diversity in the introduction:

Line X - “Quantitative functional traits can form the basis for mechanistic assessments of diversity that describe the range and distribution of ecological strategies within a community and their associated environmental effects.”

P6 L133 – what is functional composition?

Changes to text:

Replaced ‘functional composition’ with ‘functional diversity’

P6 L140 – What is functional diversity?  
  
Please refer to our response to the reviewer’s general comment.

Methods  
P7 L159 – The method used to develop FDis from selected traits need to more explicitly explained.  It took me a long while to figure out what had been done.

Changes to text:

Clarified that FDis is calculated for each site using the FD packge in R, using species trait values and relative abundances for each site (Lines X)

P10 L234 – A description of FDis is mentioned in the introduction but how it is measured should be described in the methods.  I'm confused about the difference in functional traits and functional diversity?

Hopefully the clarifications described above alleviate this confusion.

P10 L237-241 – Consider deleting this sentence.  Unnecessary detail.

Changes to text:

Deleted sentence (Line X)   
  
Results  
P11 L264 – Consider deleting this first sentence.

This sentence has been retained as it is important structurally.

P12 L280 – The opening and concluding sentences for this paragraph seem to say the data indicate different things.  Which is correct?  Probably don't need both.

The point is restated but it appears to me to say the same thing.

P12 L286 - The opening sentence to this paragraph is a little confusing and probably unnecessary, consider deleting (similar to previous paragraph).

Changes to text:

Rewrote sentence (line X)

P12 L288 – What do you mean by less uniform?  Is this less variable?

We are using ‘uniformity’ to describe the time series of seasonal flow distributions – in this instance ‘less uniform’ implies lesser variability in seasonal flow distributions between years.   
  
Discussion  
P18 L442– This may be so but at the lower end of variability of Australian river flows compared with semi-arid and tropical regions.

We do refer to this:

* Line X: “Our survey covered approximately half of the range of hydrological variability present within the Australian continent (Peel *et al.* 2004).”

P19 L451 – See Jardine et al.  (2015) Flood rhythm and ecosystem responses in tropical riverscapes. Ecology, 96(3), 684-692.) for productivity/ variability relationships on Australian tropical floodplains.

Changes to text:

Have added comments on this study to the Discussion (Lines X, Line X).

P19 L461 - And what of the effects of other disturbances such as fire and drought which may affect the plant traits measured (particularly leaf size).

Changes to text:

Have commented in the Discussion on a study describing functional diversity promotion by natural fire regimes (Lines X).

P20 L474 – See also Richter et al. (2000) Conserv. Biol. 14, 1467–1478;  Naiman et al 2008 C. R. GeoScience 340, 629-643.

Changes to text:

Commented on Naiman et al. paper in discussion (Lines X).

P20 L489 – Also species diversity.

No change.

**REVIEWER 2**

This paper reports an empirical investigation into the relationship between the functional diversity of riparian vegetation and temporal river flow patterns. It was based on 15 sites for which long-term discharge data were available. The high resolution of discharge data ensured a proper characterization of flow variability at different time scales.  Species abundance data were collected once, as part of a companion study whose findings are reported in a paper in press provided with the submitted material. Functional diversity was estimated based on multiple plant traits from a adhoc database. Functional diversity was estimated using a single index, an approach that has some drawbacks. Because functional diversity is a multifaceted concept, it makes more sense to assess it through several complementary indices. A single index is unlikely to capture all facets of functional diversity and therefore may lead to overlook ecological relevant results. The use of several indices may also help to better understand mechanisms and processes that shape the different facets of functional diversity. The FDis index selected for this study provides compelling results in support for the prediction that flow variability trigger plant diversity.  It is questionable, however, whether another functional diversity index could have provided stronger support for the classical hump-shaped disturbance diversity relationship. That said, the use of several indices comes with challenge and can complicate substantially the interpretation of results.

Functional diversity is certainly multifaceted, and a multitude of different metrics exist to describe it. We initially intended to use the framework described by Villeger et al. (2008), which characterises functional diversity according to functional richness, functional evenness and functional divergence. As the reviewer suggested, the results of this analysis were multiplied, and comparatively complicated to interpret. Given the space constraints of the journal, and the ability to weight FDis by species’ relative abundance, we argue that this using single metric allows for the most succinct and compelling interpretation of the data.

I enjoyed reading this paper. It is well-written, logically organized, and easy to follow. The study is based on the state-of-the art method to assess plant functional diversity although I think it is a shame that analyses were not conducted within a multifaceted framework of functional diversity.  The results missed important information on the collinearity of explanatory variables, which is inevitable when broad ecological gradients are examined. In particular, I would like to see a PCA or correlation matrix before the results of univariate and multiple regression analyses are shown.

Following the reviewer’s request, we have added a PCA analysis of collinearity between hydrological variables to the Supporting Materials (Table X).

It is also worth noting that explanatory variables all relate to hydrology, precluding test of competing hypotheses. Yet, cross-site variations in functional diversity may also be accounted by other ecological factors (e.g. geology, climate, biogeography), which might not be independent of hydrological factors. As such, it is important that the authors provide evidence that observed effect of hydrology on functional diversity is not driven by some confounding factors.

The reviewer’s comment describes an ever present issue in environmental gradient studies. We have added an additional analysis to the manuscript to address this concern. The following excerpt from the Methods section describes this analysis:

“Optimal models explaining variation in FDis according to climatic and soil variables were then generated using the same process as for hydrological metrics. Variance explained by these models was then partitioned by partial regression following Borcard, Gillet & Legendre 2011, using the function *varpart* in R (vegan package, Oksanen *et al.* 2013).”

This analysis shows that the effect of hydrology on functional dispersion was dominant, and that only a very small amount of variation in FDis was non-redundantly explained by climate. Soil properties explained no non-redundant information.

Changes to text:

Described additional analysis in Methods (lines X)

Described results of additional analysis in Results (lines X)

Commented on the implications of this additional analysis in Discussion (lines X)

l.28-29. Two comments here. First the term ‘functional composition’ does not seem to be used appropriately. Functional composition is usually assessed through community-weighted mean trait values, which are not provided in the paper. Better to use “functional diversity” consistently throughout the text.

Changes to text:

We have removed inappropriate use of the term ‘functional composition’ and replaced it with ‘functional diversity’, except in line X where we feel it is useful.

Second, I feel the authors overstate the lack of studies that have taken a functional perspective. For instance, plant life-form classification based on morphological traits has long been used to survey riparian plant community.

The reviewer makes a valid point, and we have softened our stance.

Changes to the text:

Clarified that we are referring specifically to quantitative functional trait approaches, rather than all functional approaches.   
  
l.51-52. The first paragraph does not introduce well the notion of functional diversity and does not tell much about its relevance to understanding patterns and processes in riparian zones.  
  
The concept of functional diversity and its relevance to patterns and processes in riparian zones are described later in the text (e.g. lines X)  
  
l.59. not sure what “functional heterogeneity” means.

We mean heterogeneity in ecological strategy. We have not altered the text, but please advise if alteration is required.

l.82-83. I see the point but the relationship between biodiversity and ecosystem functions is awkwardly stated here.

Changes to text:

Rewrote sentence to be clearer (Line X).   
  
l.84-86. not sure this definition of functional traits conforms to most broadly accepted ones. Here you hint at response traits, which drive species response to environmental fluctuations. Effect traits (i.e. how species affect its environments) are excluded from the present definition.

The reviewer makes a valid point, and we have clarified the text.

Changes to text:

Referred to functional response vs effect traits more explicitly (lines X)  
  
l.86: “more powerful”, I agree, and also more meaningful (than taxonomic metrics). Functional diversity is likely to inform on mechanisms by which species and their interactions drive ecosystem functioning (e.g. niche complementarity, competition, per capita resource uptake, etc.)

These are also valid points, although we feel that these points are adequately covered by the references given.   
  
l. 89. “undermine ecosystems” according to what criteria? Stability, performance, etc.

We are referring to ecosystem resilience and functioning.

Changes to text:

Updated this sentence as per reviewer’s request (Line X).

l.116-117. This statement suggests that a functional diversity index estimated from multiple traits is always better than a single-trait metric.  I will argue that it depends on the objective pursued by the study. If the study focuses on mechanisms underlying species effect on ecosystem and/or species response to environmental changes, a single well-chosen (hard) trait should yield greater insight than a suite of soft traits whose contribution to functional diversity indices is difficult to assess.

The reviewer makes a sound case, and we did not mean to imply that multivariate indices of functional diversity are always better than univariate metrics.

Changes to text:

Updated text to soften argument and remove false implication (Line X).

l.172-173. Since the publication of these papers, empirical evidence have emerged that intraspecific trait variability can be as great as interspecific trait variability.

This is an important point which was not covered adequately. We now comment on two recent references which discuss the use of values from databases to approximate real trait values.

Changes to text:

“Single values for each trait were recorded, under the assumption that for our chosen traits, interspecific variation is strong enough allow differentiation between species despite noise due to intraspecific variation, and that species trait hierarchies are largely conserved across different spatial scales and datasets (Cordlandwehr *et al.* 2013; Kazakou *et al.* 2014).”

Cordlandwehr V., Meredith R.L., Ozinga W. a., Bekker R.M., Van Groenendael J.M. & Bakker J.P. (2013) Do plant traits retrieved from a database accurately predict on-site measurements? *Journal of Ecology* **101**, 662–670.

Kazakou E., Violle C., Roumet C., Navas M.L., Vile D., Kattge J., *et al.* (2014) Are trait-based species rankings consistent across data sets and spatial scales? *Journal of Vegetation Science* **25**, 235–247.

l. 355. Correct the typo in “homogeneous”

This is the correct spelling. Refer http://grammarist.com/usage/homogenous-homogeneous/