Discussion:

While a number of studies have investigated ecohydrological classification as a tool to explain community attributes such as species richness, stand structure and composition (following ELOHA), functional approaches in ecohydrology are still novel. Despite the small sample size, different hydrological classes showed significant differences in mean wood density. Differences in wood density between classes also tracked differences in hydrology.

While resolution between hydrologically similar classes was weak, these results lend credibility to broad-scale ecohydrological classification as a coarse but useful tool in riparian functional ecology. Where river systems belong to different hydrological classes but are spatially or climatically close, it makes sense to dig deeper than lumped categorical comparisons and look compare continuous hydrological parameters.

We found that wood density increased with intensity of flooding disturbance. Wood density was not correlated with the frequency of high flow periods, which individually may not correspond to significant disturbance events, depending on the hydrological characteristics of the given river. Rather, it was the actual magnitude of flow during high flow periods that was important. The model describing interannual variability in high flows was non-significant, although visual inspection of the data reveals a strong trend. Removal of site (Snowy Creek), which has a considerably higher mean wood density than other stable winter baseflow sites, produces a significant relationship. The observation that variability but not average values of flood rise and fall rates predicted wood density, indicates the influence of low frequency, intensely flashy outlier flow events not captured by the mean. A pattern is apparent then, in which wood density in riparian communities is driven by powerful but relatively rare flow events. That high wood density strategies are more abundant in these environments indicates that infrequent but high-stakes events are a greater force of selection in riparian plant communities than average conditions. We therefore suggest that a ‘brick house’ ecological strategy is selected for in riparian environments that experience intense flooding.

Predictability of water availability in the riparian zone also emerged as strongly predictive of mean wood density. We can extend the observation about the influence of intense ‘pulse’ flow events on wood density: plants living in environments where flow occurs largely in specific events, rather than being evenly distributed throughout time, will experience more intense pulses of water stress. In this case, conservative resource-use strategies are likely to be increasingly successful. Numerous studies have discussed the role of various anatomical components of woody tissue in stabilising xylem against cavitation when plants are under severe water stress (REFS – Zanne et al.). High wood density may be symptomatic of wood anatomy strategies that allow plants to tolerate water stress (see Hacke et al 2001, Jacobsen 2005, 2007a – in Martiez Cabrera 2009 paper), although the exact role that woody fibres play in stabilising xylem vessels appears to be inconsistent across taxa (Martinez-Cabrera 2009). Perhaps a more compelling rationale for these findings is that in the absence of predictable cues about water availability, phenotypic plasticity may be maladaptive, conservative resource-use phenotypes such as high wood density are favoured (Valladares et al. 2007).

If poorly plastic, high wood density ecological strategies are selected for their ability to allow plants to tolerate harsh environmental conditions, strategies which let species avoid such conditions instead may also be successful. It is therefore worthwhile considering the inability of abundance weighted means to capture multimodality in trait distributions. This is salient where pioneer species employing a fast relative growth rate, low wood density ecological strategy are benefitted by repeated setbacks to early successional conditions. In this case, higher abundance of these species would drive down mean wood density values through the upper ranges of disturbance intensity.

A third possible strategy exists in the face of harsh conditions. Some species also have the ability to radically change their wood density throughout their life history. *Casuarina cunnhinghamiana*, for instance, is an obligate riparian species whose entire life history revolves around response to flooding disturbance. After seeding *en masse* onto fresh substrate, dense stands of flexible-stemmed saplings emerge, protecting each other from flood flows by sheer numbers. Self-thinning subsequently occurs, and stem wood density increases in the maturing plant to help it withstand its environment.

This observation offers a potential explanation for the goodness of fit of quadratic models which begin to dip after reaching an apex at three quarters of their maximum value. Metrics of baseflow index and variability in baseflow index exhibit this trend (Fig X. a,b), and as descriptors of the contribution of flood flows to total flow, provide good candidates for this explanation. [ignore please]

The gradient we identified by Principal Components Analysis integrates predictability of water availability, seasonality and flood intensity into a single axis of hydrological variation. It is not possible therefore to tease out individual drivers of variation in wood density, however based on our findings, hydrological regionalisation frameworks that distinguish between rivers according to predictability and perenniality of flow should provide a useful basis for predicting wood density.

Hydrological classification therefore becomes useful in projecting changes to the functional attributes of riparian plant communities under changing flow conditions. In the south-eastern Australian context, changing flow conditions are caused by damming and water extraction, and the changing climate. Artificial flow modification by damming and water extraction reduces overall flow volume and the magnitude and frequency of high flow events, while increasing flow predictability and altering seasonality. The converse of this situation is presented by predictions of future climate conditons in south-eastern Australia. In the North Coast region of New South Wales, the Eastern Australian Cyclone Genesis Region is projected to shift southwards by 200km in 2050. This is likely to increase the severity and magnitude of extreme flooding events, with profound consequences for riparian vegetation communities. Further south, a drier, hotter climate is projected, with higher interannual variability in precipitation, and increased prevalence of extreme drought events. If changes in spatial extent of climate zones can be related to changes in runoff (a complicated, but progressing area of research in hydroclimatology), the findings of this study give insight into the changing ecology of riparian plant communities.

Our study highlights the importance of hydrological conditions – particularly disturbance and environmental unpredictability, as determinants of ecological strategy in riparian plants. This is likely to hold important ecological consequences for riparian plant communities in south-eastern Australia, where increasing climatic variability and frequency of extreme events are hallmarks of climate change predictions.