DEPARTMENT OF PLANNING, INDUSTRY & ENVIRONMENT

Native Vegetation Integrity Benchmarks

Release notes supporting Static Benchmarks
June 2019 (Version 1.2)

Cover photo: Native vegetation, Wyrrabalong National Park. Ian Oliver/DPIE

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1. Background

Benchmarks describe the reference state to which sites are compared to assess and score their site-scale biodiversity values. The three primary attributes of biodiversity; composition, structure and function can be described by benchmarks. When scores for composition, structure and function are combined into a vegetation integrity score, they provide the rigour and transparency needed to make site-scaled comparisons and inform natural resource management decision making tools such as the Biodiversity Assessment Method (BAM).

This document focuses on the changes in static vegetation condition benchmarks between Version 1.1 (August 2017) and Version 1.2 (June 2019). These changes have resulted from improvements to empirical data and long-term average rainfall prediction. These release notes also document the new confidence ratings and summed cover capping applied to V1.2 benchmarks. Further release notes specific to dynamic benchmarks (which may vary by month and/or preceding 12 month rainfall) will be made available at the time of delivery. At the time of writing, evaluation of dynamic benchmarks was still underway.

All V1.2 benchmarks are available in the BioNet Vegetation Classification application

In summary;

- Benchmarks have been updated based on revised empirical data and improved long-term rainfall predictions for each regional Vegetation Class (RVC).
- Changes in composition (richness) and structure (cover) benchmark values tend to be small for RVCs represented by many plots.
- Large changes in composition and structure benchmark values tend to be limited to RVCs represented by few plots.
- All revised benchmarks have an estimate of confidence based on the number of plots.
- Capping has been applied to cover benchmarks and this mostly affects RVCs that do not exist in the current landscape (e.g. Alpine Bogs and Fens in the Riverina).
- There have been some changes to function benchmarks based on improved empirical data.

2. New confidence field and new maximum cover values

2.1 Benchmark confidence

All V1.2 benchmarks have confidence ratings which are available in the BioNet Vegetation Classification application. These were not available for V1.1 benchmarks. Details describing the derivation of confidence ratings can be found in Oliver et al. (2019). As these confidence ratings have practical implications for the use of local benchmarks (described below), they should be consulted before using the available benchmarks.

Local benchmarks 'should be' considered for attributes with low or very low confidence, and 'may be' considered for attributes with moderate confidence. Conversely, local benchmarks 'should not be' considered for attributes with high or very high confidence. Exceptions to this guidance may apply (see BAM).

Note: all V1.2 composition benchmarks (growth form richness) have high confidence, and all V1.2 structure benchmarks (growth form cover) have low or moderate confidence. Function attribute benchmarks (number of large trees, length of logs and cover of litter) range from very low to very high confidence (Oliver et al. 2019).

2.2 Capped summed cover benchmarks

Distributions of raw growth form foliage cover data revealed some summed species cover values much greater than 100% for all growth forms (see Vegetation Condition Benchmarks Cover and Richness raw data V1.2). Although summed species cover values greater than 100% are to be expected due to overlapping foliage or canopies, very high outlier values are questionable and may simply reflect poor field practices.

Benchmark models also resulted in predicted growth form foliage cover values much greater than 100% for grass and grass-like, shrub and tree growth forms in V1.1 (Table 1). While the very large values occurred in unlikely RVCs (e.g. grass & grass-like cover in Alpine Bogs and Fens in the Riverina), some observed RVCs had high predicted benchmark values. Unexpectedly high cover benchmarks are undesirable as they may not meet assessor expectations and will lead to unwarranted dominance of a single growth form in the calculation of the BAM structure score due to dynamic weighting (OEH 2018). Improved rainfall estimates in V1.2 modelling (see later section) did not reduce these maxima, although very large values were again limited to RVCs with fewer than 20 plots and particularly those with 0 plots (Table 1).

To guard against the undesirable effects of outliers, estimated cover benchmarks delivered for V1.2 were manually capped at the maximum 75th percentile observed from RVCs with 20 or more plots (Table 1). This process ensured that estimated benchmarks fell within the global range of 75th percentile values observed within RVCs with > 20 plots.

Table 1 Maximum benchmark estimates for summed foliage cover for each growth form

Growth form	Maximum V1.1 cover benchmark	Maximum V1.2 cover benchmark	V1.2 Capped to 75th percentile of observed data
Fern	52	77	56
Forb	44	84	22
Grass & grass-like	410	1274	102
Other	55	55	48
Shrub	392	343	113
Tree	349	349	171

3. Enhancements

3.1 Raw data

Composition and structure

V1.1 composition and structure benchmarks were derived from two datasets separately compiled due to time constraints. The V1.1 composition (growth form richness) raw data file contained 36543 census id records and the V1.1 structure (sum of growth form cover) raw data file contained 36372 census id records. A single V1.2 dataset was subsequently compiled containing 36335 census id records with both composition and structure data (see Vegetation Condition Benchmarks Cover and Richness raw data V1.2; Somerville et al. 2019). Differences in the numbers of census id records in the V1.2 dataset were the result of additional data screening and updating.

In addition, there were some changes in the allocation of records to Vegetation Class in V1.2. In V1.1 where the same record had been linked to two or more different plant community types (PCTs) by the State Vegetation Type Mapping Program (SVTMP) and the State Vegetation Type Classification Program (SVTCP) the allocation made by the SVTCP was accepted. However, for V1.2, a plot to PCT allocation prioritisation approach was used that took account of the rigour by which plots were allocated to PCT. For full details see Somerville et al. (2019).

Function

Function attribute benchmarks were created at a range of classification levels from Class by Interim Biogeographic Regionalisation of Australia (IBRA) bioregion (or RVC – regional Vegetation Class) to formation based on the number of available survey plot records. At least 30 plots were required to generate the benchmark values at the RVC level. RVC combinations with fewer than 30 plots inherited benchmark values from calculations at the Class level, regardless of bioregion. If the Class had fewer than 30 plots, amalgamated data from the relevant combination of formation by Bioregion was used. Where there were fewer than 30 plots at the formation by Bioregion level, amalgamated data from the corresponding formation was used (see Capararo et al. 2019).

The V1.1 Function dataset included many records without an IBRA bioregion allocation (2298 of 6971 plots for litter, 2223 of 4367 plots for logs and 482 of 2302 plots for stem sizes). Due to time constraints these were not updated prior to the delivery of V1.1 Function benchmarks. IBRA bioregion was allocated to all these records prior to the calculation of V1.2 Function benchmarks. These changes increased the number of plots allocated to finer levels in the classification hierarchy and therefore resulted in some changes to benchmarks as well as increased benchmark confidence (see latter section).

3.2 Long-term average RVC rainfall prediction

Static benchmarks are estimated for average rainfall conditions. Because benchmarks are created at the RVC level, average long-term rainfall was modelled for all 1710 RVCs (18 IBRA bioregions x 95 available Vegetation Classes). In reality, approximately 650 RVCs are extant but benchmarks were estimated for all 1710 necessitating the modelling of average long-term rainfall for all RVCs (see Yen et al. in press).

Long-term average rainfall (116 years (1900-2015)) was modelled for each RVC for V1.1 benchmarks using 62249 (V1.1) long-term rainfall observations at BioNet Atlas flora survey plot locations (Oliver et al. 2019). The initial rainfall models accepted plots that lacked a

Vegetation Class allocation to better model IBRA estimates in those regions with few data. This approach assumes that bioregion has a consistent influence on rainfall, regardless of the Vegetation Class. Modelling was based on an additive model which allowed for variation in both IBRA and Vegetation Class: Rain = IBRA + VEG CLASS.

This additive approach, however, assumed that the effects of IBRA and Vegetation Class did not vary jointly. To accommodate more realistic variation in long-term rainfall related to RVC distribution within IBRA we used an interaction model to estimate long-term RVC rainfall. These values were used to generate V1.2 static composition and structure benchmarks. The interaction model was: Rain = IBRA + VEG CLASS + IBRAxVEG CLASS.

The interaction model required plots with both IBRA and Vegetation Class allocations. This reduced the long-term rainfall dataset to 51047 rainfall observations at BioNet Atlas flora survey plot locations. RVCs that were not observed in the long-term rainfall dataset were estimated based on the additive component of the model, but those with observations for both drew on the interaction between IBRA and Vegetation Class.

Changes in predicted average rainfall between V1.1 and V1.2 tended to be small for RVCs represented by many plots. However, where RVCs were represented by few plots and especially for RVCs represented by no plots, changes in predicted long-term average rainfall could be large (Figure 1). The majority of RVCs represented by no plots represent RVC combinations that do not exist in the current landscape and are unlikely to exist in future landscapes (e.g. Subtropical Rainforests in the Australian Alps Bioregion).

Note: Many more plots were used to predict long-term rainfall than were used to create benchmarks as the screening criteria for the latter were stricter (see Somerville et al. 2019).

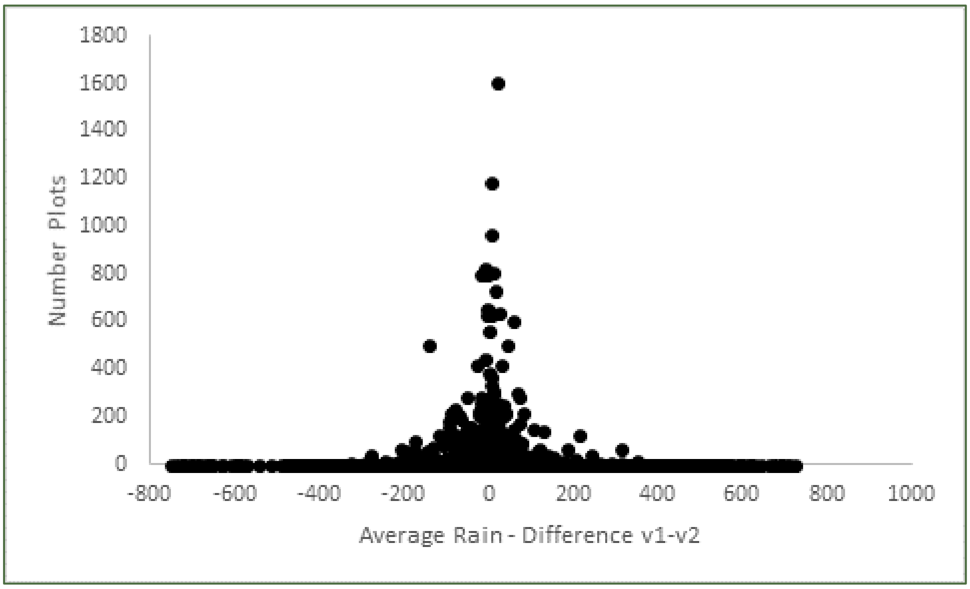

Figure 1 **Difference between V1.1 (2017) and V1.2 (2019) long-term rainfall predictions for each RVC for an average rainfall year in relation to RVC plot numbers**

On average, the interaction model led to increases in predicted average rainfall in many RVCs, particularly in drier IBRA bioregions (Figure 2). The relationship between magnitude of change and plot numbers seen in Figure 1 was consistent within bioregions (Figure 3).

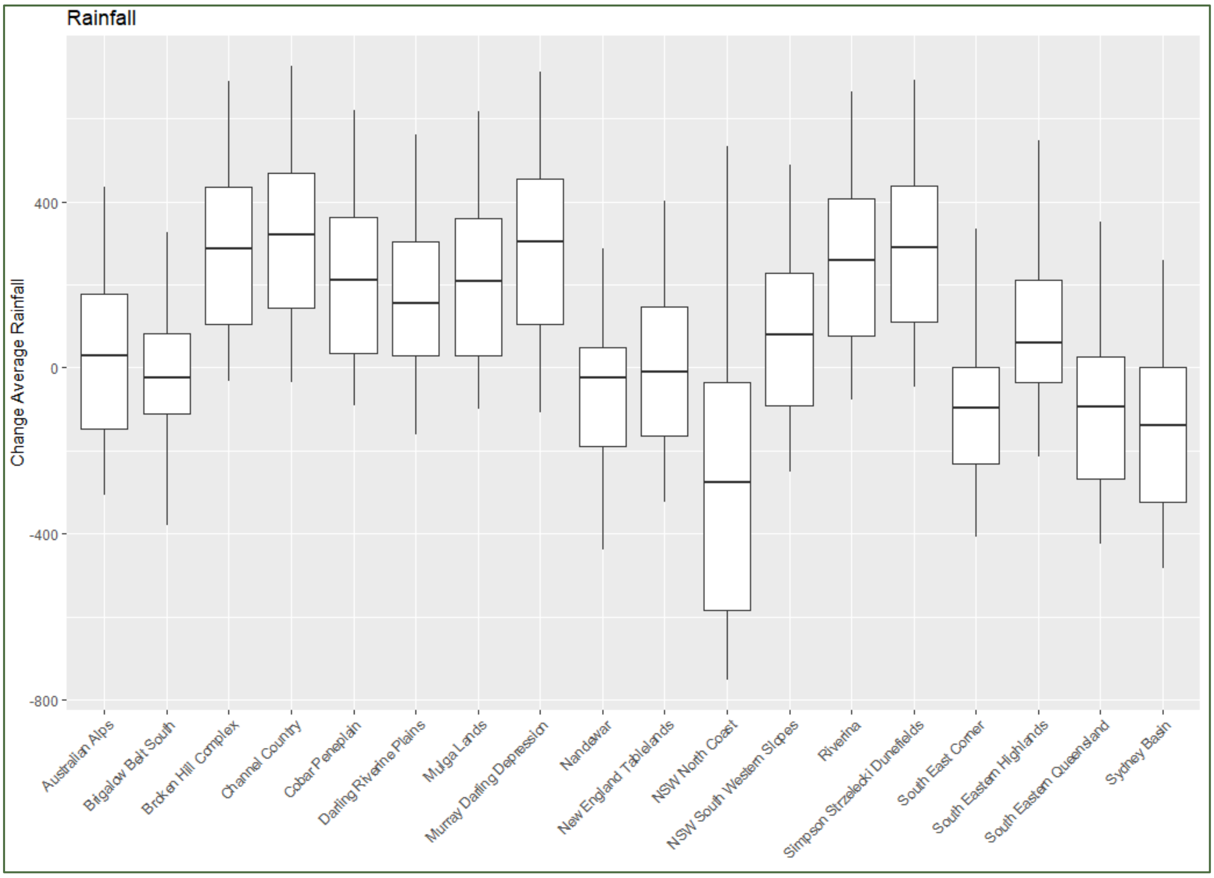

Figure 2 **Changes in predicted long-term average rainfall (mm) between the two rainfall models**

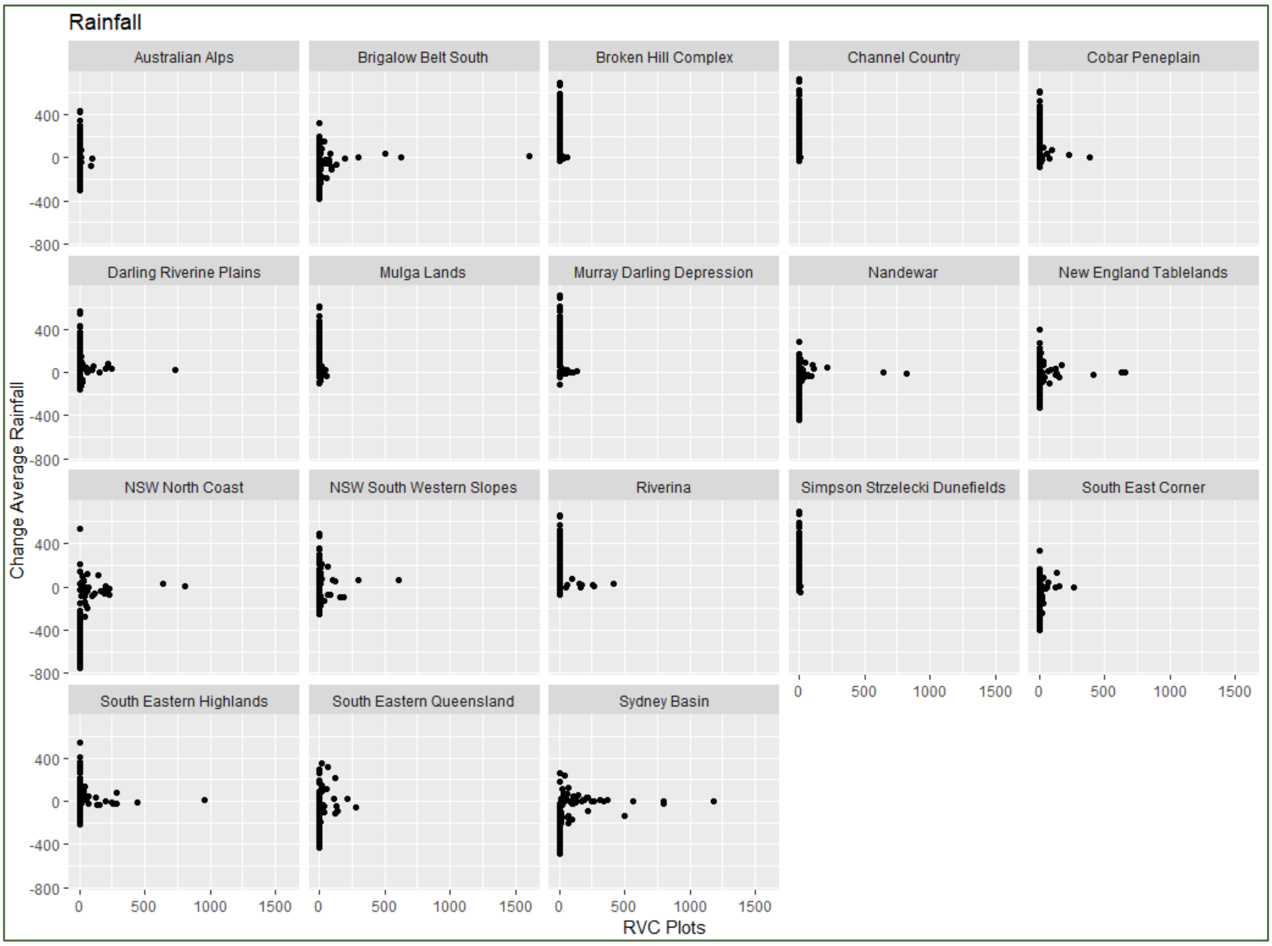

Figure 3 **Relationships between numbers of plots within RVCs and the difference in predicted long-term average rainfall between the two rainfall models**

3.2.1 Benchmark changes due to revised long-term average RVC rainfall

Structure

Changes in cover benchmark values were generally small for RVCs with greater than 20 plots (Appendix 1). Large changes were again mostly restricted to RVCs with no plots (Appendix 2). Absolute changes in benchmarks (BMs) were in some cases positively correlated with absolute changes in average rainfall and as might be expected these changes were most evident in drier bioregions (Appendix 3). Interestingly, this relationship was largely driven by increases in percentage cover with increases in rainfall, whereas decreases in rainfall were not associated with decreases in percentage cover (Appendix 3).

Composition

Changes in richness benchmark values were generally small (~1-2 species) with larger changes mostly limited to RVCs with fewer than 20 plots (Appendix 4) and particularly those with no plots (Appendix 5). There was little evidence to suggest that changes in average rainfall were correlated with the changes in richness benchmarks (Appendix 6).

4. References

Capararo S, Watson CJ, Somerville M, Travers SK, McNellie MJ, Dorrough J and Oliver I 2019, *Function attribute benchmarks for the Biodiversity Assessment Method*, Data compilation and analysis, Department of Planning, Industry and Environment, Sydney.

Office of Environment and Heritage 2018, *Biodiversity Assessment Method Operational Manual – Stage 1. Office of Environment and Heritage*, NSW Government, Sydney, Australia https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Biodiversity/biodiversity-assessment-method-operational-manual-stage-1-180276.pdf

Oliver I, Dorrough J, Yen JDL, McNellie MJ and Watson CJ 2019, *Native Vegetation Integrity Benchmarks: Technical details supporting Static Benchmarks June 2019 (Version 1.2)*, Department of Planning, Industry and Environment, Sydney.

Somerville M, McNellie MJ, Watson CJ, Dorrough J and Oliver I 2019, *Floristic data audit and preparation for data driven benchmarks for the Biodiversity Assessment Method*, Department of Planning, Industry and Environment, Sydney.

Yen JDL, Dorrough J, Oliver I, Somerville M, McNellie MJ, Watson CJ and Vesk PA (2019) Modelling biodiversity benchmarks in variable environments, *Ecological Applications*. https://esajournals.onlinelibrary.wiley.com/doi/10.1002/eap.1970

5. Warnings and limitations

All V1.2 benchmarks have confidence ratings which are available in the BioNet Vegetation Classification application.

Confidence ratings have practical implications for the use of local benchmarks and should be consulted before using the available benchmarks.

Local benchmarks ‘should be’ considered for attributes with low or very low confidence, and ‘may be’ considered for attributes with moderate confidence.

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All V1.2 composition benchmarks (growth form richness) have high confidence.

All V1.2 structure benchmarks (growth form cover) have low or moderate confidence.

Function attribute benchmarks (number of large trees, length of logs and cover of litter) range from very low to very high confidence (Oliver et al. 2019).

6. Appendices

Appendix 1 Change in growth form cover benchmarks between V1.1 and V1.2

In the following figures, V1.1 benchmarks are presented on the x-axis as ‘2018 Static Cover BM (benchmarks)’. These are capped V1.1 (2017) benchmarks (note – V1.1 benchmarks available in BioNet are not capped). V1.2 benchmarks are presented on the y-axis as ‘2019 Static Cover BM’

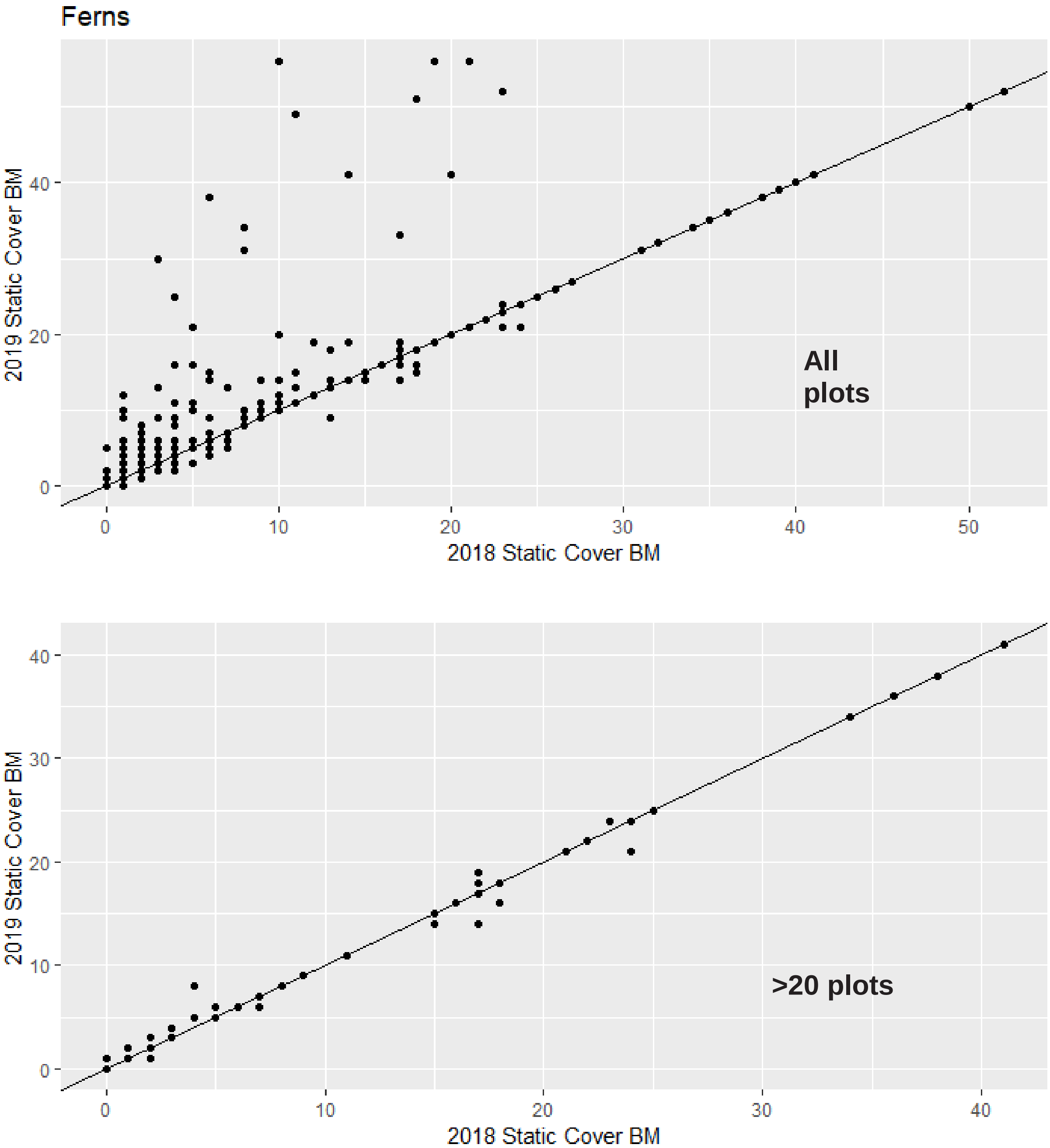


Figure 4 Change in fern cover benchmarks between V1.1 and V1.2

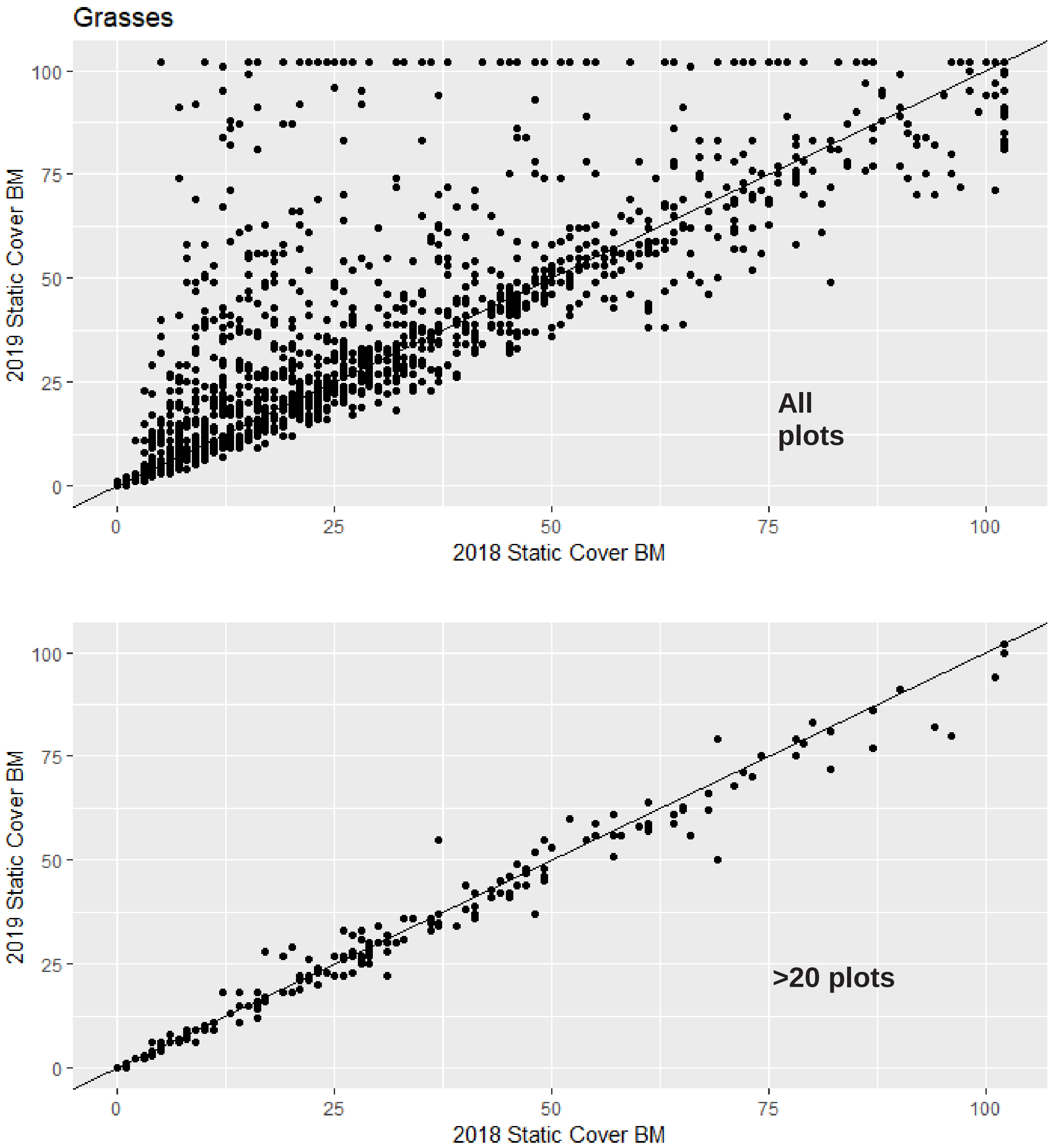


Figure 5 **Change in grass cover benchmarks between V1.1 and V1.2**

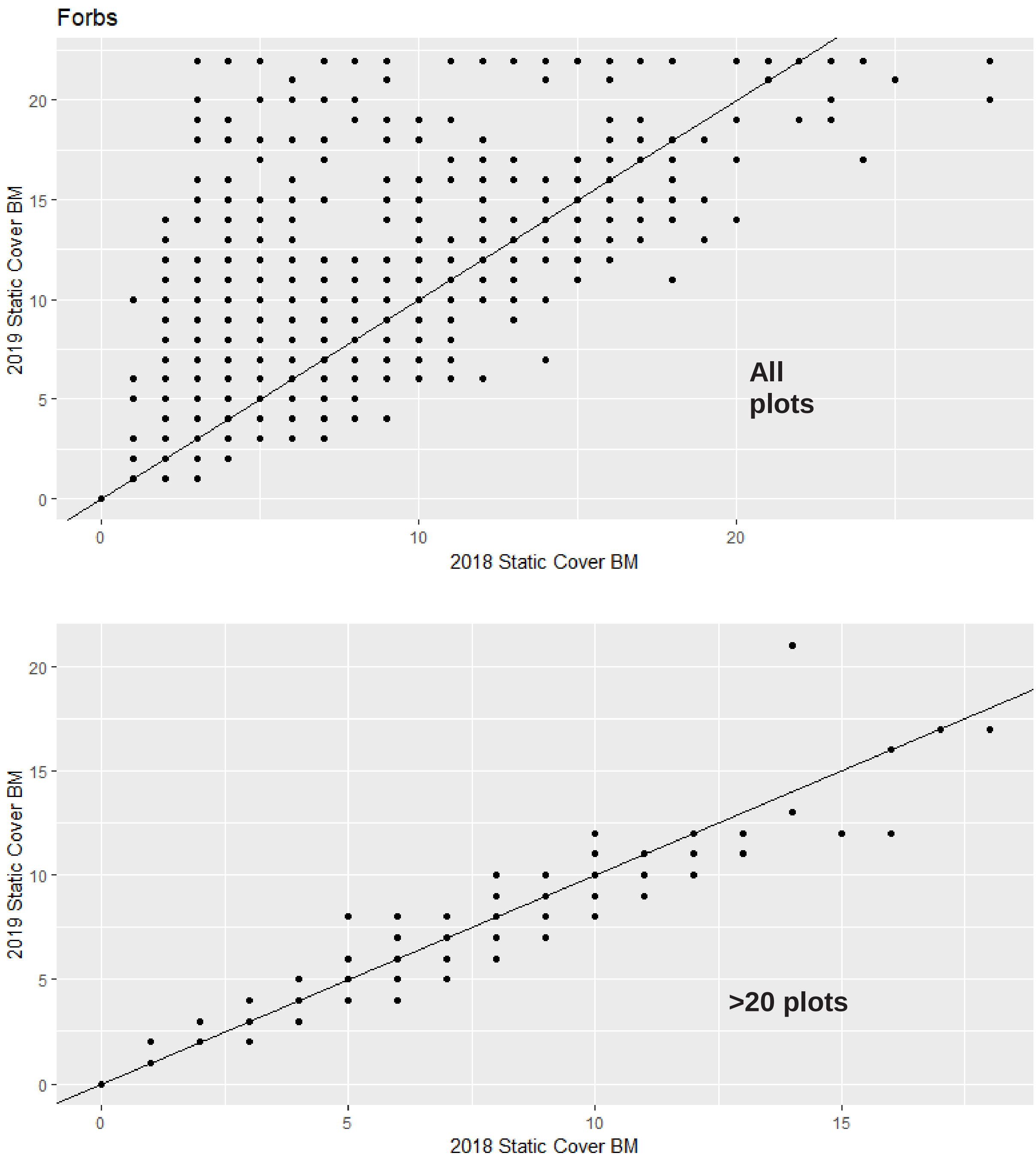


Figure 6 Change in forb cover benchmarks between V1.1 and V1.2

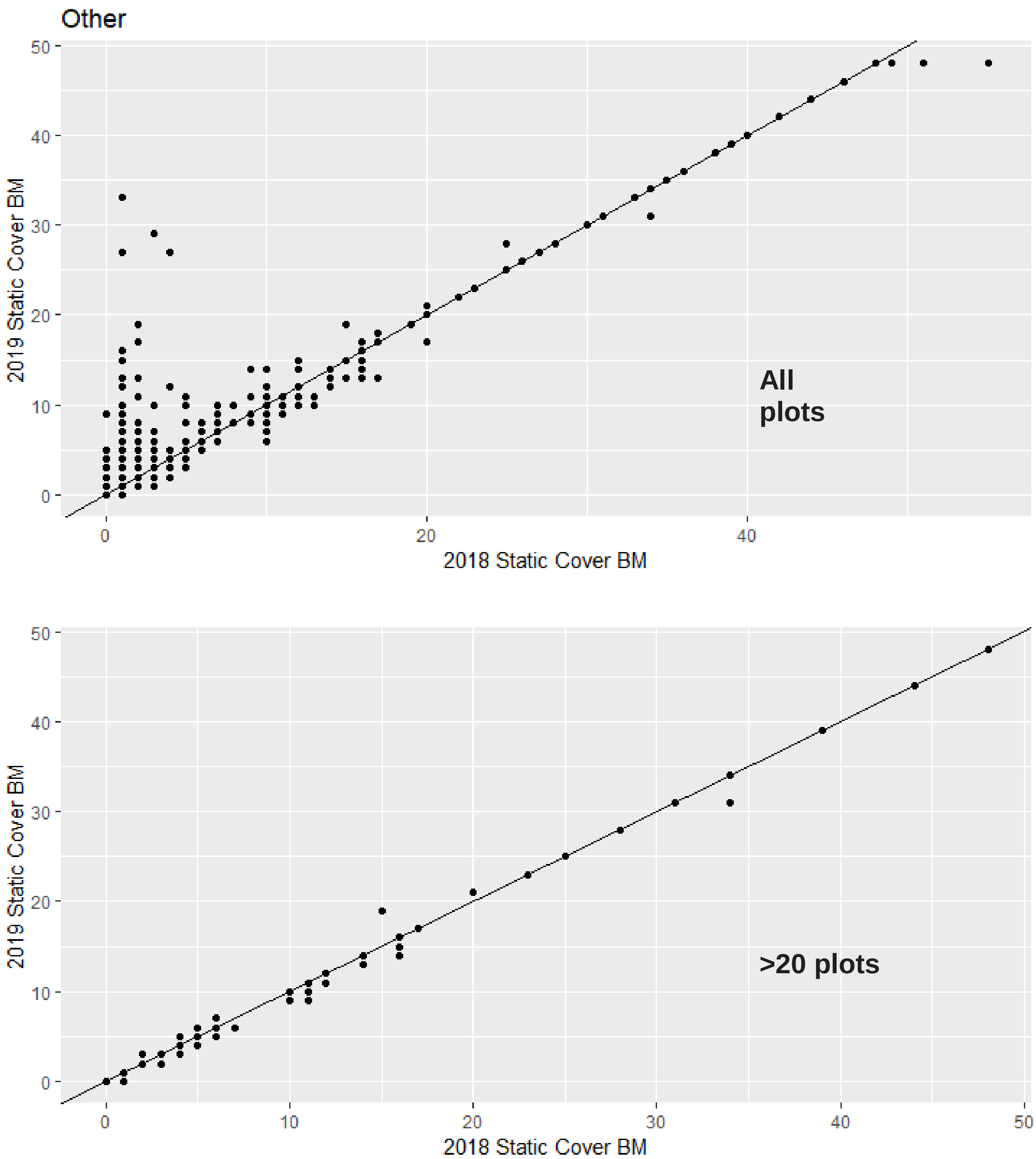


Figure 7 **Change in other cover benchmarks between V1.1 and V1.2**

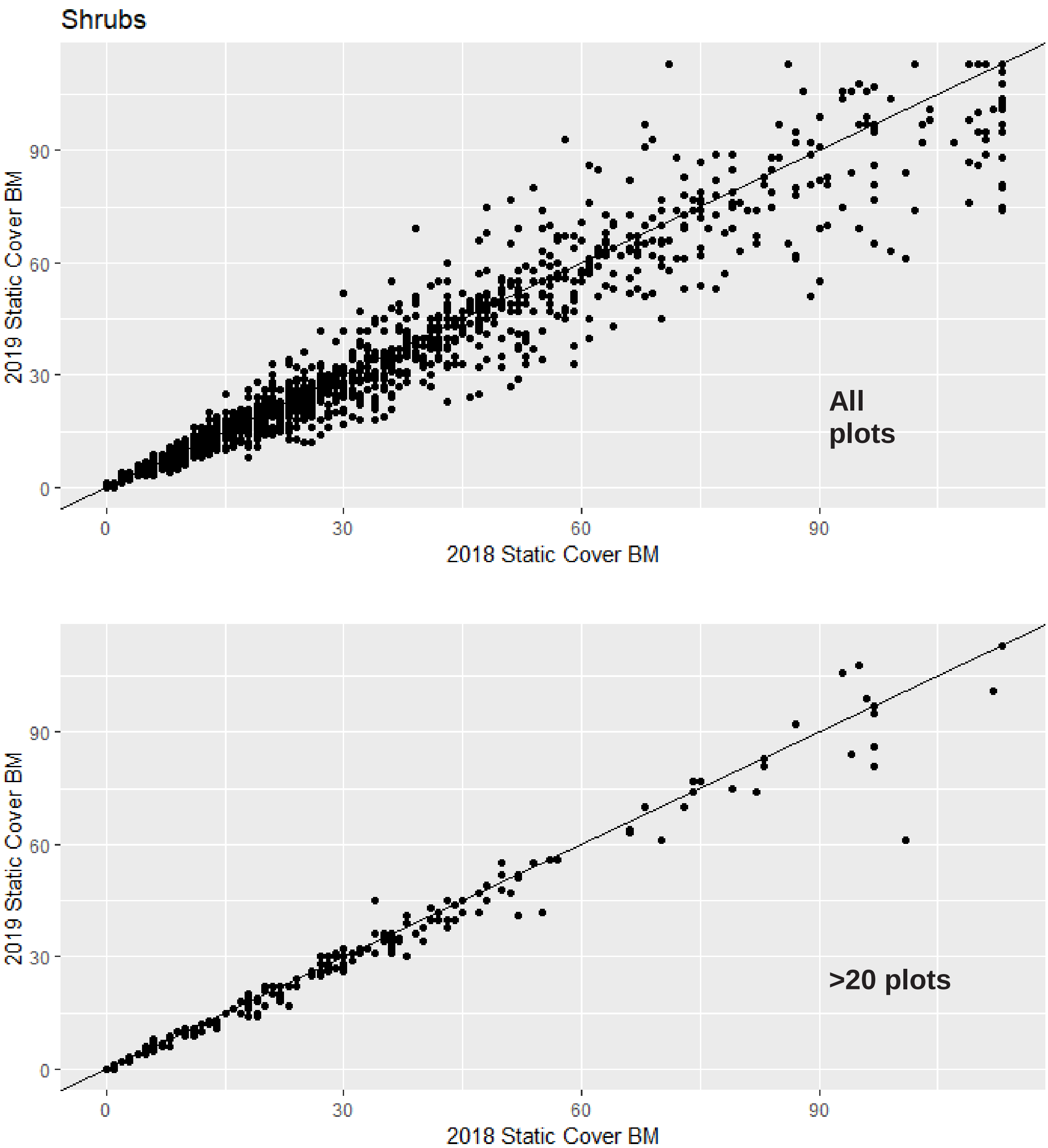


Figure 8 **Change in shrub cover benchmarks between V1.1 and V1.2**

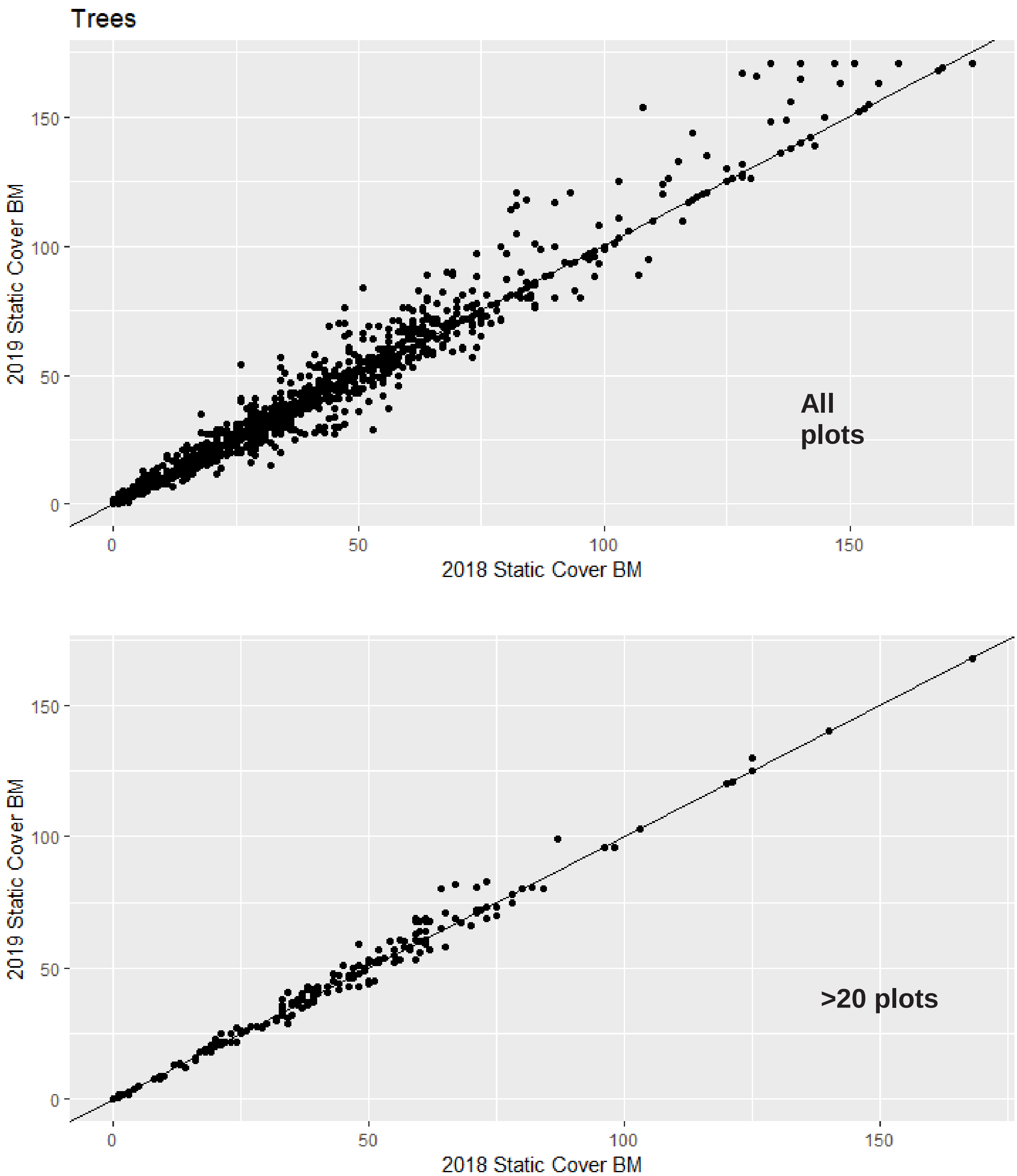


Figure 9 Change in tree cover benchmarks between V1.1 and V1.2

Appendix 2 Relationships between the absolute change in cover benchmarks and RVC plot numbers

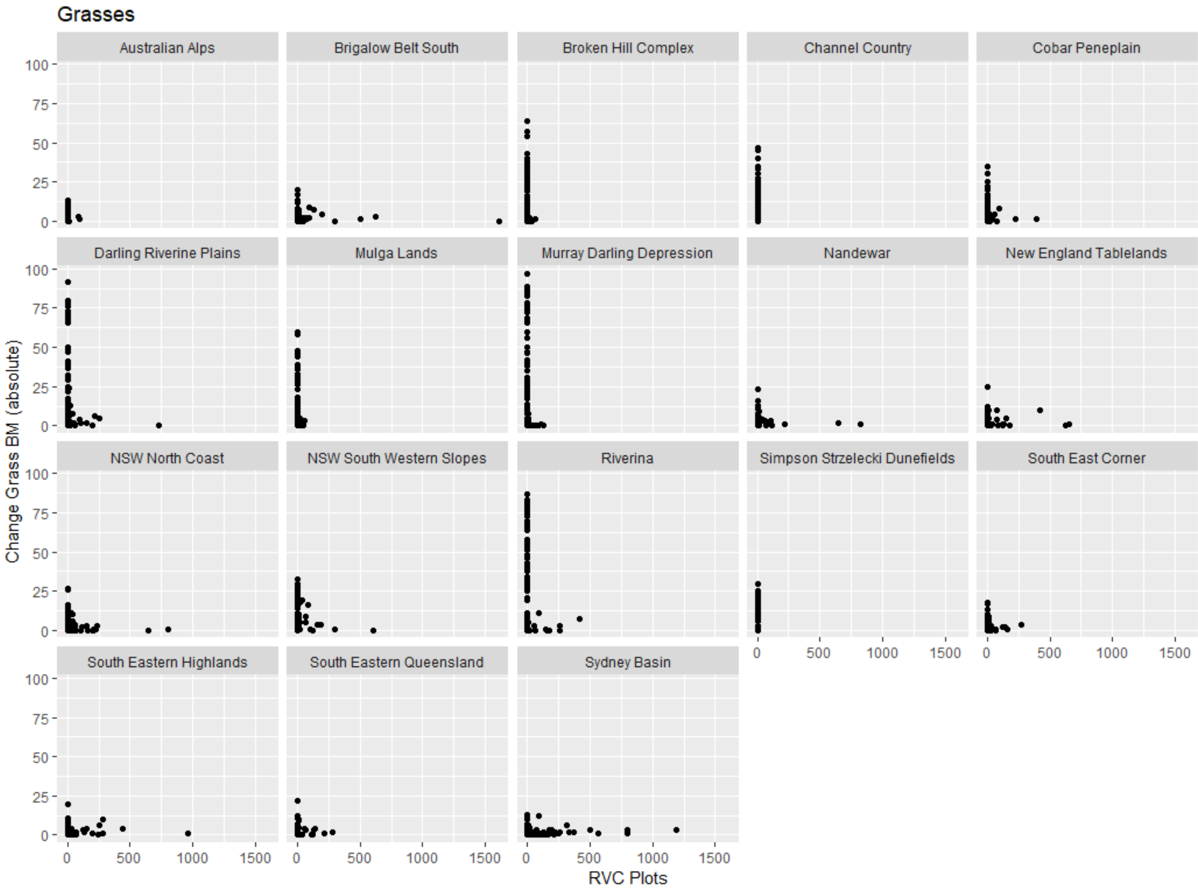


Figure 10 Absolute change in grass cover benchmarks by plot numbers and bioregion

Figure 11 **Absolute change in forb cover benchmarks by plot numbers and bioregion**

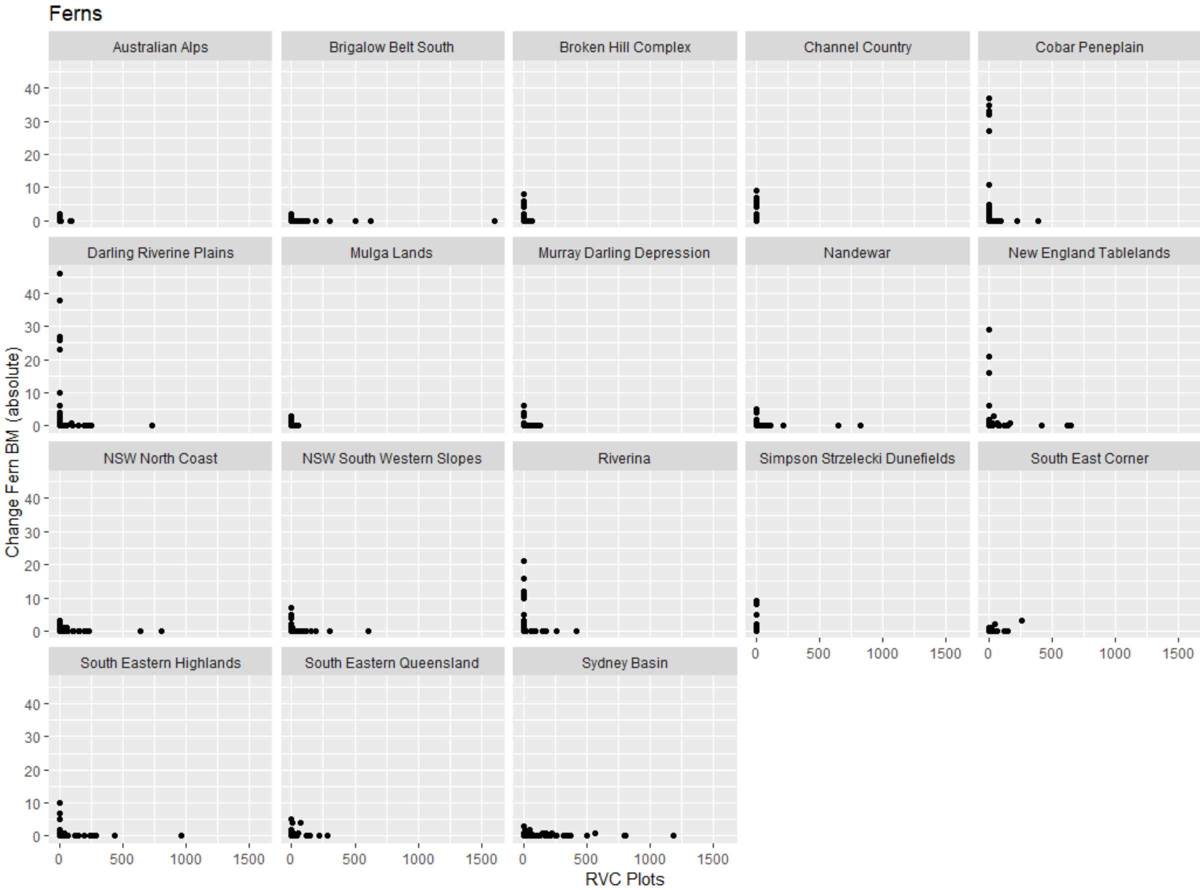


Figure 12 **Absolute change in fern cover benchmarks by plot numbers and bioregion**

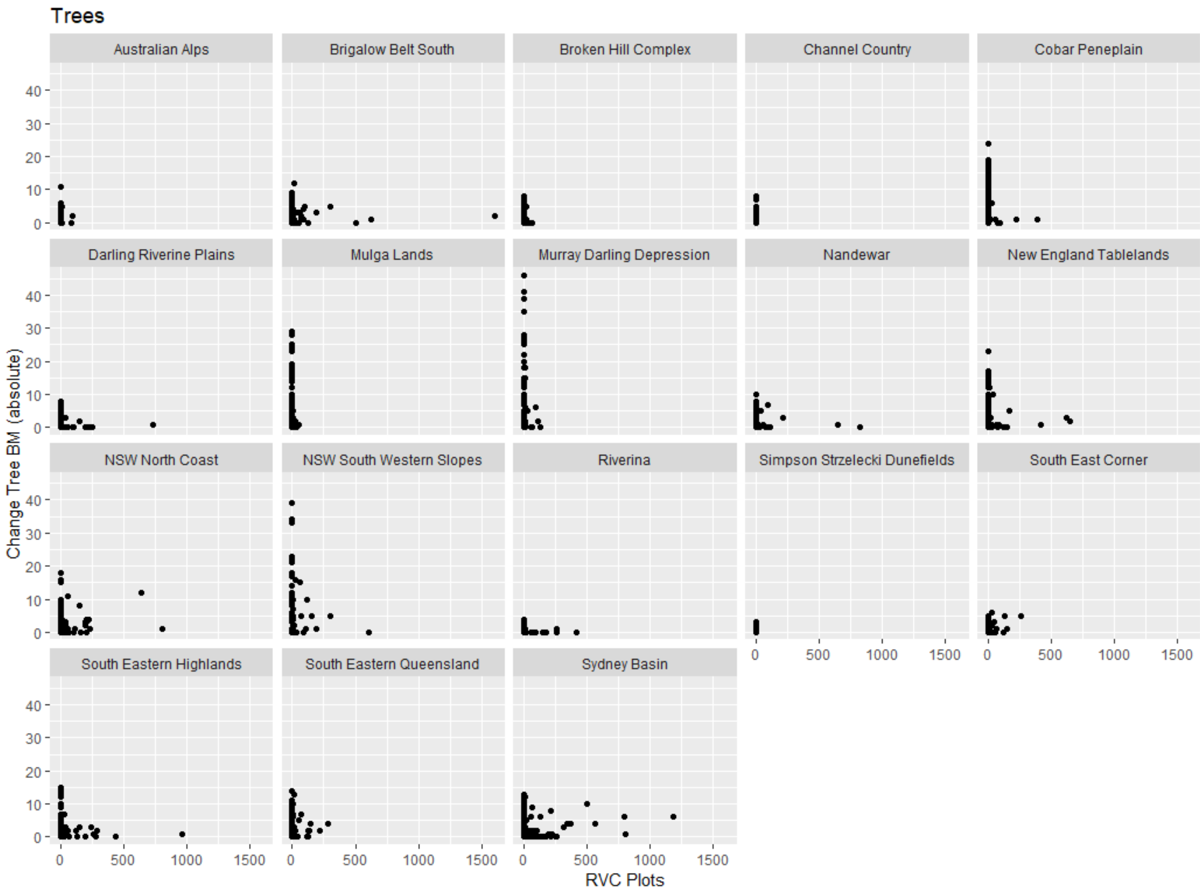


Figure 13 **Absolute change in tree cover benchmarks by plot numbers and bioregion**

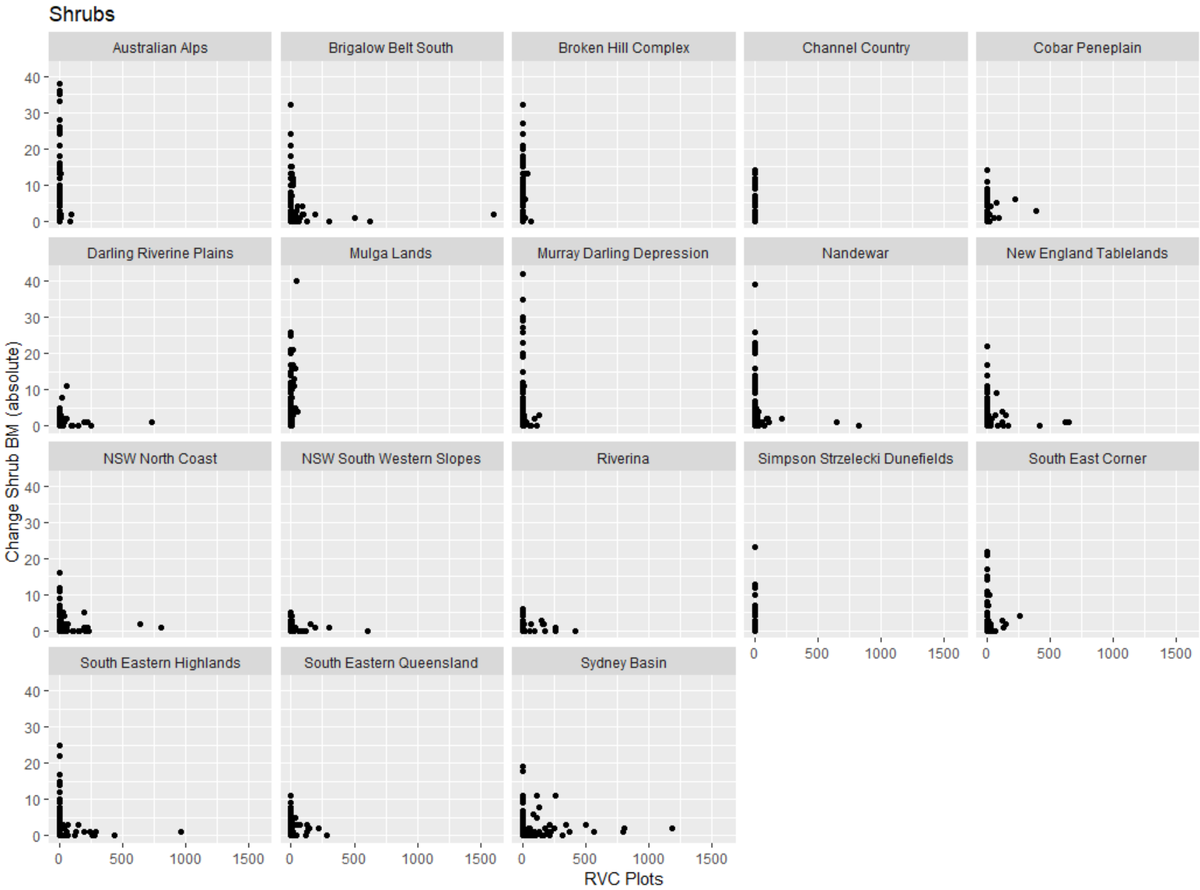


Figure 14 Absolute change in shrub cover benchmarks by plot numbers and bioregion

Figure 15 **Absolute change in other cover benchmarks by plot numbers and bioregion**

Appendix 3 Relationships between absolute changes in rainfall and absolute changes in cover benchmarks (top panel) and actual changes in rainfall and actual changes in cover benchmarks (bottom panel)

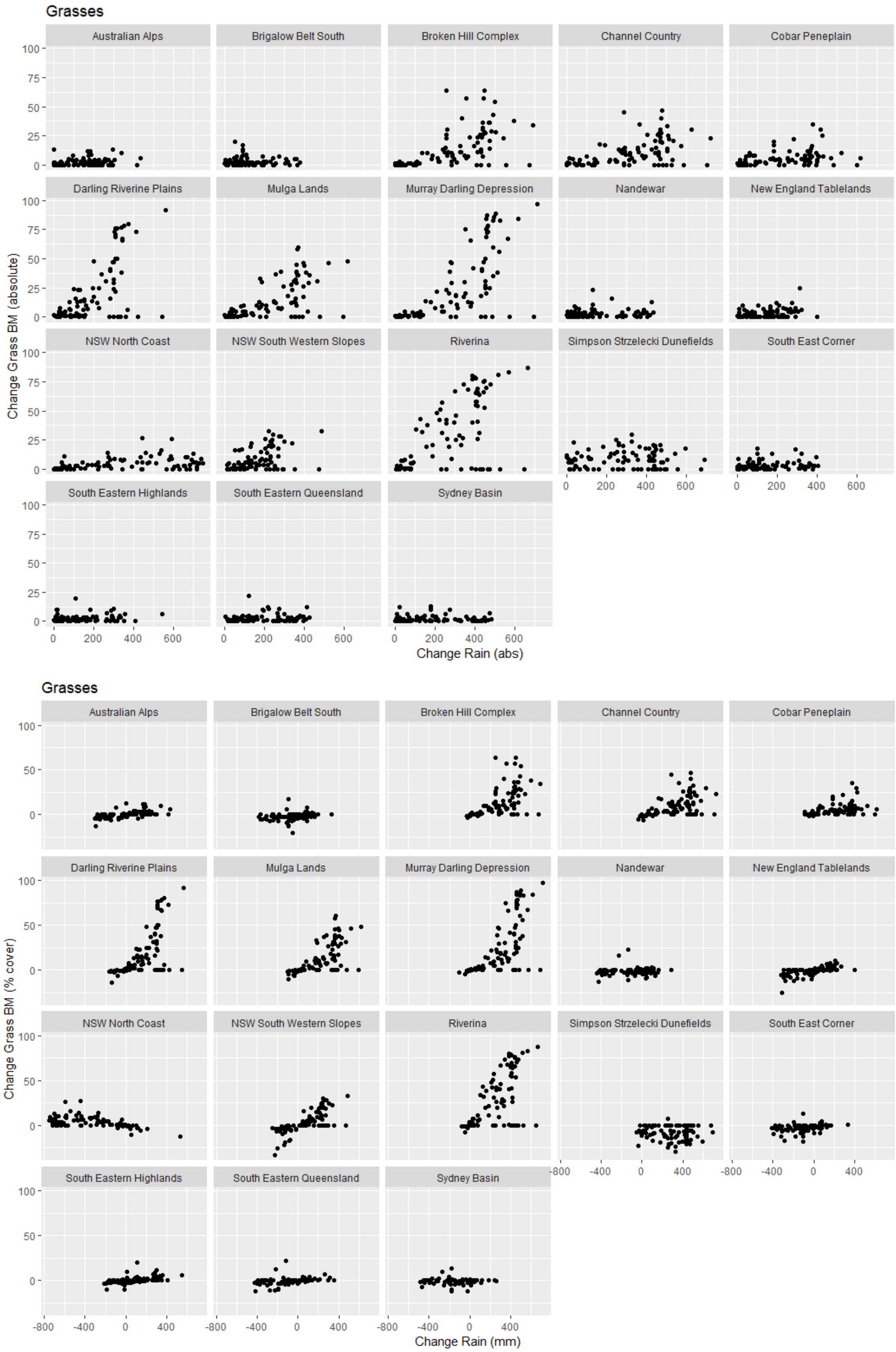


Figure 16 Change in grass cover benchmarks by change in rainfall

Absolute changes in cover benchmarks and rainfall are shown in the top panel, whereas actual changes in cover benchmarks and rainfall are shown in the bottom panel.

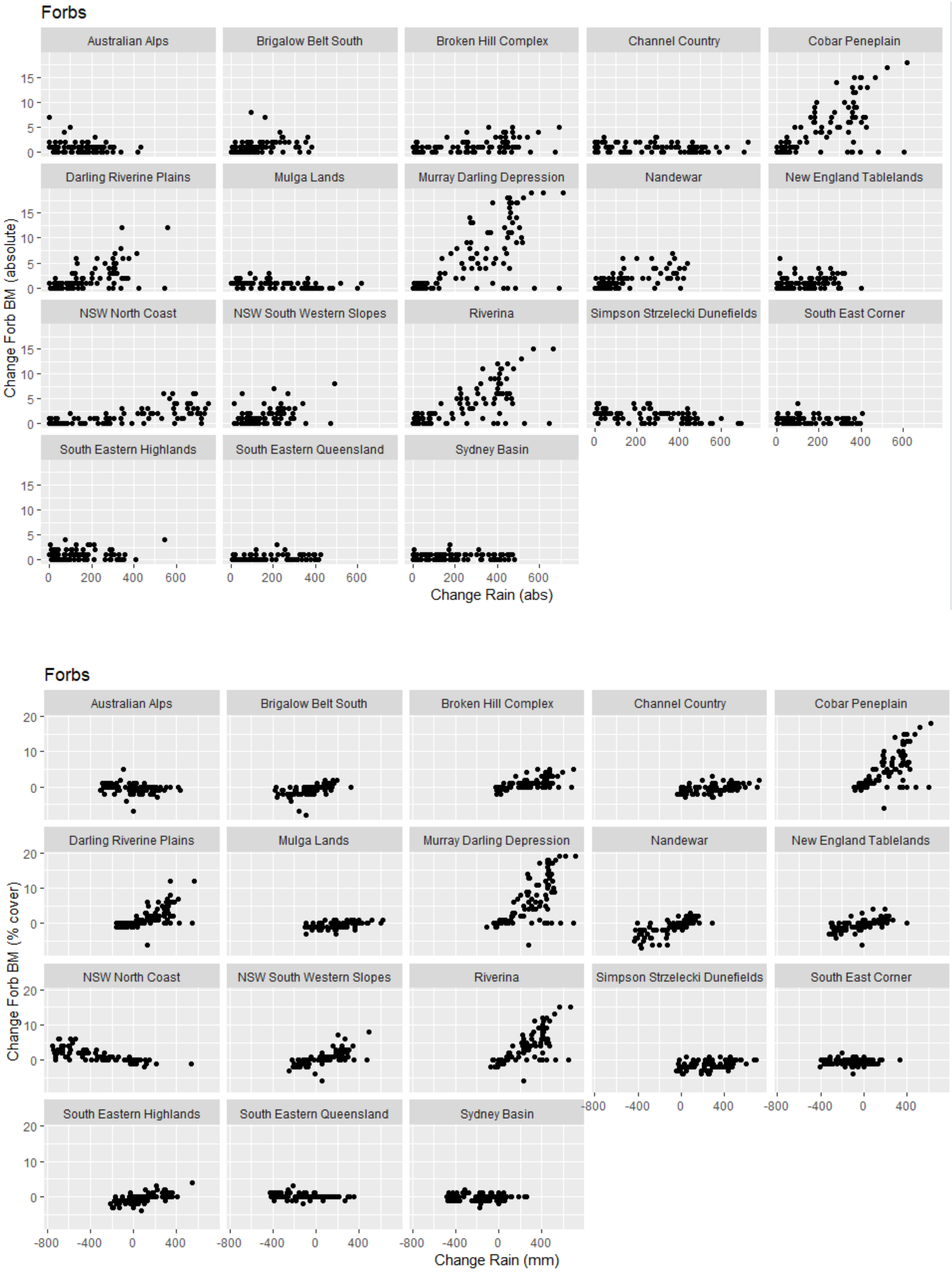


Figure 17 Change in forb cover benchmarks by change in rainfall

Absolute changes in cover benchmarks and rainfall are shown in the top panel, whereas actual changes in cover benchmarks and rainfall are shown in the bottom panel.

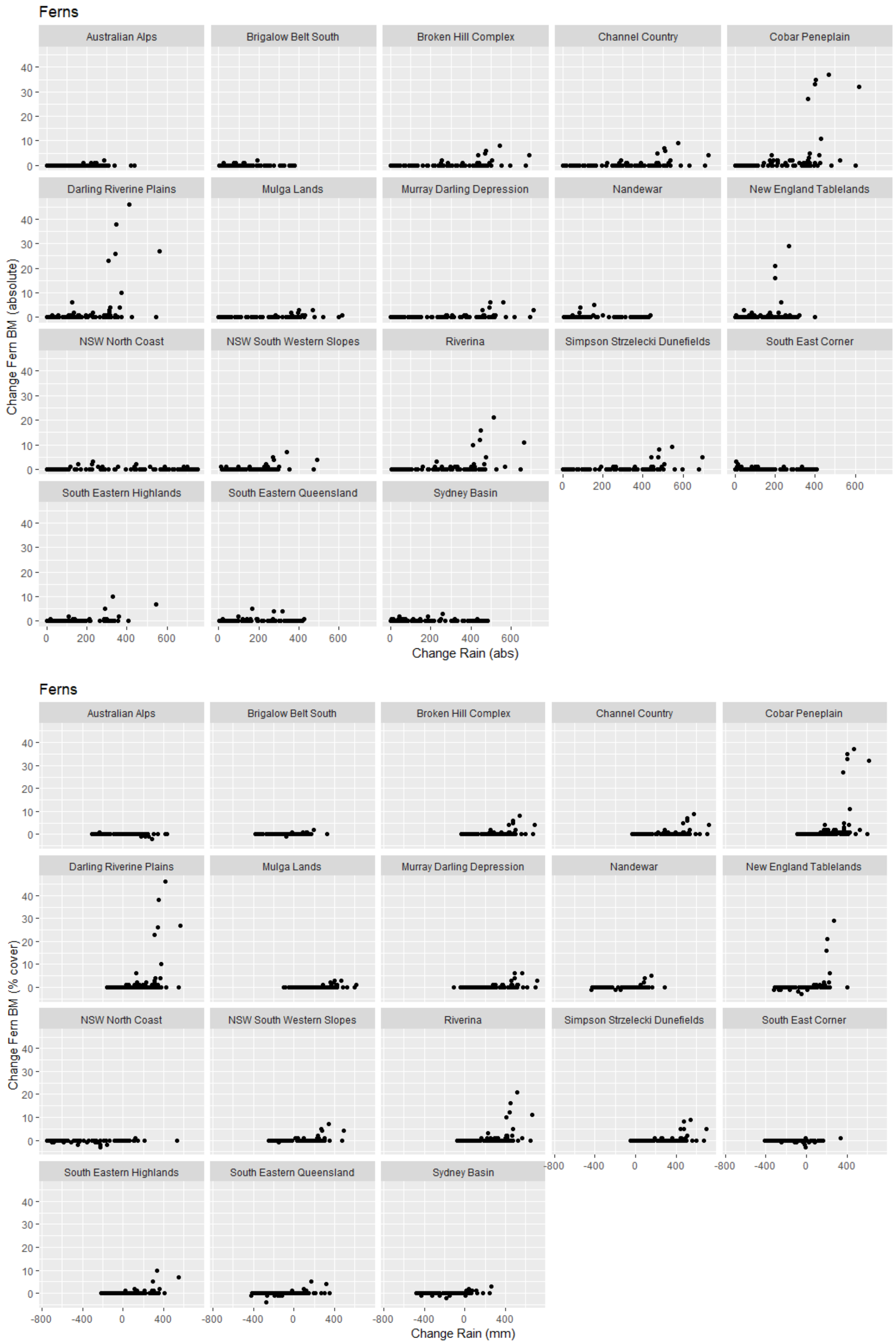


Figure 18 Change in fern cover benchmarks by change in rainfall

Absolute changes in cover benchmarks and rainfall are shown in the top panel, whereas actual changes in cover benchmarks and rainfall are shown in the bottom panel.

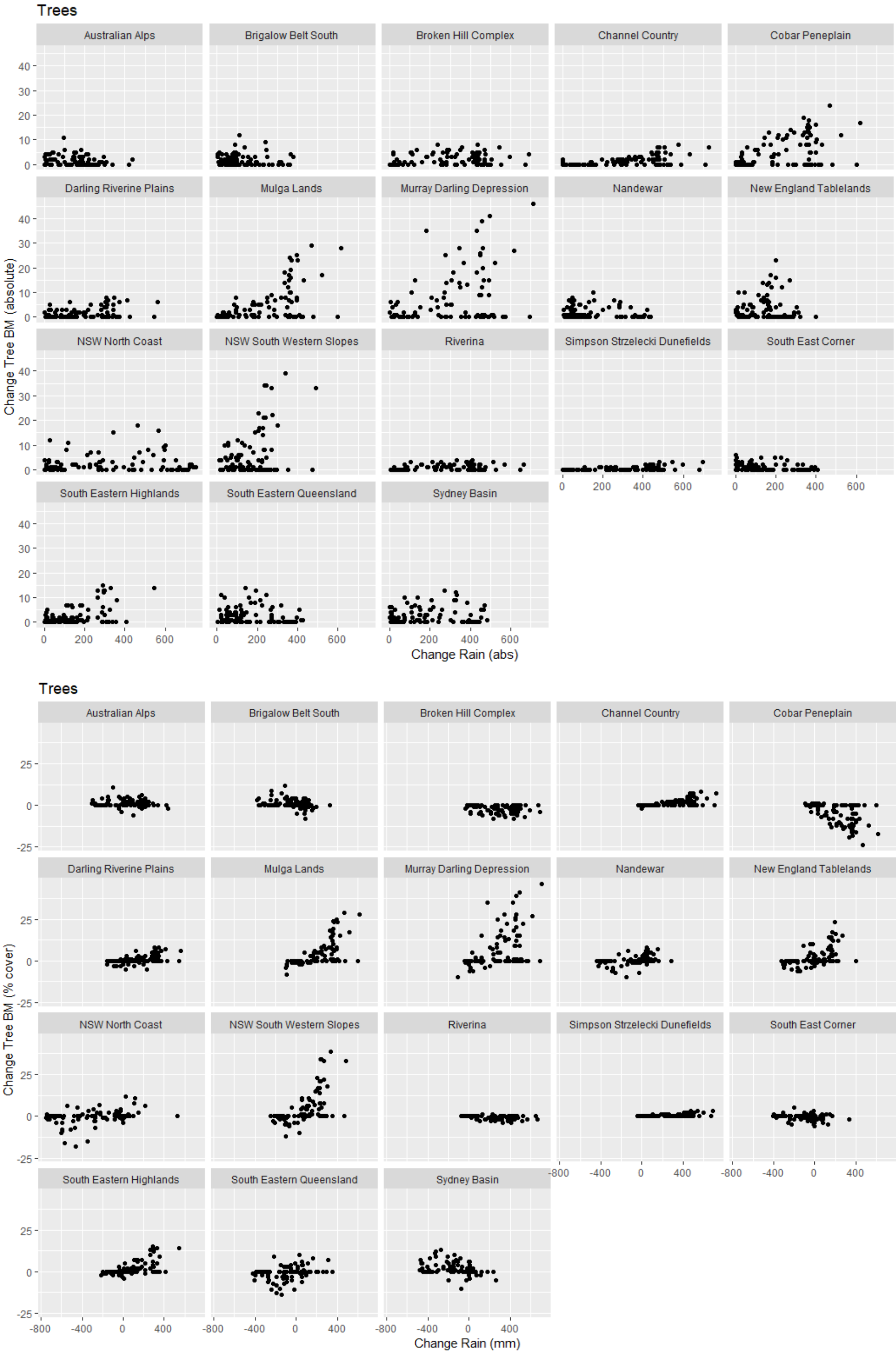


Figure 19 Change in tree cover benchmarks by change in rainfall

Absolute changes in cover benchmarks and rainfall are shown in the top panel, whereas actual changes in cover benchmarks and rainfall are shown in the bottom panel.

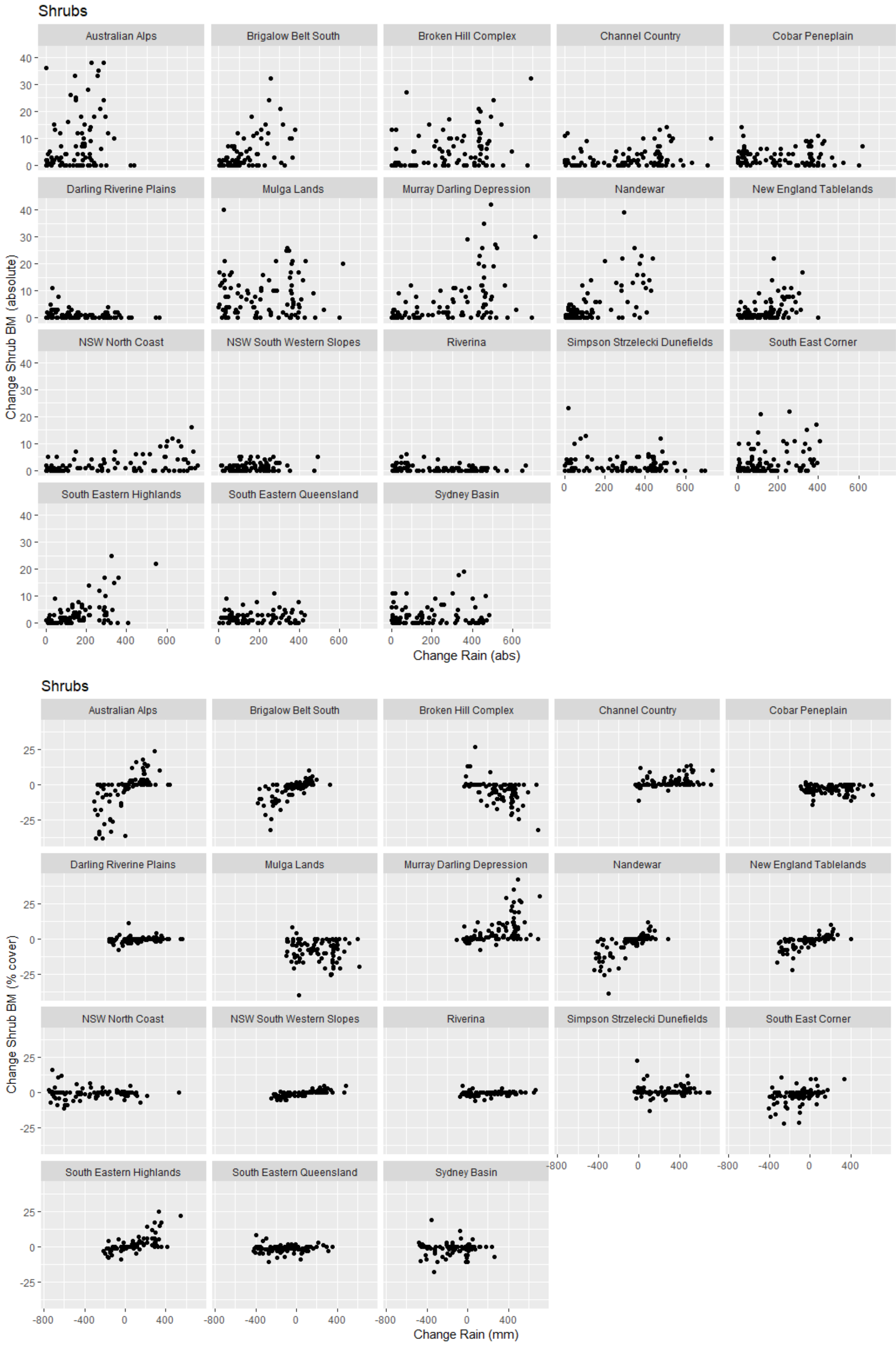


Figure 20 Change in shrub cover benchmarks by change in rainfall

Absolute changes in cover benchmarks and rainfall are shown in the top panel, whereas actual changes in cover benchmarks and rainfall are shown in the bottom panel.

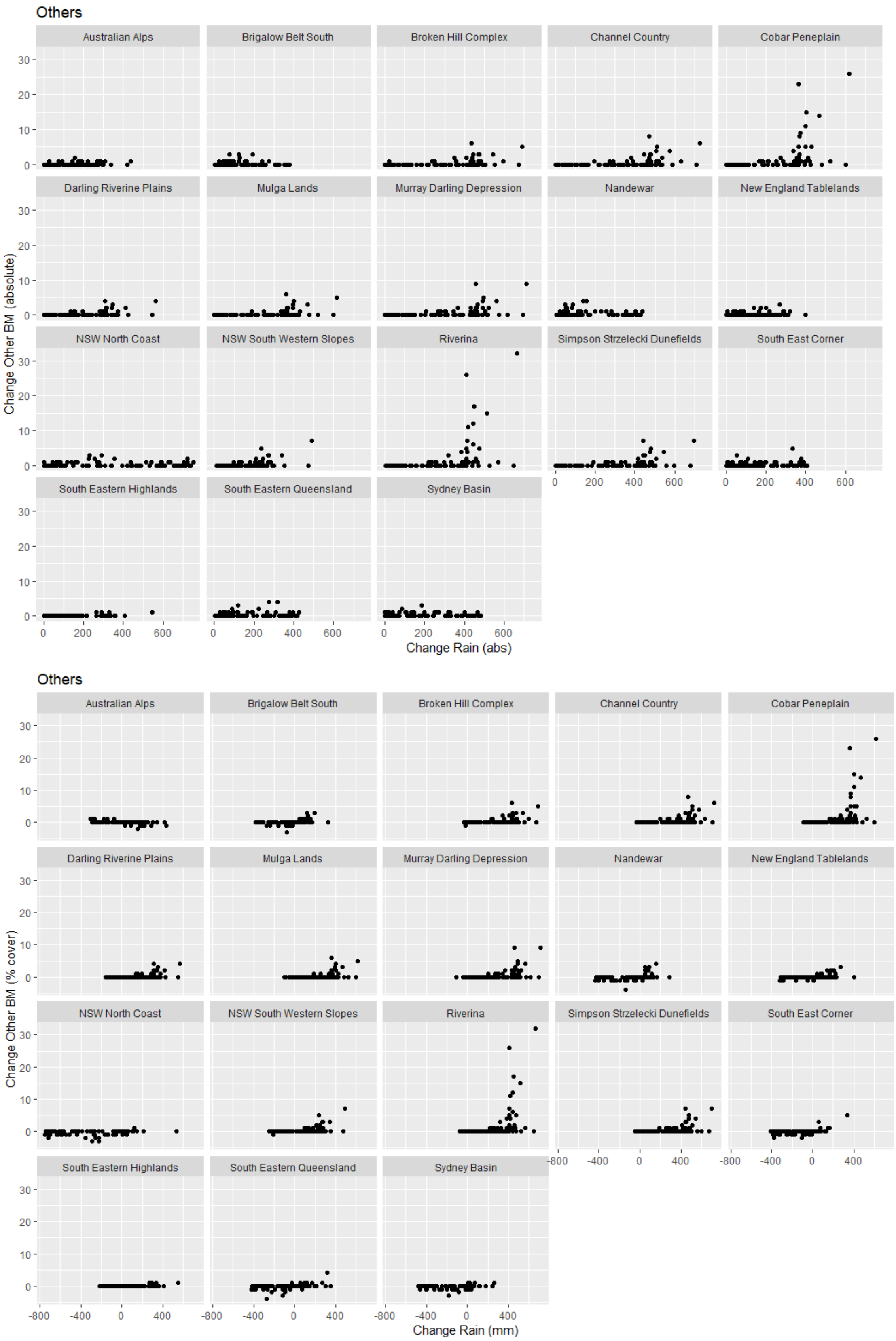
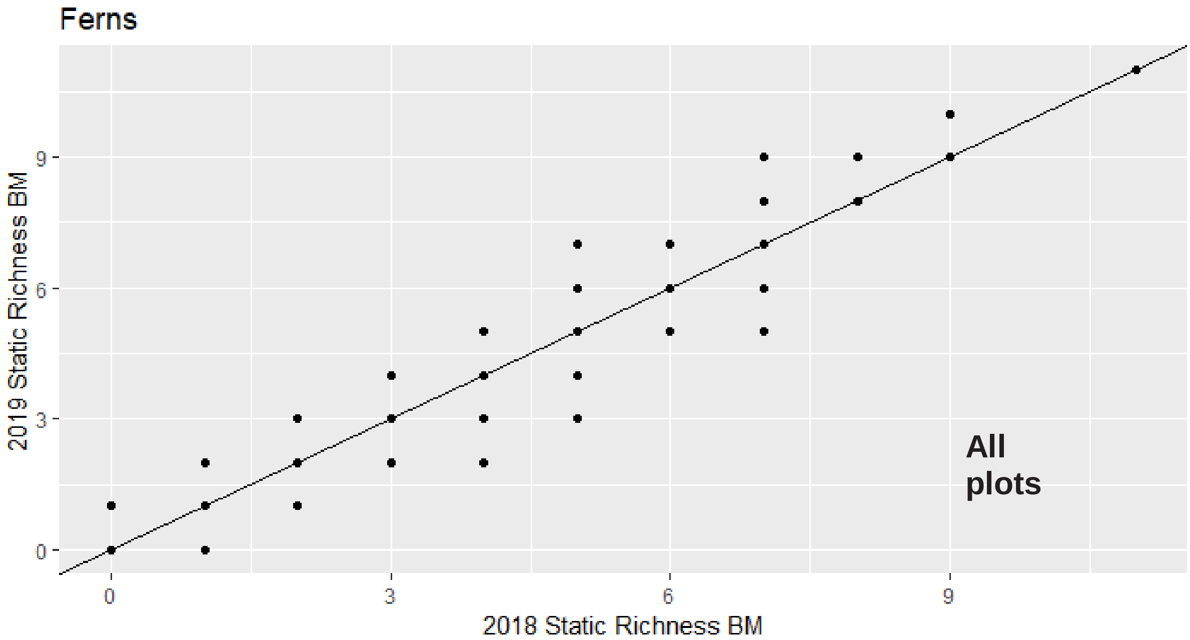


Figure 21 Change in other cover benchmarks by change in rainfall

Absolute changes in cover benchmarks and rainfall are shown in the top panel, whereas actual changes in cover benchmarks and rainfall are shown in the bottom panel.

Appendix 4 Change in growth form richness benchmarks between V1.1 and V1.2

In the following figures, V1.1 benchmarks are presented on the x-axis as '2018 Static Richness BM (benchmarks)' and V1.2 benchmarks are presented on the y-axis as '2019 Static Richness BM'



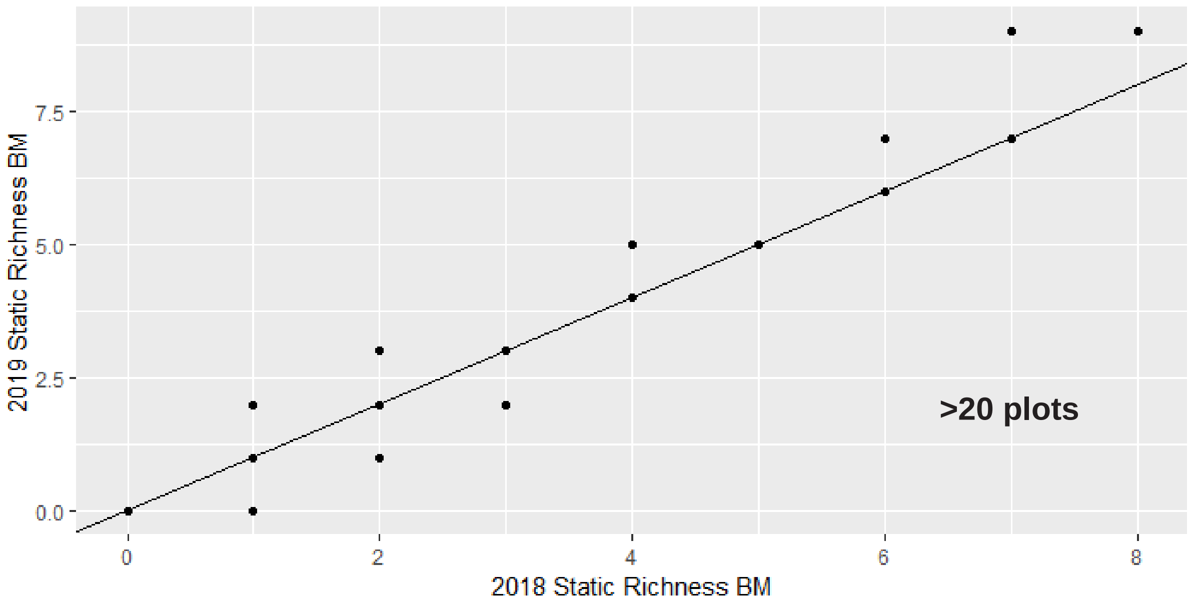


Figure 22 **Change in fern richness benchmarks between V1.1 and V1.2**

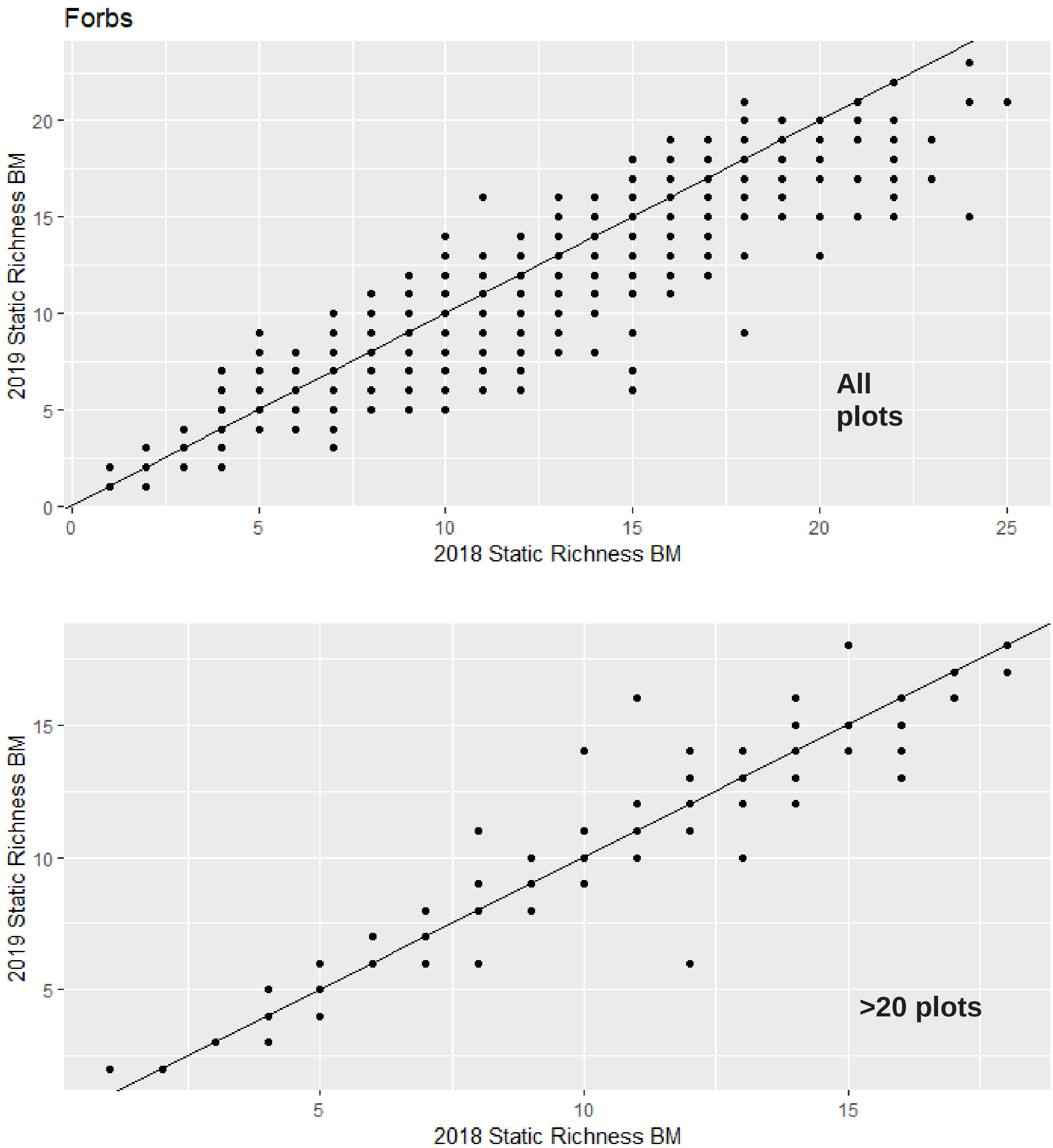
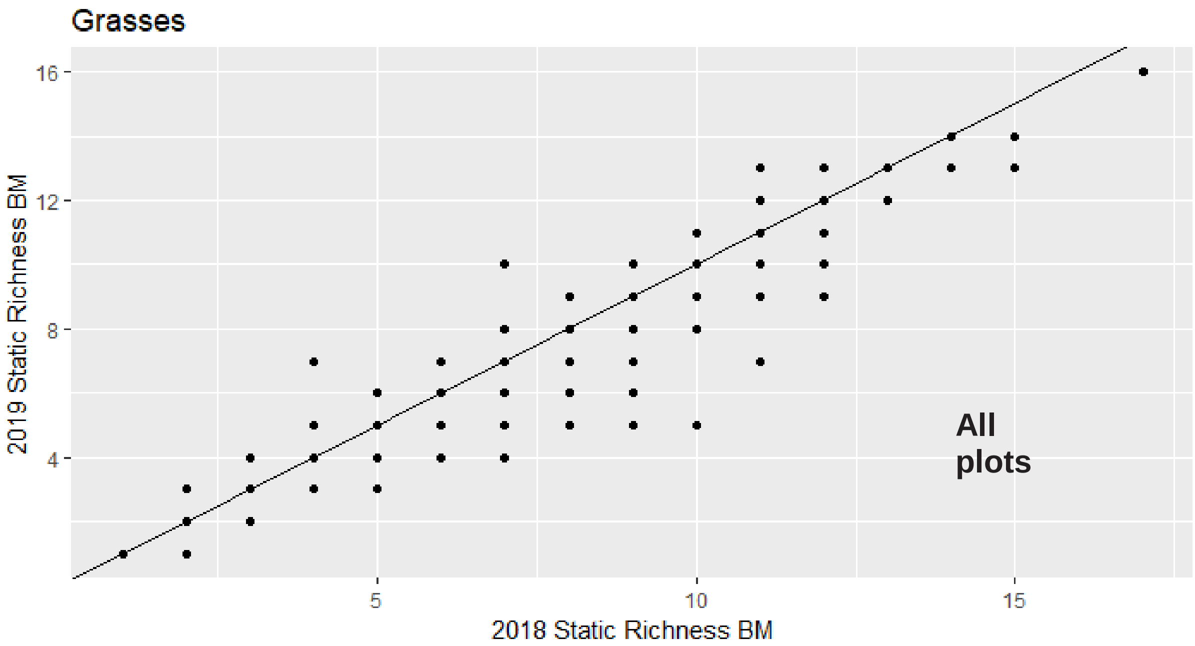


Figure 23 Change in forb richness benchmarks between V1.1 and V1.2



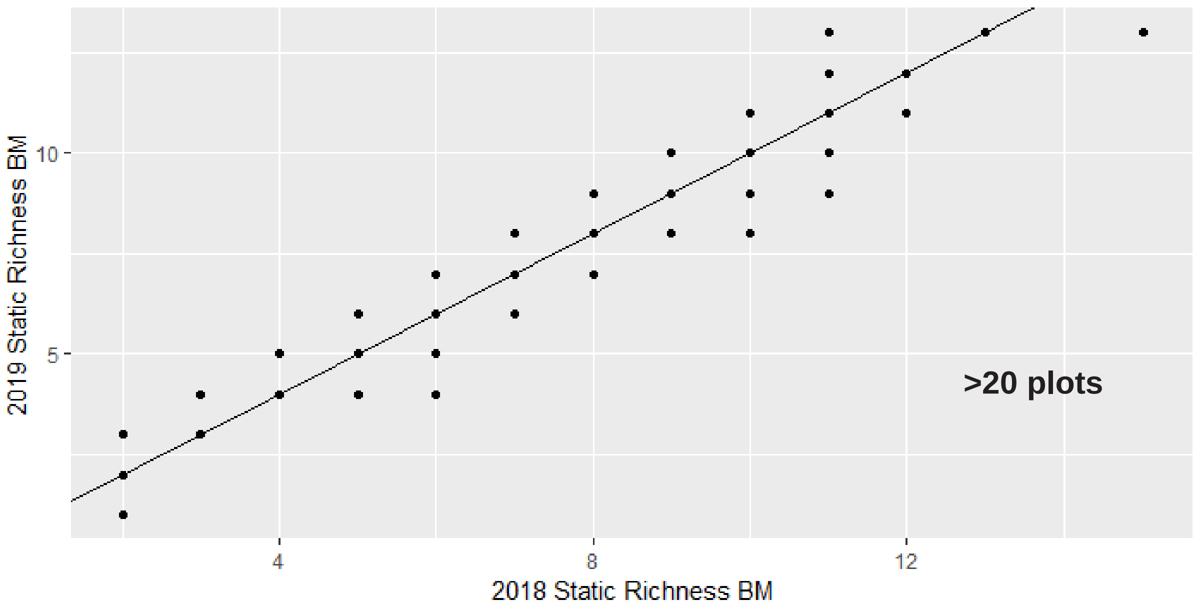


Figure 24 Change in grass richness benchmarks between V1.1 and V1.2

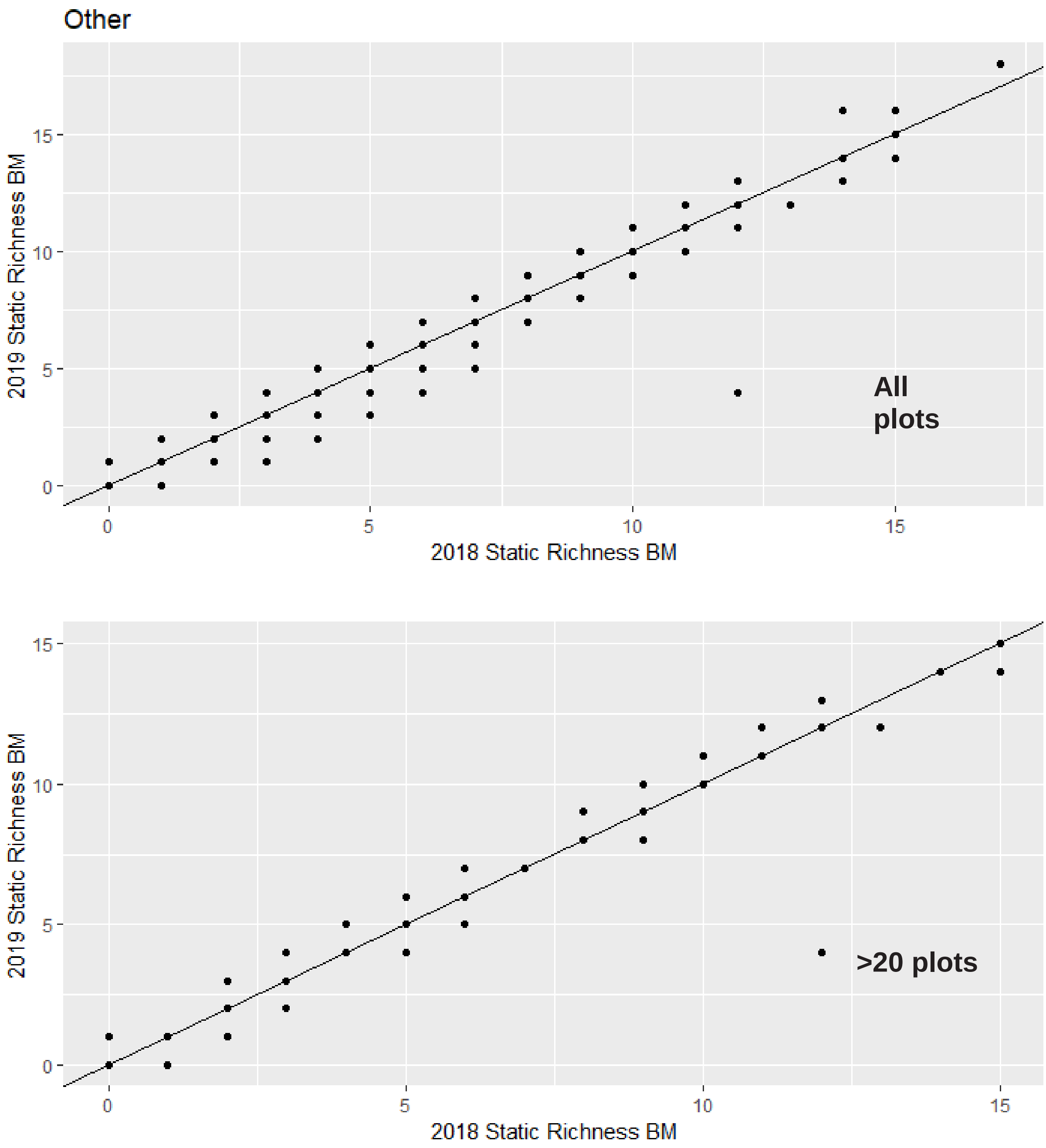


Figure 25 Change in other richness benchmarks between V1.1 and V1.2

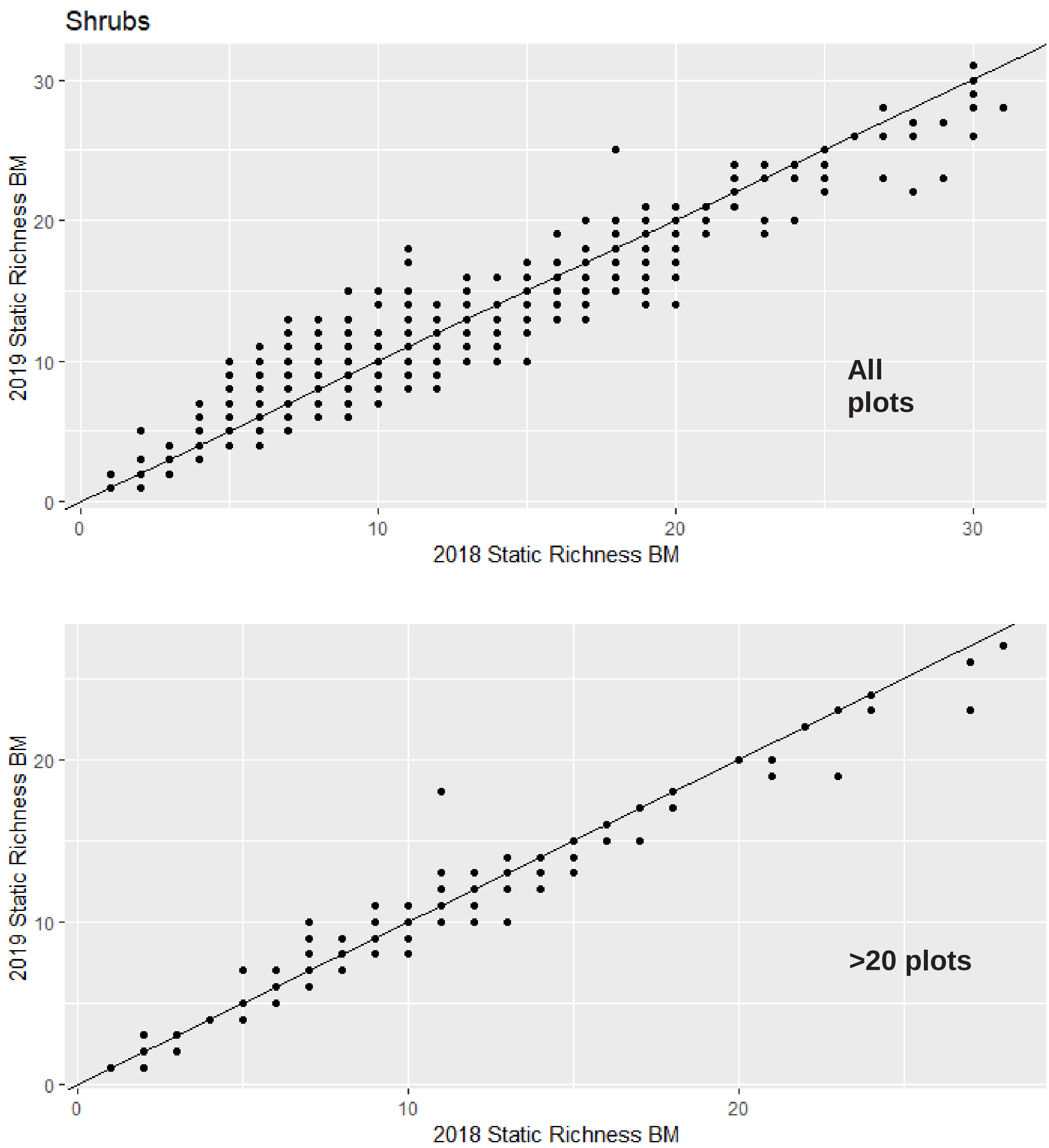
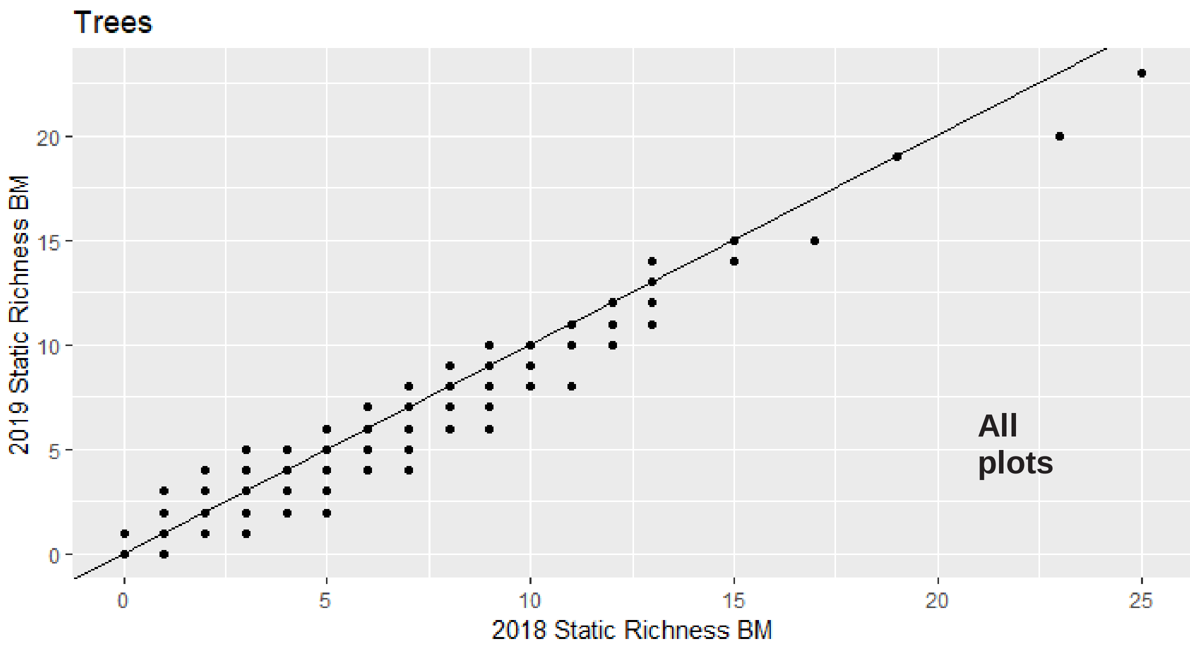


Figure 26 **Change in shrub richness benchmarks between V1.1 and V1.2**



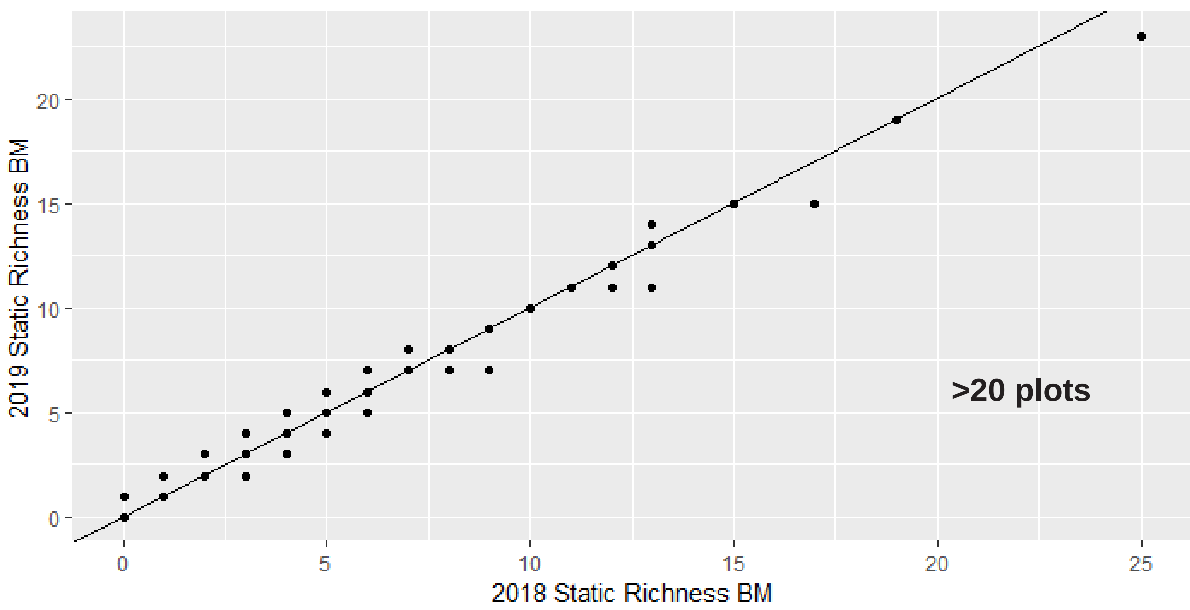


Figure 27 Change in tree richness benchmarks between V1.1 and V1.2

Appendix 5 Relationships between the absolute change in richness benchmarks and RVC plot numbers

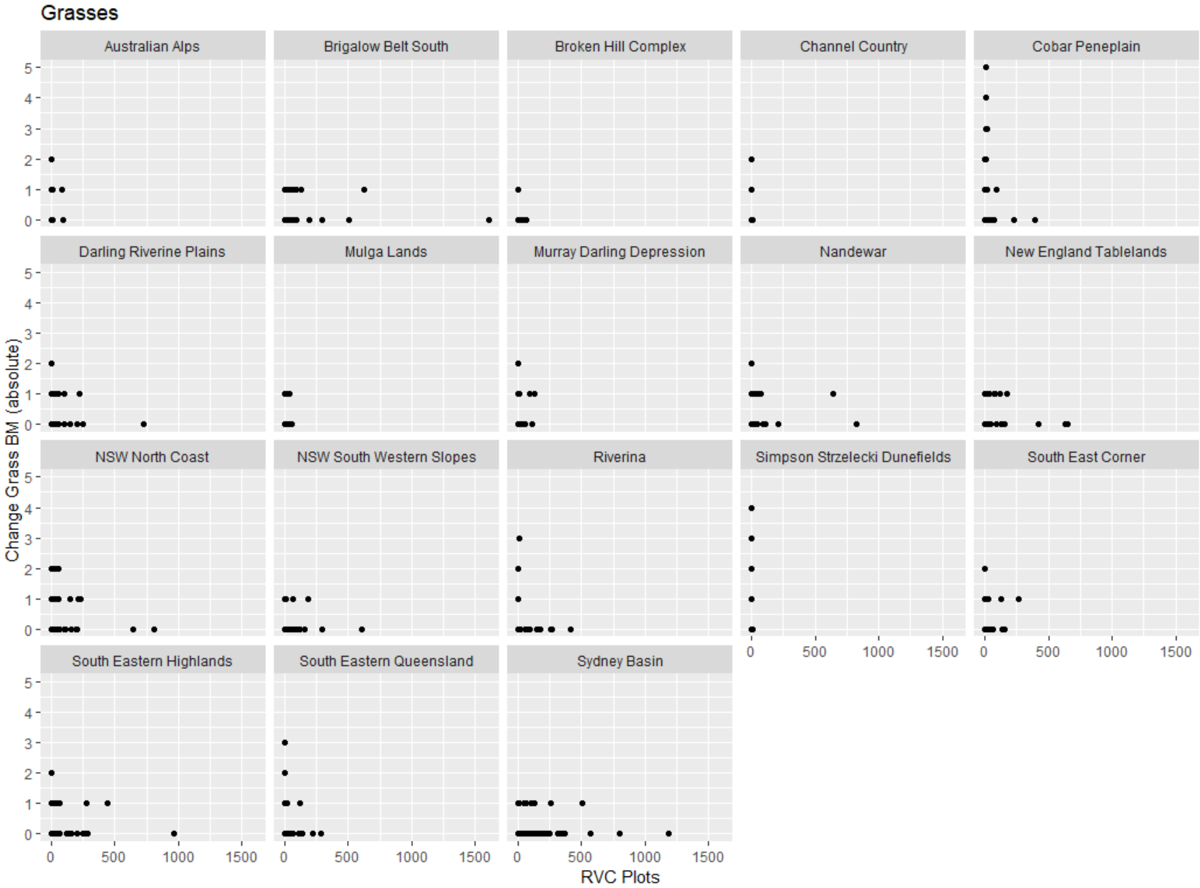


Figure 28 **Absolute change in grass richness benchmarks by plot numbers and bioregion**

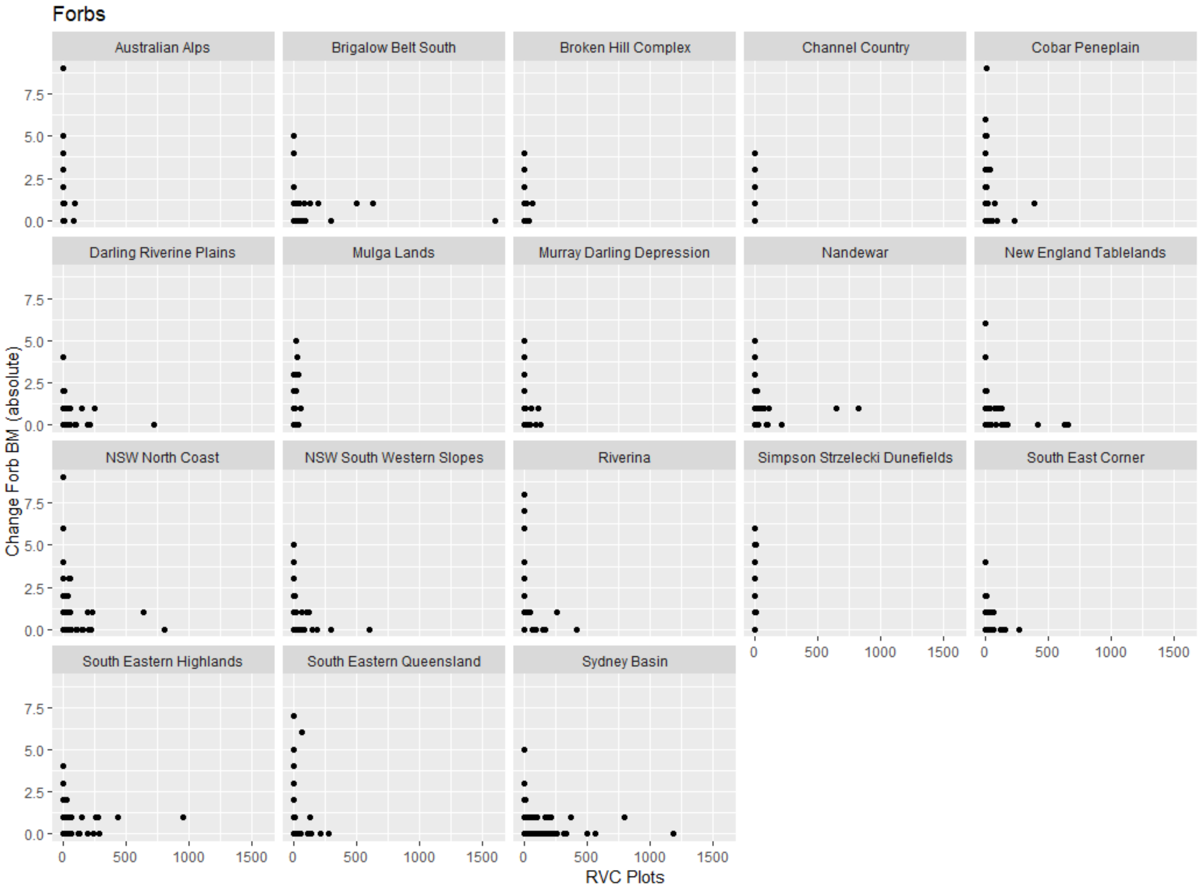


Figure 29 Absolute change in forb richness benchmarks by plot numbers and bioregion

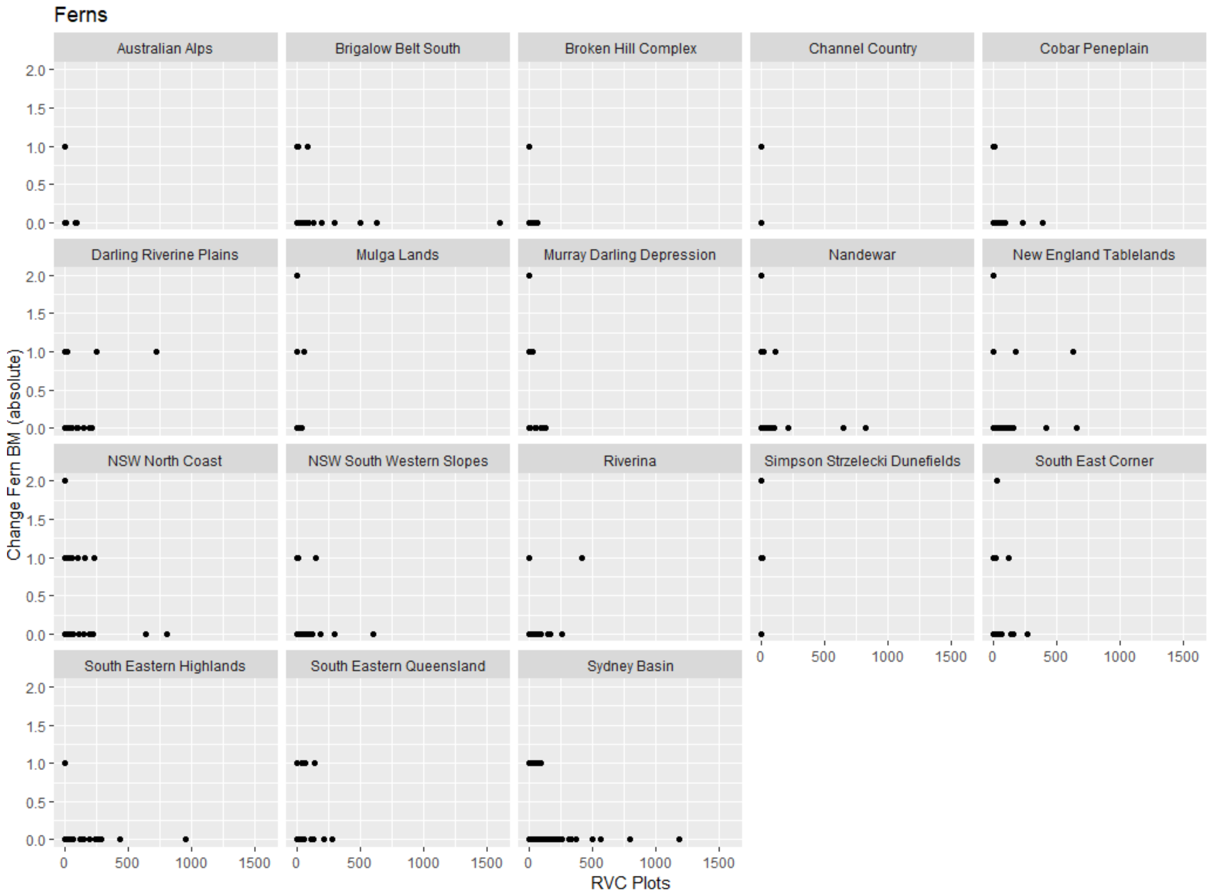


Figure 30 Absolute change in fern richness benchmarks by plot numbers and bioregion

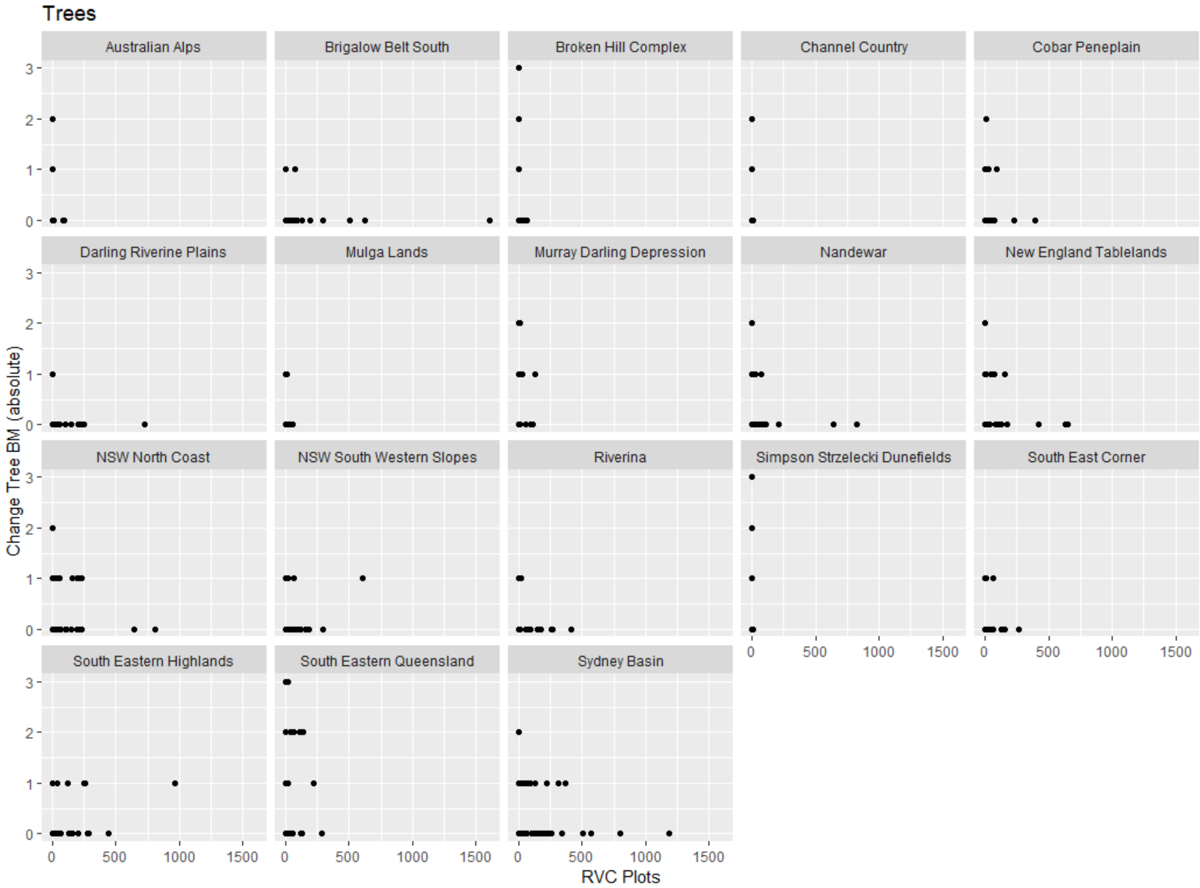


Figure 31 Absolute change in tree richness benchmarks by plot numbers and bioregion

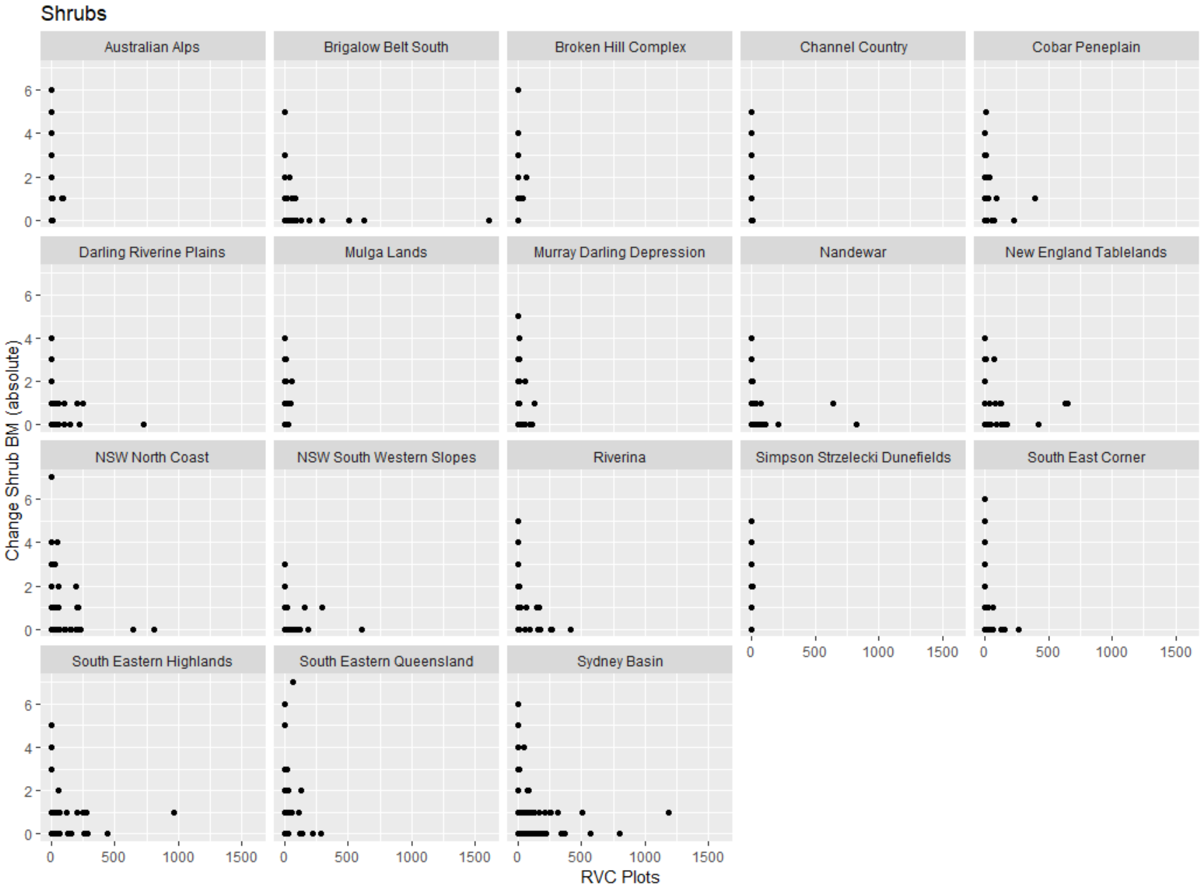


Figure 32 Absolute change in shrub richness benchmarks by plot numbers and bioregion

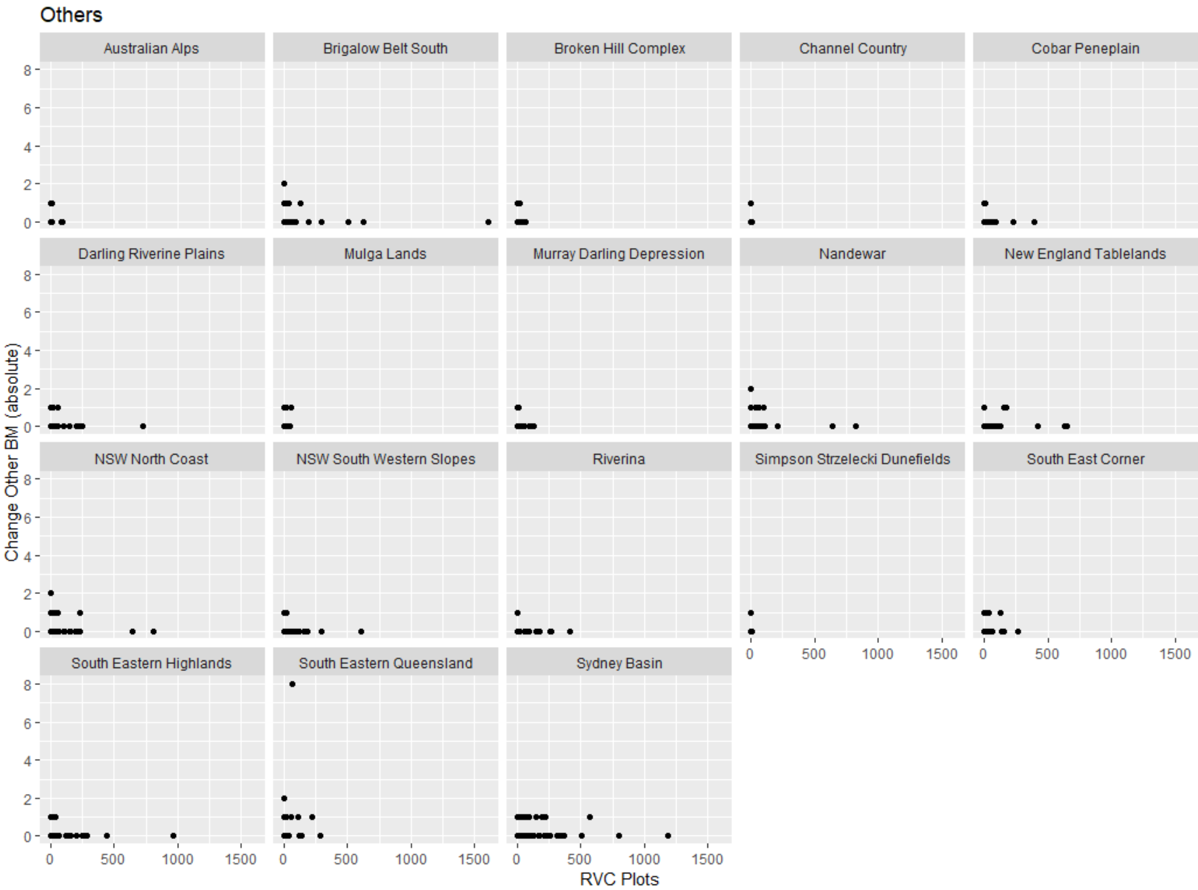


Figure 33 Absolute change in other richness benchmarks by plot numbers and bioregion

Appendix 6 Relationships between absolute changes in rainfall and absolute changes in richness benchmarks (top panel) and actual changes in rainfall and actual changes in richness benchmarks (bottom panel)

Figure 34 Change in grass richness benchmarks by change in rainfall

Absolute changes in richness benchmarks and rainfall are shown in the top panel, whereas actual changes in richness benchmarks and rainfall are shown in the bottom panel.

Figure 35 **Change in forb richness benchmarks by change in rainfall**

Absolute changes in richness benchmarks and rainfall are shown in the top panel, whereas actual changes in richness benchmarks and rainfall are shown in the bottom panel.

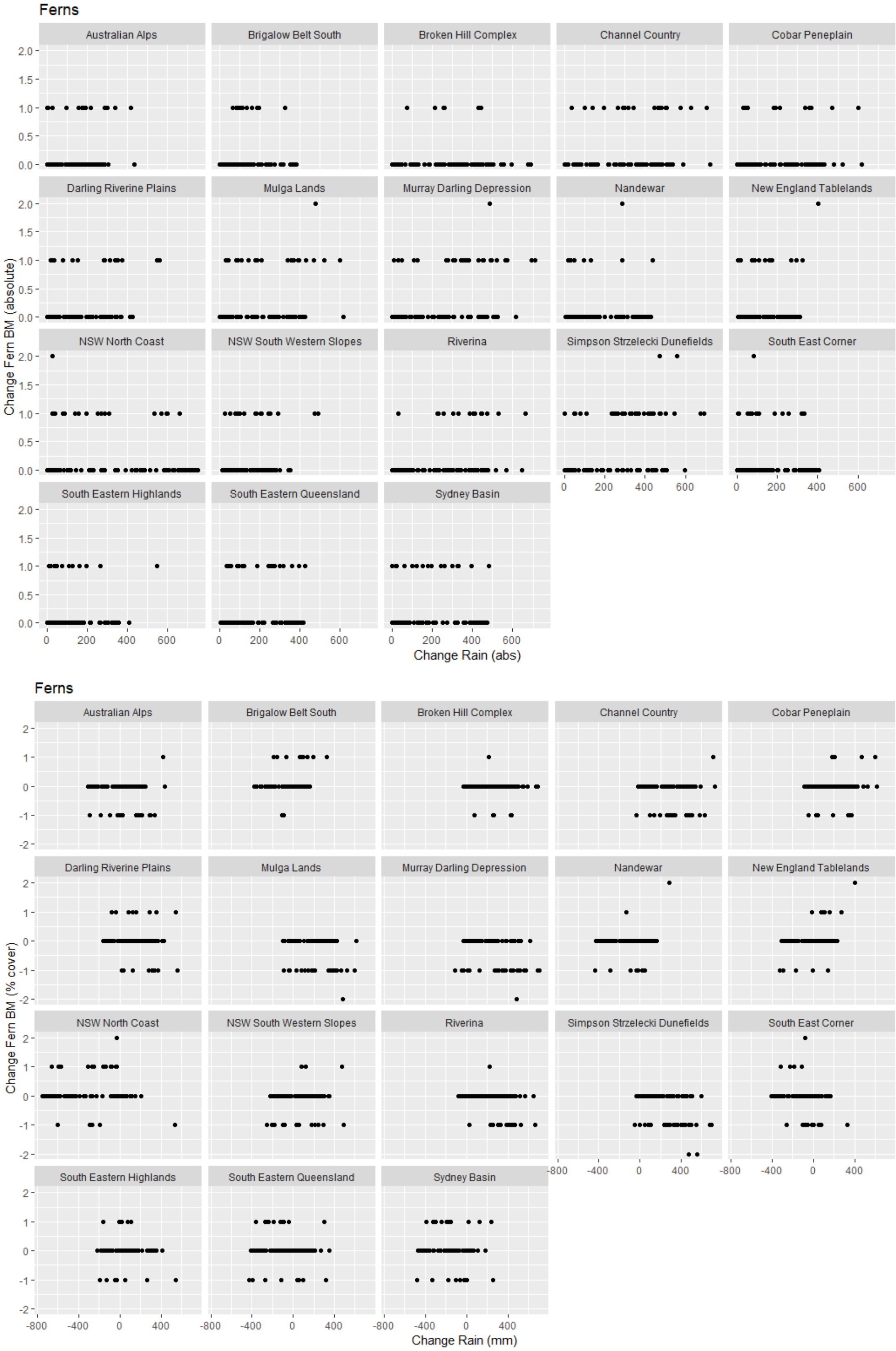


Figure 36 Change in fern richness benchmarks by change in rainfall

Absolute changes in richness benchmarks and rainfall are shown in the top panel, whereas actual changes in richness benchmarks and rainfall are shown in the bottom panel.

Figure 37 Change in tree richness benchmarks by change in rainfall

Absolute changes in richness benchmarks and rainfall are shown in the top panel, whereas actual changes in richness benchmarks and rainfall are shown in the bottom panel.

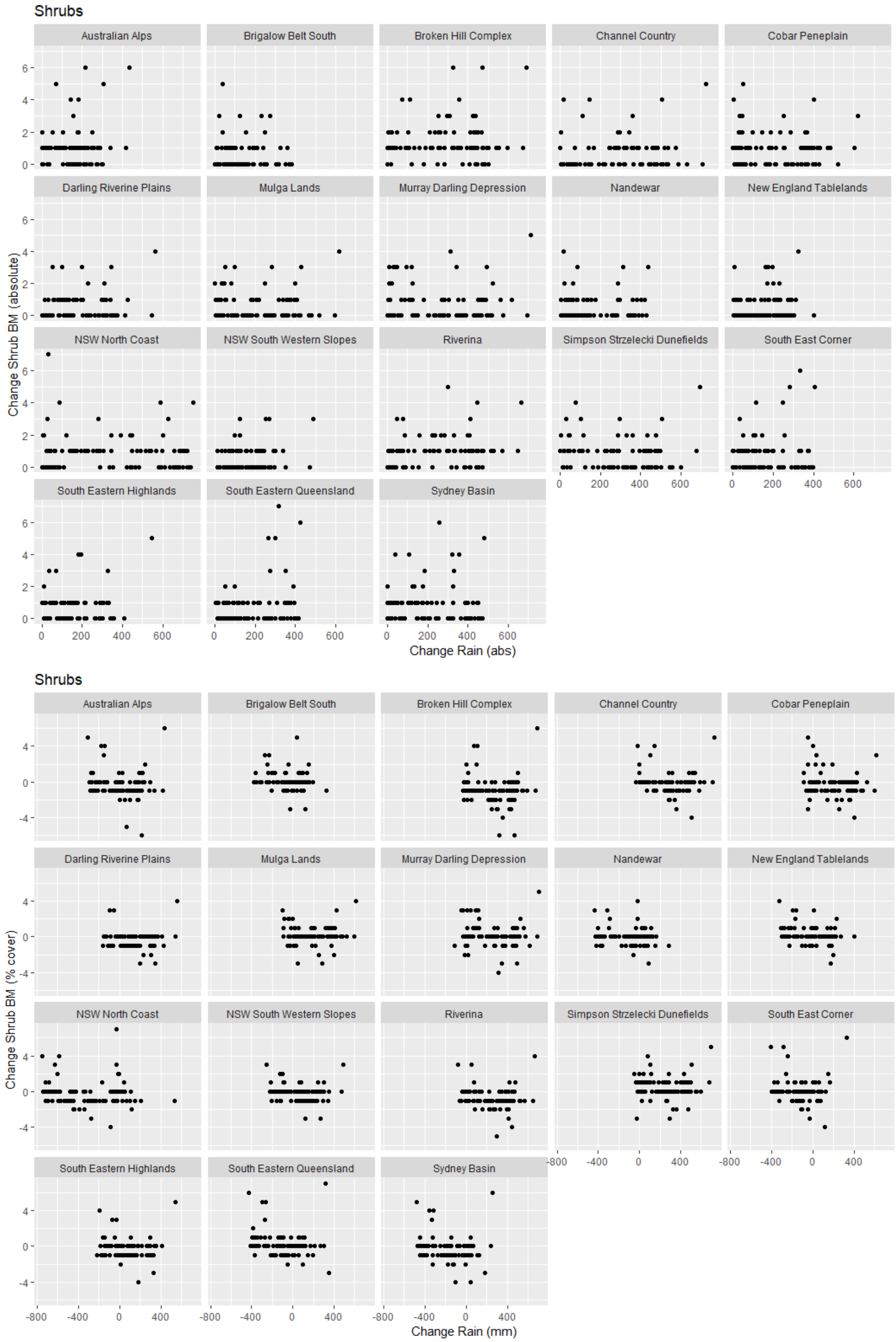


Figure 38 **Change in shrub richness benchmarks by change in rainfall**

Absolute changes in richness benchmarks and rainfall are shown in the top panel, whereas actual changes in richness benchmarks and rainfall are shown in the bottom panel.

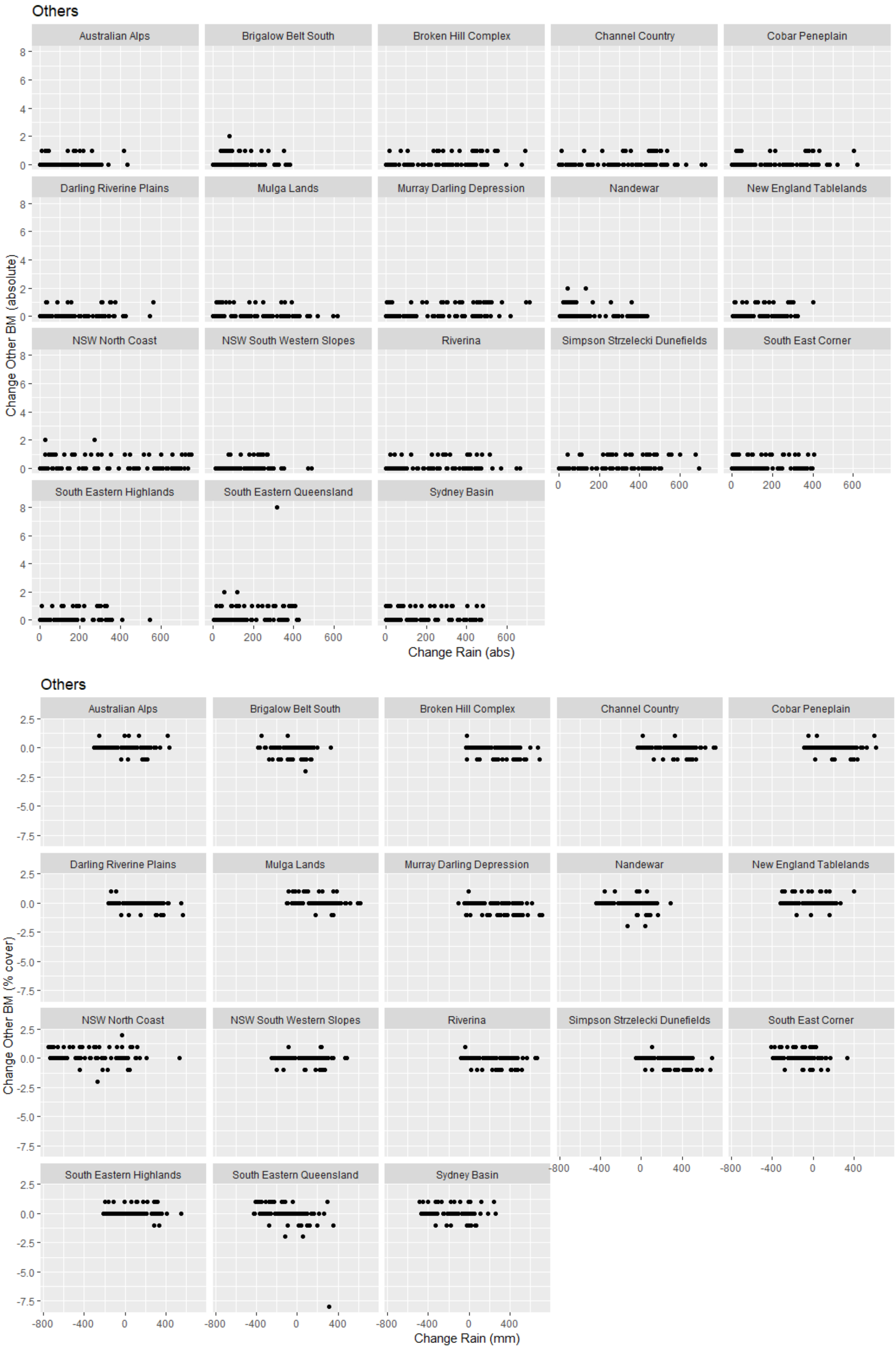


Figure 39 Change in other richness benchmarks by change in rainfall

Absolute changes in richness benchmarks and rainfall are shown in the top panel, whereas actual changes in richness benchmarks and rainfall are shown in the bottom panel.