

Appendix 1. Separating complementarity and selection effects by 'additive partitioning' method.

Here we explain why we did not use Loreau and Hector's (2001) 'additive partitioning' equation to estimate complementarity and selection effects in our paper.

Loreau and Hector (2001) developed an 'additive partitioning' method to quantitatively separate complementarity and selection effects in biodiversity experiments, and applied the method to the BIODDEPTH experiment (Hector et al. 1999). In their method, the null hypothesis is that no complementarity or selection effect occurs. Net biodiversity effect is measured as the difference between the observed yield of a mixture and its expected yield, which is calculated as the weighted (by the initial relative abundance of species in the mixture) average of the monoculture yields for the component species. Selection effect is measured as the covariance between the monoculture yield of species and their change in relative yield in the mixture. Complementarity effect is proportional to the average of change in relative yield over all the species in the mixture. The sum of selection and complementarity effects is the net biodiversity effect. To date, this method has most often been applied to experiments in which substitutive experimental design was used and species had even initial abundance in mixtures (Loreau and Hector 2001, Spaekova and Leps 2001, Zhang and Zhang 2006). Under the null hypothesis, relative yield total, RYT, is equal to one, and relative yield, RY, of species maintains unchanged; and biomass of a mixture is equal to the mean of monoculture yields of its component species. Positive net biodiversity effect means that the mixture outperforms the average of its component species. Positive complementarity effect is indicated by RYT greater than one. Positive selection effect is detected when high-yielding species have greater RY than low-yielding ones. The reverse is true for negative values of the three terms.

When the 'additive partitioning' method is applied to our experiment, the null hypothesis (RYT = 1, and RY of species maintains unchanged) means that the late arriving species could not invade the early colonizers, and a mixture produces the same amount of biomass as the monoculture of its initial species. For mixtures with high-yielding species as initial colonizers (productive-unproductive assemblages), positive net biodiversity effect means that transgressiveoveryielding occurs (i.e. a mixture outperforms monoculture of any component species); zero and negative values have no specific meanings (e.g. zero net effect can result from the failure of late arrivals to invade the communities, or the summed effect of complementarity effect and reduced biomass of the resident high-yielding species by the invasion of late arrivals). For unproductive-productive assemblages, negative net effect indicates interference effect; zero and positive values have no specific meanings (e.g. zero net effect can result from the failure of late arrivals to invade the communities, or the summed effect of interference effect and increased biomass of the invading high-yielding species).

For either productive-unproductive or unproductive-productive assemblages, the complementarity effect values should be consistent with the RYT analysis results. Positive complementarity indicates RYT greater than one.

In productive-unproductive assemblages, selection effect can be zero (when the low-yielding species cannot invade) or negative (when the low-yielding species can invade), but unlikely to be positive (the initial RY of high-yielding species is one, which should not be able to increase further). In unproductive-productive assemblages, selection effect can be zero (when the high-yielding species cannot invade) or positive (when the high-yielding species can invade), but unlikely to be negative (the initial RY of low-yielding species is one, and should not increase further). Therefore, same value of net biodiversity effect or selection effect may have different meanings for the assemblages with different colonization sequences; and the 'additive partitioning' method is not suitable for the present study to infer biodiversity effects.

Nevertheless, we did 'additive partitioning' calculation for our experiment, and present the results here. We used monoculture yields of species at day 12 as the initial biomass for the resident species in mixtures. The initial biomass of the invading species was assumed to be 1000 cells microcosm⁻¹, converted into biomass data. The initial RY of the resident species in mixtures is one, and that of the invading species is their initial biomass (1000 cells microcosm⁻¹) divided by their monoculture yields at day 12. The initial RY of invading species in mixtures is very low and the initial RYT does not differ from one, so that we can assume the experiment as a substitutive experiment and do the 'additive partitioning' analysis.

Overall, net biodiversity effect is negative in mixtures with high-yielding species as initial residents, but positive in mixtures with the opposite assembly order; complementarity effect is negative in productive-unproductive assemblages, and non-significantly positive in unproductive-productive assemblages; selection effect is negative in productive-unproductive assemblages, and positive in mixtures with the opposite colonization order (Fig. A1). These results make two points that in a sense complement the relative yield analyses in the main text. Firstly, the net biodiversity effect values suggest that there is, overall, no transgressive overyielding or interference effect. Secondly, the selection effect values imply that, on average, the late arriving species can invade the early colonizers.

References

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- Loreau, M. and Hector, A. 2001. Partitioning selection and complementarity in biodiversity experiments. – *Nature* 412: 72–76.
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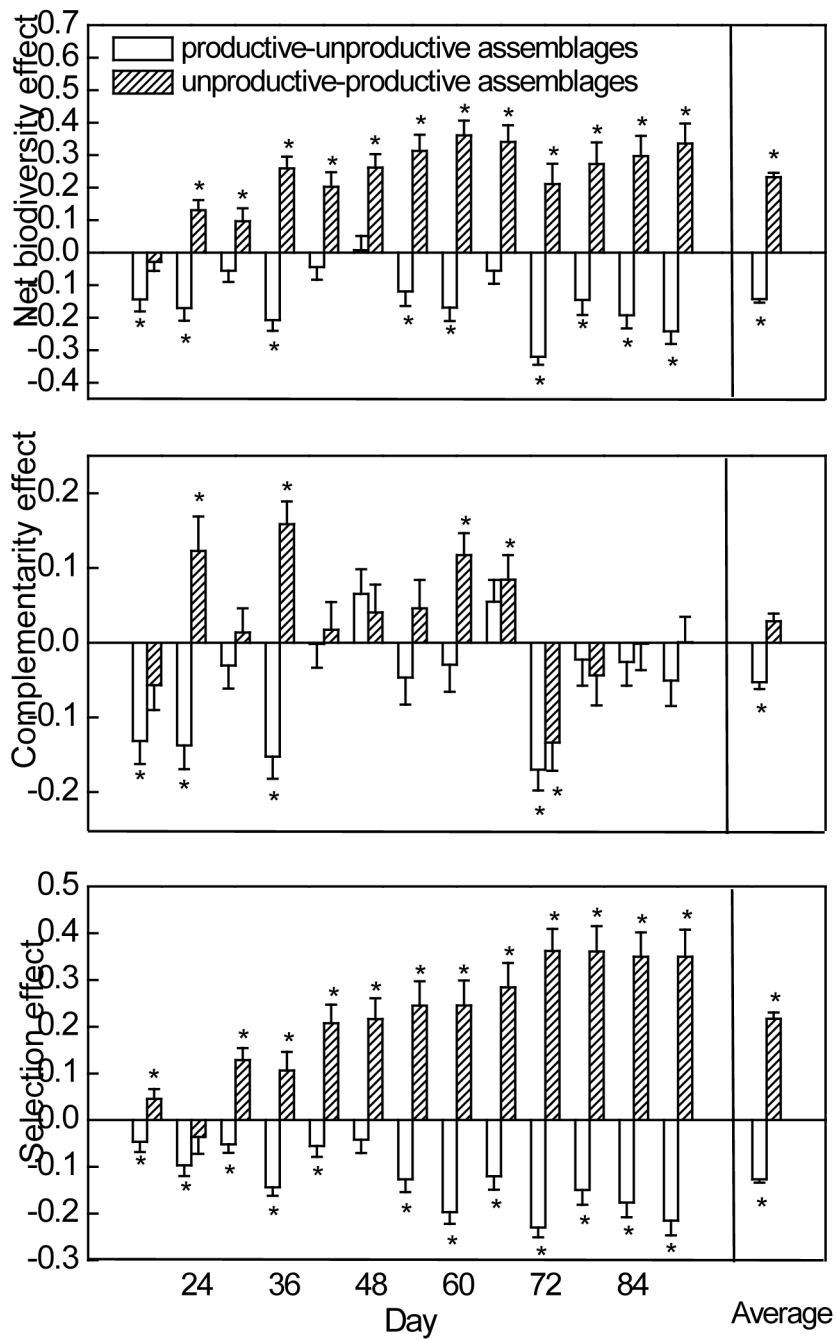


Fig. A1. Net, complementarity and selection effects calculated by ‘additive portioning’ method (Loreau and Hector 2001). Values were square-root transformed with their original positive and negative signs preserved. Asterisks indicate significant difference from zero ($p < 0.050$, based on one-sample t-test).