Supplementary Material – S1

Young mixed planted forests store more carbon than monocultures – a meta-analysis

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# Supplementary Figures and Tables

**Table S1** Information on the studies used in the meta-analysis, including whether they were obtained from the original literature search or from the Tree Diversity Network.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Study | Source | Site | Age | Country | Latitude | Longitude |
| 1 | (DeBell et al., 1997) | Literature search | 1 | 11 | USA (Hawaii) | 19.860 | −155.150 |
| 2 | (Bauhus et al., 2004) | Literature search | 2 | 10 | Australia | −37.600 | 149.162 |
| 3 | (Forrester et al., 2013) | Literature search | 3 | 11 | Australia | −37.600 | 149.162 |
| 4 | (He et al., 2013) | Literature search | 5 | 28 | China | 22.0518 | 106.86854 |
| 5 | (Piotto et al., 2010) | Literature search | 6 | 17 | Costa Rica | 10.433333 | −83.983333 |
| 6 | (Piotto et al., 2010) | Literature search | 7 | 17 | Costa Rica | 10.433333 | −83.983333 |
| 7 | (Piotto et al., 2010) | Literature search | 8 | 16 | Costa Rica | 10.433333 | −83.983333 |
| 8 | (Nunes et al., 2014) | Literature search | 9 | 28 | Portugal | 41.400000 | −7.100000 |
| 9 | (Wang et al., 2009) | Literature search | 10 | 15 | China | 26.826522 | 109.859850 |
| 10 | (Mao et al., 2010) | Literature search | 11 | 5 | China | 41.705729 | 119.454350 |
| 11 | (Mao et al., 2010) | Literature search | 11 | 15 | China | 41.705729 | 119.454350 |
| 12 | (Nichols and Carpenter, 2006) | Literature search | 12 | 11 | Costa Rica | 9.000000 | −83.000000 |
| 13 | (Kaye et al., 2000) | Zhang *et al.* 2012 | 13 | 17 | USA (Hawaii) | 19.5 | -155.25 |
| 14 | (Son et al., 2007) | Zhang *et al.* 2012 | 14 | 27 | South Korea | 37.783333 | 127.8 |
| 15 | TreeDivNet – Orphee | TreeDivNet | 15 | 9 | France | 44.740100 | −0.796800 |
| 16 | TreeDivNet – Ident SSM | TreeDivNet | 16 | 6 | Canada | 46.546501 | −84.455650 |
| 17 | TreeDivNet – MyDiv | TreeDivNet | 17 | 3.5 | Germany | 51.383000 | 11.883000 |
| 18 | TreeDivNet – IDENT Auclair | TreeDivNet | 18 | 8 | Canada | 47.696611 | −68.656306 |
| 19 | TreeDivNet – IDENT Cloquet | TreeDivNet | 19 | 8 | Canada | 46.705083 | −92.524972 |
| 20 | TreeDivNet – Sardinilla | TreeDivNet | 20 | 16 | Panama | 9.316667 | −79.633333 |
| 21 | TreeDivNet – Agua Salud | TreeDivNet | 21 | 7 | Panama | 9.216667 | −79.7833333 |

**Table S2** Species classified as commercial species for the comparison of mixed plantation to monocultures of commercial species.

|  |  |  |
| --- | --- | --- |
| Study | Country | Commercial species |
| Debell et al., 1997 | USA (Hawaii) | *Eucalyptus saligna* |
| Forrester et al., 2013 | Australia | *Eucalyptus globulus* |
| Piotto et al., 2010 | Costa Rica | *Vochysia guatemalensis Terminalia amazonia**Hyeronima alchorneoides* |
| Nunes et al., 2014 | Portugal | *Pseudotsuga menziesii* |
| Wang et al., 2009 | China | *Cunninghamia lanceolata* |
| Mao et al., 2010 | China | *Populus xiaozhuanica* |
| Nichols & Carpenter, 2006 | Costa Rica | *Terminalia amazonia* |
| TreeDivNet – Agua Salud | Panama | *Anacardium excelsum**Tabebuia rosea**Terminalia amazonia* |
| Kaye et al., 2000 | USA (Hawaii) | *Eucalyptus saligna* |
| Son et al., 2007 | South Korea | *Pinus koraiensis* |

**Table S3** Model structures used for each research question. Showing the type of monoculture used to calculate the Standardised Mean Difference (SMD) for each mixed vs monoculture comparison, the size of the dataset, the random effects structure and the moderator used if applicable.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | SMD calculated relative to | Number of comparisons | Random effects | Moderator |
| Are carbon stocks in mixed-species planted forests higher than in monocultures? | Average of monocultures | 79 | list(~1|site,~1|comparison ID) | NA |
| Most productive monoculture | 79 | list(~ 1|site/monoculture plot ID, ~1|comparison ID) | NA |
| Commercial monoculture | 38 | list(~ 1|site/shared mixture or monoculture plot ID, ~1|comparison ID) | NA |
| Is any advantage of mixtures over monocultures positively related to how species rich the mixture is? | Average of monocultures | 79 | list(~1|site, ~1|comparison ID) | Species richness (continuous 2-6) |
| Most productive monoculture | 79 | list(~ 1|site/monoculture plot ID, ~1|comparison ID) | Species richness (continuous 2-6) |
| Estimation of mean SMD for species richness 2 | Average of monocultures | 58 | list(~1|site, ~1|comparison ID) | NA |
| Most productive monoculture | 58 | list(~ 1|site/monoculture plot ID, ~1|comparison ID) | NA |
| Commercial monoculture | 32 | list(~ 1|site/shared mixture or monoculture plot ID, ~1|comparison ID) | NA |
| Estimation of mean SMD for species richness 4 | Average of monocultures | 11 | list(~1|site, ~1|comparison ID) | NA |
| Most productive monoculture | 11 | list(~ 1|site/monoculture plot ID, ~1|comparison ID) | NA |
| Estimation of mean SMD for species richness 6 | Average of monocultures | 8 | list(~1|site, ~1|comparison ID) | NA |
| Most productive monoculture | 8 | list(~ 1|site/monoculture plot ID, ~1|comparison ID) | NA |
| Effect of nitrogen fixers on difference in carbon stocks between mixtures and monocultures (species richness 2 only) | Average of monocultures | 58 | list(~1|site, ~1|comparison ID) | Nitrogen fixer (2 level factor: present, absent) |
| Most productive monoculture | 58 | list(~ 1|site/monoculture plot ID, ~1|comparison ID) | Nitrogen fixer (2 level factor: present, absent) |
| Commercial monoculture | 32 | list(~ 1|site/shared mixture or monoculture plot ID, ~1|comparison ID) | Nitrogen fixer (2 level factor: present, absent) |
| Effect of species origin on difference in carbon stocks between mixtures and monocultures (species richness 2 only) | Average of monocultures | 58 | list(~1|site, ~1|comparison ID) | Species origin (2 level factor: native, non-native) |
| Most productive monoculture | 58 | list(~ 1|site/monoculture plot ID, ~1|comparison ID) | Species origin (2 level factor: native, non-native/mixed origin) |
| Commercial monoculture | 32 | list(~ 1|site/shared mixture or monoculture plot ID, ~1|comparison ID) | Species origin (2 level factor: native, non-native) |
| Effect of study design on difference in carbon stocks between mixtures and monocultures (species richness 2 only) | Average of monocultures | 58 | list(~1|site, ~1|comparison ID) | Study design (2 level factor: designed experiment, existing plantation |
| Most productive monoculture | 58 | list(~ 1|site/monoculture plot ID, ~1|comparison ID) | Study design (2 level factor: designed experiment, existing plantation |
| Commercial monoculture | 32 | list(~ 1|site/shared mixture or monoculture plot ID, ~1|comparison ID) | Study design (2 level factor: designed experiment, existing plantation |
| Effect of age on difference in carbon stocks between mixtures and monocultures (species richness 2 only) | Average of monocultures | 58 | list(~1|site, ~1|comparison ID) | Age (continuous: 3.5-28 years) |
| Most productive monoculture | 58 | list(~ 1|site/monoculture plot ID, ~1|comparison ID) | Age (continuous: 3.5-28 years) |
| Commercial monoculture | 32 | list(~ 1|site/shared mixture or monoculture plot ID, ~1|comparison ID) | Age (continuous: 3.5-28 years) |



**Figure S1** Number of mixed to monoculture comparisons at each level of species richness for (a) mixed plantations compared to the average of relevant monocultures/most productive monoculture and (b) mixed plantations compared to commercial monocultures.

**Table S4** Carbon accumulation in each mixed plantation (MxP), the average of monoculture plantations (average of MPs) and the most productive monoculture (most productive MP) for each comparison. The % carbon in the mixed plantation relative to the average of monocultures and most productive monoculture is also shown. The comparisons are ordered by species richness (SR) and the % of the average of monocultures carbon in the mixed plantation. The age and species in the mixed and most productive monoculture plantations are given.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SR | MxP carbon (Mg/ha) | average of MPs carbon (Mg/ha) | most productive MP carbon (Mg/ha) | % of average of monocultures carbon in MxP | % of most productive monoculture carbon in MxP | Age | Mixed plantation species | Most productive monoculture species |
| 2 | 4.9 | 10.2 | 16.9 | 48 | 29 | 8 | *Larix laricina, Quercus rubra* | *Larix laricina* |
| 2 | 8.2 | 11.7 | 12.9 | 70 | 63 | 8 | *Acer saccharum, Picea glauca* | *Acer saccharum* |
| 2 | 9.9 | 13.6 | 16.9 | 73 | 58 | 8 | *Larix laricina, Pinus strobus* | *Larix laricina* |
| 2 | 68.5 | 82.2 | 82.2 | 83 | 83 | 27 | *Alnus hirsute, Pinus koraiensis* | *Pinus koraiensis* |
| 2 | 3.5 | 4.2 | 6.7 | 84 | 53 | 7 | *Anacardium excelsium, Tabebuia rosea* | *Anacardium excelsum* |
| 2 | 9.9 | 11.8 | 12.2 | 84 | 82 | 8 | *Betula papyrifera, Quercus rubra* | *Betula papyrifera* |
| 2 | 4.8 | 5.4 | 6.6 | 89 | 73 | 8 | *Acer saccharum, Picea glauca* | *Picea glauca* |
| 2 | 13.1 | 14.0 | 16.2 | 93 | 81 | 6 | *Pinus strobus, Quercus rubra* | *Pinus strobus* |
| 2 | 8.1 | 8.5 | 10.3 | 96 | 79 | 8 | *Picea glauca, Pinus strobus* | *Pinus strobus* |
| 2 | 7.0 | 6.9 | 7.0 | 102 | 100 | 7 | *Anacardium excelsium, Dalbergia retusa* | *Dalbergia retusa* |
| 2 | 9.2 | 9.0 | 9.0 | 102 | 102 | 5 | *Populus xiaozhuanica, Hippophae rhamnoides* | *Populus xiaozhuanica* |
| 2 | 67.2 | 63.8 | 88.3 | 105 | 76 | 28 | *Castanopsis hystrix, Pinus massoniana* | *Pinus massoniana* |
| 2 | 24.7 | 23.1 | 49.2 | 107 | 107 | 15 | *Cunninghamia lanceolata, Kalopanax septemlobus* | *Cunninghamia lanceolata* |
| 2 | 11.0 | 10.1 | 10.6 | 109 | 104 | 8 | *Picea glauca, Pinus strobus* | *Picea glauca* |
| 2 | 4.8 | 4.4 | 7.0 | 110 | 68 | 7 | *Dalbergia retusa, Tabebuia rosea* | *Dalbergia retusa* |
| 2 | 16.6 | 15.1 | 17.6 | 110 | 94 | 6 | *Larix larcinia, Picea glauca* | *Larix larcinia* |
| 2 | 10.6 | 9.4 | 11.9 | 113 | 89 | 6 | *Acer saccharum, Quercus rubra* | *Quercus rubra* |
| 2 | 123.8 | 109.4 | 127.8 | 113 | 97 | 11 | *Eucalyptus saligna, Falcataria moluccana* | *Eucalyptus saligna* |
| 2 | 16.6 | 14.5 | 16.2 | 114 | 103 | 6 | *Betula papyrifera, Pinus strobus* | *Pinus strobus* |
| 2 | 12.3 | 10.6 | 10.8 | 117 | 114 | 8 | *Betula papyrifera, Pinus strobus* | *Betula papyrifera* |
| 2 | 5.2 | 4.4 | 6.7 | 118 | 78 | 7 | *Anacardium excelsium, Pachira quinata* | *Anacardium excelsum* |
| 2 | 12.9 | 10.8 | 12.2 | 119 | 106 | 8 | *Betula papyrifera, Pinus strobus* | *Betula papyrifera* |
| 2 | 43.0 | 36.0 | 36.0 | 119 | 119 | 11 | *Eucalyptus globulus, Acacia mearnsii* | *Acacia mearnsii* |
| 2 | 43.1 | 36.0 | 36.0 | 120 | 120 | 11 | *Eucalyptus globulus, Acacia mearnsii* | *Acacia mearnsii* |
| 2 | 131.9 | 109.4 | 127.8 | 120 | 103 | 11 | *Eucalyptus saligna, Falcataria moluccana* | *Eucalyptus saligna* |
| 2 | 60.0 | 49.2 | 49.2 | 122 | 122 | 15 | *Cunninghamia lanceolata, Alnus cremastogyne* | *Cunninghamia lanceolata* |
| 2 | 14.8 | 12.1 | 14.8 | 122 | 101 | 8 | *Larix laricina, Pinus strobus* | *Larix laricina* |
| 2 | 12.2 | 9.9 | 12.9 | 124 | 95 | 6 | *Acer saccharum, Betula papyrifera* | *Betula papyrifera* |
| 2 | 16.9 | 13.6 | 16.9 | 124 | 100 | 8 | *Larix laricina, Pinus strobus* | *Larix laricina* |
| 2 | 18.0 | 14.3 | 16.2 | 125 | 111 | 6 | *Picea glauca, Pinus strobus* | *Pinus strobus* |
| 2 | 10.8 | 8.5 | 10.3 | 128 | 105 | 8 | *Picea glauca, Pinus strobus* | *Pinus strobus* |
| 2 | 15.5 | 11.9 | 22.2 | 130 | 70 | 7 | *Terminalia amazonia, Tabebuia rosea* | *Terminalia amazonia* |
| 2 | 47.0 | 36.0 | 36.0 | 130 | 130 | 11 | *Eucalyptus globulus, Acacia mearnsii* | *Acacia mearnsii* |
| 2 | 19.1 | 14.6 | 22.2 | 131 | 86 | 7 | *Dalbergia retusa, Terminalia amazonia* | *Terminalia amazonia* |
| 2 | 144.8 | 109.4 | 127.8 | 132 | 113 | 11 | *Eucalyptus saligna, Falcataria moluccana* | *Eucalyptus saligna* |
| 2 | 17.4 | 13.1 | 14.8 | 133 | 118 | 8 | *Larix laricina, Quercus rubra* | *Larix laricina* |
| 2 | 31.4 | 23.5 | 30.6 | 134 | 103 | 10 | *Eucalyptus globulus, Acacia mearnsii* | *Acacia mearnsii* |
| 2 | 66.9 | 48.9 | 62.7 | 137 | 107 | 28 | *Pseudotsuga menziesii, Castanea sativa* | *Pseudotsuga menziesii* |
| 2 | 19.9 | 14.4 | 22.2 | 138 | 90 | 7 | *Anacardium excelsium, Terminialia amazonia* | *Terminalia amazonia* |
| 2 | 17.4 | 12.5 | 12.9 | 139 | 135 | 8 | *Acer saccharum, Betula papyrifera* | *Acer saccharum* |
| 2 | 170.3 | 120.5 | 120.5 | 141 | 141 | 15 | *Populus xiaozhuanica, Hippophae rhamnoides* | *Populus xiaozhuanica* |
| 2 | 162.1 | 109.4 | 127.8 | 148 | 127 | 11 | *Eucalyptus saligna, Falcataria moluccana* | *Eucalyptus saligna* |
| 2 | 35.0 | 23.5 | 30.6 | 149 | 115 | 10 | *Eucalyptus globulus, Acacia mearnsii* | *Acacia mearnsii* |
| 2 | 35.4 | 23.5 | 30.6 | 151 | 116 | 10 | *Eucalyptus globulus, Acacia mearnsii* | *Acacia mearnsii* |
| 2 | 156.1 | 101.1 | 100.7 | 154 | 155 | 17 | *Eucalyptus saligna, Falcataria moluccana* | *Eucalyptus saligna* |
| 2 | 19.2 | 12.1 | 22.2 | 158 | 86 | 7 | *Pachira quinate, Terminalia amazonia* | *Terminalia amazonia* |
| 2 | 180.6 | 109.4 | 127.8 | 165 | 141 | 11 | *Eucalyptus saligna, Falcataria moluccana* | *Eucalyptus saligna* |
| 2 | 46.7 | 27.5 | 40.6 | 170 | 115 | 17 | *Vochysia guatemalensis, Jacaranda copaia* | *Vochysia guatemalensis* |
| 2 | 83.7 | 48.9 | 62.7 | 171 | 133 | 28 | *Pseudotsuga menziesii, Castanea sativa* | *Pseudotsuga menziesii* |
| 2 | 12.9 | 7.5 | 10.8 | 172 | 119 | 8 | *Acer saccharum, Betula papyrifera* | *Betula papyrifera* |
| 2 | 177.5 | 101.1 | 100.7 | 176 | 176 | 17 | *Eucalyptus saligna, Falcataria moluccana* | *Eucalyptus saligna* |
| 2 | 8.1 | 4.6 | 7.0 | 177 | 115 | 7 | *Dalbergia retusa, Pachira quinata* | *Dalbergia retusa* |
| 2 | 3.5 | 1.9 | 2.1 | 185 | 166 | 7 | *Pachira quinate, Tabebuia rosea* | *Pachira quinata* |
| 2 | 191.1 | 101.1 | 100.7 | 189 | 190 | 17 | *Eucalyptus saligna, Falcataria moluccana* | *Eucalyptus saligna* |
| 2 | 209.9 | 101.1 | 100.7 | 208 | 208 | 17 | *Eucalyptus saligna, Falcataria moluccana* | *Eucalyptus saligna* |
| 2 | 17.9 | 7.2 | 10.8 | 250 | 165 | 8 | *Betula papyrifera, Quercus rubra* | *Betula papyrifera* |
| 2 | 31.2 | 11.0 | 12.5 | 285 | 250 | 9 | *Betula pendula, Pinus pinaster* | *Pinus pinaster* |
| 2 | 10.8 | 3.7 | 3.7 | 293 | 293 | 11 | *Terminalia amazonia, Inga edulis* | *Terminalia amazonia* |
| 3 | 26.5 | 18.5 | 22.1 | 144 | 120 | 16 | *Hyeronima alchorneoides, Vochysia ferruginea, Balizia elegans* | *Hyeronima alchorneoides* |
| 4 | 63.4 | 42.8 | 55.0 | 148 | 115 | 17 | *Terminalia amazonia, Virola koschnyi, Dipteryx panamensis* | *Terminalia amazonia* |
| 4 | 31.1 | 10.1 | 16.5 | 308 | 189 | 3.5 | *Aesculus hippocastanum, Fraxinus excelsior, Prunus avium, Sorbus aucuparia* | *Sorbus aucuparia* |
| 4 | 44.9 | 13.3 | 30.5 | 336 | 147 | 3.5 | *Betula pendula, Carpinus betulus, Quercus petraea, Tilia platyphyllos* | *Carpinus betulus* |
| 4 | 47.2 | 13.4 | 30.5 | 351 | 155 | 3.5 | *Betula pendula, Carpinus betulus, Fagus sylvatica, Tilia platyphyllos* | *Carpinus betulus* |
| 4 | 45.6 | 12.5 | 30.5 | 365 | 150 | 3.5 | *Betula pendula, Carpinus betulus, Fagus sylvatica, Quercus petraea* | *Carpinus betulus* |
| 4 | 51.6 | 14.1 | 16.9 | 367 | 304 | 3.5 | *Acer pseudoplatanus, Fraxinus excelsior, Prunus avium, Sorbus aucuparia* | *Acer pseudoplatanus* |
| 4 | 55.7 | 12.8 | 16.9 | 435 | 329 | 3.5 | *Acer pseudoplatanus, Aesculus hippocastanum, Fraxinus excelsior, Sorbus aucuparia* | *Acer pseudoplatanus* |
| 4 | 46.1 | 10.2 | 16.9 | 450 | 272 | 3.5 | *Acer pseudoplatanus, Aesculus hippocastanum, Fraxinus excelsior, Prunus avium* | *Acer pseudoplatanus* |
| 4 | 64.0 | 11.8 | 16.9 | 543 | 378 | 3.5 | *Acer pseudoplatanus, Aesculus hippocastanum, Prunus avium, Sorbus aucuparia* | *Acer pseudoplatanus* |
| 4 | 58.7 | 10.7 | 30.5 | 548 | 193 | 3.5 | *Carpinus betulus, Fagus sylvatica, Quercus petraea, Tilia platyphyllos* | *Carpinus betulus* |
| 4 | 43.9 | 6.5 | 13.7 | 674 | 321 | 3.5 | *Betula pendula, Fagus sylvatica, Quercus petraea, Tilia platyphyllos* | *Betula pendula* |
| 5 | 14.4 | 7.9 | 22.2 | 182 | 65 | 7 | *Terminalia amazonia, Tabebuia rosea, Dalbergia retusa, Pachira quinate, Anacardium excelsium* | *Terminalia amazonia* |
| 6 | 2.6 | 6.7 | 6.7 | 39 | 39 | 7 | *Anacardium excelsium, Erythrina fusca, Gliricidia sepium, Inga punctata, Luehea speciose, Ochroma pyramidale* | *Anacardium excelsum* |
| 6 | 5.1 | 7.0 | 7.0 | 72 | 72 | 7 | *Dalbergia retusa, Erythrina fusca, Gliricidia sepium, Inga punctata, Luehea speciose, Ochroma pyramidale* | *Dalbergia retusa* |
| 6 | 17.2 | 22.2 | 22.2 | 78 | 78 | 7 | *Terminalia amazonia, Erythrina fusca, Gliricidia sepium, Inga punctata, Luehea speciose, Ochroma pyramidale* | *Terminalia amazonia* |
| 6 | 7.9 | 8.7 | 16.9 | 91 | 47 | 8 | *Acer saccharum, Betula papyrifera, Larix laricina, Picea glauca, Pinus strobus, Quercus rubra* | *Larix larici* |
| 6 | 1.7 | 1.7 | 1.7 | 102 | 102 | 7 | *Tabebuia rosea, Erythrina fusca, Gliricidia sepium, Inga punctata, Luehea speciose, Ochroma pyramidale* | *Tabebuia rosea* |
| 6 | 13.5 | 11.9 | 14.8 | 113 | 91 | 8 | *Acer saccharum, Betula papyrifera, Larix laricina, Picea glauca, Pinus strobus, Quercus rubra* | *Larix larici* |
| 6 | 36.9 | 23.3 | 36.3 | 158 | 102 | 16 | *Anacardium excelsum, Cedrela odorata, Hura crepitans, Luehea seemanii, Tabebuia rosea, Cordia alliodora* | *Luehea seemanii* |
| 6 | 5.6 | 2.1 | 2.1 | 263 | 263 | 7 | *Pachira quinate, Erythrina fusca, Gliricidia sepium, Inga punctata, Luehea speciose, Ochroma pyramidale* | *Pachira quinata* |
| Overall |  |  |  | **170.3 [95% CI 143.9, 196.8]** | **128.0 [95% CI 112.4, 143.5]** |  |  |  |

**Table S5** Carbon accumulation in mixed plantations (MxP) compared to commercial species monocultures (commercial MP). The % carbon in the mixed plantation relative to the commercial species monoculture is shown. The comparisons are ordered by species richness (SR) and the % of the commercial species monoculture carbon in the mixed plantation. The age and species in the mixed and commercial species monoculture plantations are given.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| SR | MxP carbon (Mg/ha) | commercial MP carbon (Mg/ha) | % of commercial monoculture carbon in MxP | Age | Mixed plantation species | Commercial monoculture species |
| 2 | 3.5 | 6.7 | 53 | 7 | *Anacardium excelsium Tabebuia rosea* | *Anacardium excelsum* |
| 2 | 15.5 | 22.2 | 70 | 7 | *Terminalia amazonia Tabebuia rosea* | *Terminalia amazonia* |
| 2 | 5.2 | 6.7 | 78 | 7 | *Anacardium excelsium Pachira quinata* | *Anacardium excelsum* |
| 2 | 68.5 | 82.2 | 83 | 27 | *Alnus hirsuta Pinus koraiensis* | *Pinus koraiensis* |
| 2 | 19.1 | 22.2 | 86 | 7 | *Dalbergia retusa Terminalia amazonia* | *Terminalia amazonia* |
| 2 | 19.2 | 22.2 | 86 | 7 | *Pachira quinata Terminalia amazonia* | *Terminalia amazonia* |
| 2 | 19.9 | 22.2 | 90 | 7 | *Anacardium excelsium Terminialia amazonia* | *Terminalia amazonia* |
| 2 | 123.8 | 127.8 | 97 | 11 | *Eucalyptus saligna Falcataria moluccana* | *Eucalyptus saligna* |
| 2 | 9.2 | 9.0 | 102 | 5 | *Populus xiaozhuanica Hippophae rhamnoides* | *Populus xiaozhuanica* |
| 2 | 131.9 | 127.8 | 103 | 11 | *Eucalyptus saligna Falcataria moluccana* | *Eucalyptus saligna* |
| 2 | 7.0 | 6.7 | 105 | 7 | *Anacardium excelsium Dalbergia retusa* | *Anacardium excelsum* |
| 2 | 66.9 | 62.7 | 107 | 28 | *Pseudotsuga menziesii Castanea sativa* | *Pseudotsuga menziesii* |
| 2 | 52.7 | 49.2 | 107 | 15 | *Cunninghamia lanceolata Kalopanax septemlobus* | *Cunninghamia lanceolata* |
| 2 | 144.8 | 127.8 | 113 | 11 | *Eucalyptus saligna Falcataria moluccana* | *Eucalyptus saligna* |
| 2 | 46.7 | 40.6 | 115 | 17 | *Vochysia guatemalensis Jacaranda copaia* | *Vochysia guatemalensis* |
| 2 | 60.0 | 49.2 | 122 | 15 | *Cunninghamia lanceolata Alnus cremastogyne* | *Cunninghamia lanceolata* |
| 2 | 162.1 | 127.8 | 127 | 11 | *Eucalyptus saligna Falcataria moluccana* | *Eucalyptus saligna* |
| 2 | 83.7 | 62.7 | 133 | 28 | *Pseudotsuga menziesii Castanea sativa* | *Pseudotsuga menziesii* |
| 2 | 180.6 | 127.8 | 141 | 11 | *Eucalyptus saligna Falcataria moluccana* | *Eucalyptus saligna* |
| 2 | 170.3 | 120.5 | 141 | 15 | *Populus xiaozhuanica Hippophae rhamnoides* | *Populus xiaozhuanica* |
| 2 | 156.1 | 100.7 | 155 | 17 | *Eucalyptus saligna Falcataria moluccana* | *Eucalyptus saligna* |
| 2 | 177.5 | 100.7 | 176 | 17 | *Eucalyptus saligna Falcataria moluccana* | *Eucalyptus saligna* |
| 2 | 191.1 | 100.7 | 190 | 17 | *Eucalyptus saligna Falcataria moluccana* | *Eucalyptus saligna* |
| 2 | 31.4 | 16.5 | 191 | 10 | *Eucalyptus globulus Acacia mearnsii* | *Eucalyptus globulus* |
| 2 | 209.9 | 100.7 | 208 | 17 | *Eucalyptus saligna Falcataria moluccana* | *Eucalyptus saligna* |
| 2 | 3.5 | 1.7 | 209 | 7 | *Pachira quinata Tabebuia rosea* | *Tabebuia rosea* |
| 2 | 35.0 | 16.5 | 213 | 10 | *Eucalyptus globulus Acacia mearnsii* | *Eucalyptus globulus* |
| 2 | 35.4 | 16.5 | 215 | 10 | *Eucalyptus globulus Acacia mearnsii* | *Eucalyptus globulus* |
| 2 | 4.8 | 1.7 | 282 | 7 | *Dalbergia retusa Tabebuia rosea* | *Tabebuia rosea* |
| 2 | 10.8 | 3.7 | 293 | 11 | *Terminalia amazonia Inga edulis* | *Terminalia amazonia* |
| 2 | 19.9 | 6.7 | 298 | 7 | *Anacardium excelsium Terminialia amazonia* | *Anacardium excelsum* |
| 2 | 15.5 | 1.7 | 913 | 7 | *Terminalia amazonia Tabebuia rosea* | *Tabebuia rosea* |
| 3 | 26.5 | 22.1 | 120 | 16 | *Hyeronima alchorneoides Vochysia ferruginea Balizia elegans* | *Hyeronima alchorneoides* |
| 4 | 63.4 | 55.0 | 115 | 17 | *Terminalia amazonia Virola koschnyi Dipteryx panamensis* | *Terminalia amazonia* |
| 5 | 14.4 | 6.7 | 216 | 7 | *Terminalia amazonia Tabebuia rosea Dalbergia retusa Pachira quinata Anacardium excelsium* | *Anacardium excelsum* |
| 5 | 14.4 | 22.2 | 65 | 7 | *Terminalia amazonia Tabebuia rosea Dalbergia retusa Pachira quinata Anacardium excelsium* | *Terminalia amazonia* |
| 5 | 14.4 | 1.7 | 851 | 7 | *Terminalia amazonia Tabebuia rosea Dalbergia retusa Pachira quinata Anacardium excelsium* | *Tabebuia rosea* |
| 6 | 17.2 | 22.2 | 78 | 7 | *Terminalia amazonia Erythrina fusca Gliricidia sepium Inga punctata Luehea speciose Ochroma pyramidale* | *Terminalia amazonia* |
| Overall |  |  | **176.6 [95% CI 119.4, 233.8]** |  |  |  |





**Figure S2** The effect of diversification at different levels of species richness on aboveground carbon stocks relative to (a) the average of associated monocultures and (b) the best associated monocultures. Effect sizes are standardised mean differences, predicted from models with species richness fitted as a discrete moderator. Confidence intervals overlapping zero suggest no statistically detectible effect of diversification. Positive values indicate higher carbon stocks in mixtures than in monocultures.

**References**

Bauhus, J., Van Winden, A. P., and Nicotra, A. B. (2004). Aboveground interactioBns and productivity in mixed-species plantations of Acacia mearnsii and Eucalyptus globulus. *Can. J. For. Res.* 34, 686–694. doi:10.1139/x03-243.

DeBell, D. S., Cole, T. G., and Whitesell, C. D. (1997). Growth, development, and yield in pure and mixed stands of Eucalyptus and Albizia. *For. Sci.* 43, 286–298.

Forrester, D. I., Pares, A., O’Hara, C., Khanna, P. K., and Bauhus, J. (2013). Soil Organic Carbon is Increased in Mixed-Species Plantations of Eucalyptus and Nitrogen-Fixing Acacia. *Ecosystems* 16, 123–132. doi:10.1007/s10021-012-9600-9.

He, Y., Qin, L., Li, Z., Liang, X., Shao, M., and Tan, L. (2013). Carbon storage capacity of monoculture and mixed-species plantations in subtropical China. *For. Ecol. Manage.* 295, 193–198. doi:10.1016/J.FORECO.2013.01.020.

Kaye, J. P., Resh, S. C., Kaye, M. W., and Chimner, R. A. (2000). Nutrient and carbon dynamics in a replacement series of Eucalyptus and Albizia trees. *Ecology* 81, 3267–3273. doi:10.2307/177491.

Mao, R., Zeng, D.-H., Ai, G.-Y., Yang, D., Li, L.-J., and Liu, Y.-X. (2010). Soil microbiological and chemical effects of a nitrogen-fixing shrub in poplar plantations in semi-arid region of Northeast China. *Eur. J. Soil Biol.* 46, 325–329. doi:10.1016/J.EJSOBI.2010.05.005.

Nichols, J. D., and Carpenter, F. L. (2006). Interplanting Inga edulis yields nitrogen benefits to Terminalia amazonia. *For. Ecol. Manage.* 233, 344–351. doi:10.1016/J.FORECO.2006.05.031.

Nunes, L., Gower, S. T., Monteiro, M. L., Lopes, D., and Rego, F. C. (2014). Growth dynamics and productivity of pure and and mixed Castanea sativa Mill. and Pseudotsuga menziesii (Mirb.) Franco plantations in northern Portugal. *iForest* 7, 92–102. doi:10.3832/ifor1087-007.

Piotto, D., Craven, D., Montagnini, F., and Alice, F. (2010). Silvicultural and economic aspects of pure and mixed native tree species plantations on degraded pasturelands in humid Costa Rica. *New For.* 39, 369–385. doi:10.1007/s11056-009-9177-0.

Son, Y., Lee, Y. Y., Lee, C. Y., and Yi, M. J. (2007). Nitrogen fixation, soil nitrogen availability, and biomass in pure and mixed plantations of alder and pine in central Korea. *J. Plant Nutr.* 30, 1841–1853. doi:10.1080/01904160701628999.

Wang, Q., Wang, S., and Zhang, J. (2009). Assessing the effects of vegetation types on carbon storage fifteen years after reforestation on a Chinese fir site. *For. Ecol. Manage.* 258, 1437–1441. doi:10.1016/J.FORECO.2009.06.050.