The main aim is to test if the diversity of neighbours affects individual tree growth, once we have controlled for the identity of neighbours. That is, if there is a diversity effect *per se.*

SECTION 1: BASE MODELS

I built the models in a stepforward way, i.e. from the most simple to the most complicated. I started with a null mode, and progressively added the effects of size and competition, as well as the effect of size on the competitive effect of neighbours (models2, 3 and 4). Then I tried different formulations to add the comeptitive identity of the neighbours: species-specific (model 8) intra vs. interspecific lambda (model 9), lambda that depends on the functional group (model 10) and lambda that depends on the shade tolerance of neighbours (Model 11). Here are the formulations and results of this step.

**Model 1: Null model**

**Model 2: Size effect**

**Model 3: Size + Competition**

**Model 4: Size + Competition (competition modulated by size)**

**Model 8: Size + Competition (species-specific competitive effect)**

**Model 9: Size + Competition (intra- vs interspecific competitive effect)**

**Model 10: Size + Competition (functional group-specific competitive effect)**

**Model 11: Size + Competition (shade tolerance-specific competitive effect)**

Table 1. Increase in AIC as compared to the best model for each species. The best model is given an AIC of 0, and the rest of models are compared with it.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Null  model  (1) | Size  effect  (2) | Size + competition effect (no lambda) | | Size + competition  effect (lambda) | | | |  |  |
|  | Base  (3) | Size  (4) | Sps-specific (8) | Intra vs  Inter (9) | Funct  Group  (10) | Shade  toler  (11) | R2 | # param. |
| ABBA | 421.3 | 383.8 | 390.3 | 390.1 | **0.0** | 301.6 | 39.0 | 166.3 | 0.50 | 28 |
| PIAB | 282.0 | 245.7 | 250.4 | 250.8 | **0.0** | 122.1 | 86.3 | 125.7 | 0.52 | 28 |
| PISY | 462.5 | 459.4 | 401.0 | 401.2 | 1.9 | 367.9 | **0.0** | 347.9 | 0.47 | 14 |
| PIGL | 558.6 | 550.5 | 551.8 | 553.9 | **0.0** | 316.4 | 403.9 | 305.5 | 0.46 | 28 |
| PIOM | 143.6 | 150.5 | 145.4 | 147.3 | 84.3 | 66.2 | 78.1 | **0.0** | 0.50 | 13 |
| PIRU | 319.7 | 305.3 | 309.9 | 311.5 | **0.0** | 161.0 | 86.0 | 108.9 | 0.40 | 28 |
| THOC | 581.0 | 535.7 | 424.5 | 440.3 | **0.0** | 235.4 | 77.0 | 225.9 | 0.41 | 28 |
| PIRE | 143.5 | 125.6 | 49.4 | 53.1 | 5.6 | 55.7 | 26.2 | **0.0** | 0.21 | 13 |
| PIST | 478.7 | 451.1 | 406.1 | 403.4 | **0.0** | 372.0 | 94.0 | 390.5 | 0.31 | 28 |
| QURO | 234.0 | 212.9 | 169.8 | 171.6 | **0.0** | 126.2 | 106.0 | 19.7 | 0.33 | 28 |
| QURU | 1271.0 | 1067.0 | 647.2 | 644.7 | **0.0** | 635.3 | 282.4 | 638.4 | 0.50 | 28 |
| ACRU | 344.4 | 337.9 | 227.9 | 230.0 | 237.3 | 219.6 | **0.0** | 111.3 | 0.15 | 14 |
| LALA | 709.7 | 625.4 | 457.0 | 459.1 | **0.0** | 367.2 | 183.1 | 358.1 | 0.33 | 28 |
| TICO | 334.6 | 209.5 | 184.5 | 169.2 | **0.0** | 108.2 | 99.2 | 131.2 | 0.19 | 28 |
| ACPL | 88.3 | 104.0 | 63.7 | 64.5 | **0.0** | 69.2 | 61.8 | 63.9 | 0.10 | 28 |
| ACSA | 257.4 | 214.0 | 184.2 | 186.2 | **0.0** | 189.0 | 135.7 | 134.8 | 0.24 | 28 |
| BEAL | 676.0 | 636.6 | 473.8 | 444.5 | **0.0** | 303.0 | 76.8 | 472.3 | 0.29 | 28 |
| BEPA | 1670.9 | 1684.6 | 1301.1 | 1299.1 | **0.0** | 888.7 | 416.7 | 241.6 | 0.41 | 28 |
| LADE | 178.4 | 78.2 | 15.3 | 0.5 | 11.1 | 3.0 | 7.0 | **0.0** | 0.18 | 13 |

We see that, in most cases, accounting for the specific identity of the neighbours gives the best result, although for some species we only need to consider the functional identity of neiighbours or their shade tolerance. But anyway, the identity matters. We can have a look at the species-specific lambdas:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Effect of neighbour…** | | | | | | | | | | | | | | | | | | | |
| **On target…** | **ABBA** | **PIAB** | **PISY** | **PIGL** | **PIOM** | **PIRU** | **THOC** | **PIRE** | **PIST** | **QURO** | **QURU** | **ACRU** | **LALA** | **TICO** | **ACPL** | **ACSA** | **BEAL** | **BEPA** | **LADE** |
| **ABBA** | **0.04** | 0.81 | 1 | 0 | 0 | 0.03 | 0 | 0.15 | 0.39 | 0.39 | 0.38 | 0.50 | 0.35 | 0.55 | 0.26 | 0.32 | 0.20 | 0.90 | 0.43 |
| **PIAB** | 0.07 | **0.1** | 0 | 0 | 0.28 | 0 | 0.24 | 0 | 0 | 0.33 | 0.55 | 0.64 | 0.93 | 1 | 0.85 | 0 | 0.5 | 0.49 | 1 |
| **PISY** | 0 | 0.3 | **0.2** | 0 | 0.31 | 0 | 0.03 | 0.10 | 0 | 1 | 1 | 0.31 | 1 | 1 | 0.14 | 0.68 | 0.7 | 0.98 | 0.75 |
| **PIGL** | 0 | 0 | 0.10 | **0.1** | 0.07 | 0 | 0.26 | 0.30 | 0.2 | 0.90 | 1 | 1 | 0.79 | 0.5 | 0.57 | 0.44 | 0.5 | 0.91 | 1 |
| **PIOM** | 0 | 0.6 | 0.5 | 0.4 | **0.01** | 1 | 0.68 | 0.80 | 0.2 | 0 | 0.07 | 0.06 | 1 | 0.1 | 0.51 | 0.42 | 0.8 | 0.05 | 0.06 |
| **PIRU** | 0 | 0.3 | 0.1 | 0.1 | 0.08 | **0** | 0.46 | 0.16 | 0 | 0.89 | 0.20 | 0.42 | 0.44 | 1 | 0.26 | 0.14 | 1 | 1 | 0.05 |
| **THOC** | 0 | 0.2 | 0 | 0.2 | 0.57 | 0.6 | **0.23** | 0 | 0.4 | 0.01 | 0.58 | 0.68 | 0.84 | 1 | 1 | 0.39 | 1 | 0.74 | 0 |
| **PIRE** | 0 | 0.2 | 0.4 | 0 | 0 | 0 | 0.59 | **0.10** | 0.1 | 0.52 | 0.01 | 0.94 | 0.98 | 1 | 1 | 0.36 | 1 | 0.38 | 0.59 |
| **PIST** | 0.09 | 0 | 0.1 | 0 | 0.05 | 0.10 | 0 | 0.07 | **0** | 0 | 0.02 | 0.28 | 0.51 | 0.1 | 0.48 | 0.39 | 1 | 1 | 0.60 |
| **QURO** | 0 | 0 | 0 | 0 | 0 | 0.5 | 0.03 | 0 | 0.2 | **0.40** | 0.87 | 0.01 | 0.24 | 0.2 | 0.46 | 0 | 0 | 1 | 0.07 |
| **QURU** | 0.39 | 0 | 0.1 | 0 | 0.01 | 0 | 0 | 0.04 | 0.3 | 0.26 | **0.22** | 0.07 | 0.19 | 0.7 | 0.80 | 0.50 | 0.3 | 1 | 0.01 |
| **ACRU** | 0.19 | 0 | 1 | 0.3 | 0 | 0.1 | 0.43 | 0 | 0 | 0.07 | 0 | **0.74** | 0 | 0.2 | 0.20 | 1 | 1 | 0.07 | 0 |
| **LALA** | 0 | 0.1 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0.1 | 0.65 | 0.58 | 0.62 | **0.30** | 0 | 0.26 | 0.26 | 0.3 | 1 | 0 |
| **TICO** | 0 | 0 | 0 | 0 | 0 | 0 | 0.57 | 0 | 0.1 | 0.32 | 0 | 0 | 0.15 | **0.4** | 0 | 0.27 | 0.6 | 0.74 | 0.98 |
| **ACPL** | 0.25 | 0.01 | 0.05 | 0.32 | 0.30 | 0 | 0 | 0.01 | 0.00 | 0.72 | 0.52 | 0.32 | 0 | 0.25 | **0** | 1 | 0.34 | 0.00 | 0.00 |
| **ACSA** | 0.06 | 0 | 0 | 0.10 | 0.14 | 0 | 0.17 | 0.12 | 0.3 | 0.10 | 0.17 | 0.55 | 0.38 | 0 | 0.36 | **0.29** | 0.5 | 1 | 0 |
| **BEAL** | 0 | 0 | 0 | 0.3 | 0 | 0 | 0 | 0.01 | 0 | 0.95 | 0.20 | 0.23 | 0.33 | 0 | 0.25 | 0 | **0.3** | 1 | 0.15 |
| **BEPA** | 0 | 0.9 | 0 | 0 | 0.25 | 0 | 0 | 0 | 0.2 | 0.36 | 0.26 | 0.79 | 0.54 | 1 | 0 | 0 | 0 | **1** | 0.96 |
| **LADE** | 1 | 0.1 | 0 | 0.7 | 0.01 | 0 | 0.98 | 0.46 | 0.2 | 0 | 0.09 | 0.83 | 0.93 | 0 | 0.02 | 0.30 | 0.6 | 0.99 | **1** |

There is a high diversity of lambda values. Apparently, we can see that deciduous species are better competitors than conifers (higher lambda). However, I am surprised by the large amount of

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Intra. Vs. interspecific** | | **Functional groups** | | | | **Shade tolerance groups** | | | **Leaf habit** | |
| **On target…** | **Intra** | **Inter** | **FG1** | **FG2** | **FG3** | **FG4** | **SG1** | **SG2** | **SG3** | **Gimno** | **Angio** |
| **ABBA** |  |  |  |  |  |  |  |  |  |  |  |
| **PIAB** |  |  |  |  |  |  |  |  |  |  |  |
| **PISY** |  |  |  |  |  |  |  |  |  |  |  |
| **PIGL** |  |  |  |  |  |  |  |  |  |  |  |
| **PIOM** |  |  |  |  |  |  |  |  |  |  |  |
| **PIRU** |  |  |  |  |  |  |  |  |  |  |  |
| **THOC** |  |  |  |  |  |  |  |  |  |  |  |
| **PIRE** |  |  |  |  |  |  |  |  |  |  |  |
| **PIST** |  |  |  |  |  |  |  |  |  |  |  |
| **QURO** |  |  |  |  |  |  |  |  |  |  |  |
| **QURU** |  |  |  |  |  |  |  |  |  |  |  |
| **ACRU** |  |  |  |  |  |  |  |  |  |  |  |
| **LALA** |  |  |  |  |  |  |  |  |  |  |  |
| **TICO** |  |  |  |  |  |  |  |  |  |  |  |
| **ACPL** |  |  |  |  |  |  |  |  |  |  |  |
| **ACSA** |  |  |  |  |  |  |  |  |  |  |  |
| **BEAL** |  |  |  |  |  |  |  |  |  |  |  |
| **BEPA** |  |  |  |  |  |  |  |  |  |  |  |
| **LADE** |  |  |  |  |  |  |  |  |  |  |  |

0s, which would mean that that species does not compete at all. I must double check this.

SECTION 2: EFFECT OF FUNCTIONAL DIVERSITY

We now test which is the effect of functional diversity, after taking into account the species identity of the neighbours. So we try three different models:

**Model 12: Competition modulated by size and species richness**

**Model 13: Competition modulated by size and functional difference**

**Model 14: Size + Competition (sp-specif. lambda) + competition modulated by size and functional dispersion)**

Table 2. Increase in AIC as compared to the best model for each species. The best model is given an AIC of 0, and the rest of models are compared with it.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Competition | competition + diversity | | |
|  | Sps- specific (8) | Species Richness (12) | Funct  Diff (13) | Funct Disp (14) |
| ABBA | 4.1 | 8.9 | **0.0** | 135.2 |
| PIAB | 3.2 | 2.2 | **0.0** | 81.2 |
| PISY | 0.9 | 3.7 | **0.0** | 3.1 |
| PIGL | **0.0** | 2.8 | 5.5 | 4.0 |
| PIOM | 7.9 | 6.1 | 5.3 | **0.0** |
| PIRU | 0.1 | **0.0** | 1.6 | 144.0 |
| THOC | 2.7 | **0.0** | 4.0 | 54.6 |
| PIRE | 187.8 | 1.8 | 1.6 | **0.0** |
| PIST | 613.3 | 14.2 | **0.0** | 15.0 |
| QURO | **0.0** | 3.1 | 0.2 | 2.7 |
| QURU | **0.0** | 252.8 | 512.4 | 502.2 |
| ACRU | 234.3 | 8.0 | **0.0** | 1.2 |
| LALA | 9.9 | 7.1 | 4.2 | **0.0** |
| TICO | 54.9 | **0.0** | 57.3 | 56.0 |
| ACPL | 3.8 | 6.9 | **0.0** | 5.6 |
| ACSA | **0.0** | 4.2 | 3.0 | 0.2 |
| BEAL | 7.7 | 6.1 | **0.0** | 9.3 |
| BEPA | 7.5 | 4.0 | **0.0** | 6.5 |
| LADE | **0.0** | 2.2 | 2.9 | 1.1 |

For most species, there is some effect of the diversity of neighbours (either species richness, functional difference or functional dispersal), but the effect is n most cases rather small.

SECTION 3: Next STEPS?

What should be the next steps?

* Allow negative parameters (lambda, C) to assess facilitation?
* Further refine our hypotheses?
* Include funtional diversity in different parts of the equation?
* Define functional diversity in new ways?