Parisi F, Mazziotta A, Vangi E, Tognetti R, Travaglini D, Marchetti M, D'Amico G, Francini S, Borghi C, Chirici G (2023). **Exposure elevation and forest structure predict the abundance of saproxylic beetles' communities in mountain managed beech forests**
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# Supplementary Material

**Tab. S1** - List of species of saproxylic beetles (in alphabetical order) sampled in each of the four sectors of the study area (Tab S1). For each species the number of specimens collected, the risk category, and the trophic category are provided. Family: taxon as defined by Carpaneto et al. (2015). IUCN = Red List Categories (Audisio et al. 2015). VU = Vulnerable, NT = Near Threatened, LC = Least Concern, DD = Data Deficient. Trophic Categories: XY = xylophagous (also on healthy trees), SX = saproxylophagous (on dead wood and woody rotting material, including wood-mould), SF = sap-feeder on trees attacked by XY, PR = predator (as larvae and/or adults) of SX/XY or of other saproxylic insects, MY = mycophagous (on hyphae of saproxylic fungi or yeasts, and myxomycetes, mostly under bark), MB = mycetobiontic on carpophora of large Polyporales and other fungi living on old trees and stumps (Audisio et al. 2015). Sectors in the study area LS, low altitude and southern exposure; LN, low altitude and northern exposure; HN, high altitude and northern exposure; and HS, high altitude and southern exposure.

| Family | Species | IUCN | Trophic categories | HN | LN | HS | LS |
|---|---|---|---|---|---|---|---|
| Biphyllidae | *Diplocoelus fagi* (Guérin-Méneville, 1844) | LC | SX | | | | 1 |
| Cerambycidae | *Leiopus nebulosus* ssp. *nebulosus* (Linnaeus, 1758) | LC | XY | 4 | 11 | 2 | 3 |
| Cerambycidae | *Mesosa nebulosa* (Fabricius, 1781) | LC | XY | | | | 1 |
| Cerambycidae | *Parmena unifasciata* (Rossi, 1790) | LC | XY | | 1 | | |
| Cerambycidae | *Pseudovadonia livida* ssp. *livida* (Fabricius, 1777) | LC | XY | | | 3 | |
| Cerambycidae | *Rhagium mordax* (De Geer, 1775) | LC | XY | | 1 | 12 | 2 |
| Cerambycidae | *Rutpela maculata* ssp. *maculata* (Poda, 1761) | LC | XY | | | 1 | |
| Cerambycidae | *Stenurella sennii* Sama, 2002 | DD | XY | 4 | 39 | 27 | 26 |
| Cerambycidae | *Tetrops praeustus* ssp. *praeustus* (Linnaeus, 1758) | LC | XY | | 1 | | |
| Cerylonidae | *Cerylon fagi* (Brisout de Barneville, 1867) | LC | MY | | 1 | | |
| Ciidae | *Cis bidentatus* (Olivier, 1790) | LC | MB | 1 | | | |
| Clerideae | *Tillus elongatus* (Linnaeus, 1758) | NT | PR | | 2 | | |
| Clerideae | *Thanasimus formicarius* (Linnaeus, 1758) | LC | PR | | 1 | 2 | |
| Cryptophagidae | *Cryptophagus scanicus* (Linnaeus, 1758) | LC | MY | 2 | | 5 | |
| Curculionidae | *Anisandrus dispar* (Fabricius, 1792) | LC | MY | 19 | 82 | 42 | 14 |
| Curculionidae | *Dissoleucas niveirostris* (Fabricius 1798) | LC | XY | | 1 | | |
| Curculionidae | *Ernoporicus fagi* (Fabricius, 1798) | LC | XY | 61 | 375 | 680 | 116 |
| Curculionidae | *Hylesinus toranio* (D'Antoine, 1788) | LC | XY | | | 1 | |
| Curculionidae | *Hylurgops palliatus* (Gyllenhal, 1813) | LC | XY | | 1 | | |
| Curculionidae | *Scolytus intricatus* (Ratzeburg, 1837) | LC | XY | | 11 | 2 | 2 |
| Curculionidae | *Trypodendron domesticum* (Linnaeus, 1758) | LC | MY | 9 | 14 | 35 | 4 |

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| Family | Species | IUCN | Trophic categories | HN | LN | HS | LS |
|---|---|---|---|---|---|---|---|
| Curculionidae | *Xyleborinus saxesenii* (Ratzeburg, 1837) | LC | MY | | | | 1 |
| Elateridae | *Melanotus villosus* (Geoffroy in Fourcroy, 1785) | LC | PR | 6 | 75 | 10 | 13 |
| Elateridae | *Stenagostus rhombeus* (Olivier, 1790) | VU | PR | | | 1 | 1 |
| Endomychidae | *Endomychus coccineus* (Linnaeus, 1758) | LC | SX | | 1 | 2 | |
| Erotylidae | *Dacne bipustulata* (Thunberg, 1781) | LC | MB | | 1 | | |
| Erotylidae | *Tritoma bipustulata* (Fabricius, 1775) | LC | MB | | 11 | | |
| Erotylidae | *Triplax lacordairii* (Crotch 1870) | NT | MB | | 2 | | |
| Eucnemideae | *Melasis buprestoides* (Linnaeus, 1760) | LC | SX | 2 | 8 | 7 | |
| Latriidae | *Cartodere* (*Aridius*) *nodifer* (Westwood, 1839) | LC | MY | 2 | | 1 | |
| Latriidae | *Enicmus brevicornis* (Mannerheim, 1844) | LC | MY | | 3 | | |
| Lucanidae | *Platycerus caraboides* (Linnaeus, 1758) | LC | SX | | | 9 | |
| Lucanidae | *Sinodendron cylindricum* (Linnaeus, 1758) | LC | SX | | 1 | 6 | 1 |
| Lycidae | *Lygistopterus anorachilus* (Ragusa, 1883) | NT | MY | | | | 1 |
| Melandryidae | *Orchesia* (*Clinocara*) *undulata* Kraatz, 1853 | LC | MY | | | 1 | |
| Melandryidae | *Phloiotrya* (*Phloiotrya*) *tenuis* (Hampe, 1850) | NT | MY | | 1 | | |
| Melyridae | *Aplocnemus* (*Aplocnemus*) *nigricornis* (Fabricius, 1792) | LC | PR | 1 | 4 | 1 | |
| Melyridae | *Dasytes* (*Mesodasytes*) *plumbeus* (Müller, 1776) | LC | PR | 40 | 20 | 105 | 9 |
| Melyridae | *Dasytes* (*Metadasytes*) *caeruleus* (De Geer, 1774) | LC | PR | 1 | | | |
| Mycetophagidae | *Mycetophagus (Ulolendus) atomarius* (Fabricius, 1787) | LC | MY | | 5 | 6 | |
| Mycetophagidae | *Mycetophagus quadripustulatus* (Linnaeus, 1761) | LC | MY | | 1 | | |
| Mycetophagidae | *Typhaea stercorea* (Linnaeus, 1758) | LC | MY | | | 1 | |
| Monotomidae | *Rhizophagus* (*Rhizophagus*) *bipustulatus* (Fabricius, 1792) | LC | MY | | 3 | 9 | |
| Nitidulidae | *Epuraea unicolor* (Olivier, 1790) | LC | SF | 1 | | | |
| Oedemeridae | *Ischnomera cinerascens* (Pandellé in Grenier, 1867) | LC | SX | | 1 | | |
| Ptinidae | *Grynobius planus* (Fabricius, 1787) | LC | XY | | 1 | 2 | |
| Ptinidae | *Hadrobregmus denticollis* (Creutzer, 1796) | LC | XY | | 1 | | 1 |
| Ptinidae | *Hemicoelus costatus* (Aragona, 1830) | LC | XY | 22 | 103 | 51 | 38 |
| Ptinidae | *Ptilinus pectinicornis* (Linnaeus, 1758) | LC | XY | | | 5 | |
| Ptinidae | *Ptinomorphus imperialis* (Linnaeus, 1767) | LC | XY | 1 | 2 | 1 | 1 |
| Salpingidae | *Salpingus planirostris* (Fabricius 1787) | LC | SX | 12 | 15 | 39 | 8 |
| Salpingidae | *Salpingus ruficollis* (Linnaeus, 1761) | NT | SX | 3 | 1 | 6 | |
| Salpingidae | *Sphaeriestes* (*Sphaeriestes*) *stockmanni* (Biström, 1977) | NT | SX | | | 1 | |
| Scarabaeidae | *Gnorimus nobilis* (Linnaeus, 1758) | NT | SX | | | 1 | 1 |
| Scarabaeidae | *Trichius fasciatus* (Linnaeus, 1758) | LC | SX | | | 4 | |
| Scraptiidae | *Anaspis lurida* (Stephens, 1832) | LC | SX | | 1 | | |
| Staphylinidae | *Phloeostiba plana* (Paykull, 1792) | LC | SX | | 1 | | |
| Tenebrionidae | *Bolitophagus reticulatus* (Linnaeus, 1767) | VU | MY | 1 | | | |
| Tenebrionidae | *Osphya bipunctata* (Fabricius, 1775) | LC | MY | | | 1 | |

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| Family | Species | IUCN | Trophic categories | HN | LN | HS | LS |
|---|---|---|---|---|---|---|---|
| Trogossitidae | *Nemozoma elongatum* (Linnaeus, 1760) | LC | PR | 2 | 2 | | 2 |
| Zopheridae | *Bitoma crenata* (Fabricius, 1775) | LC | SX | | 1 | | |
| Zopheridae | *Coxelus pictus* (Sturm, 1807) | LC | SX | | | 1 | |
| Zopheridae | *Synchita undata* (Guérin-Méneville, 1844) | NT | SX | | 1 | | |
| Zopheridae | *Synchita variegata* (Hellwig, 1792) | LC | SX | | 3 | 1 | |

**Tab. S2** - GLMs for the relationship between species abundance and variables related with topography and forest structure. Model deviance and significance for each variable. The model is a negative binomial GLM with species as a fixed effect and a species by environment interaction.

| **Models** | **Predictor** | **Deviance** | **Pr(>Dev)** | **Sign.** |
|---|---|---|---|---|
| Topographical models | Elevation: Low | 64.66 | 0.001 | *** |
| | Exposure: South | 43.56 | 0.01 | ** |
| Microhabitat models | Insect galleries and bore holes | 23.17 | 0.243 | |
| | Perennial fungal fruiting bodies | 34.13 | 0.06 | . |
| CWD models | Minimum diameter | 64.45 | 0.001 | *** |
| | Maximum diameter | 70.13 | 0.001 | *** |
| | Length | 13.94 | 0.765 | |
| | Decay state | 29.11 | 0.105 | |
| | Volume ($m^3$) | 35.93 | 0.036 | * |
| | CWD PC1 (positively correlated with all the CWD variables, explaining 50% total variance) | 58.03 | 0.004 | ** |
| STUMP models | Base diameter | 77.25 | 0.003 | ** |
| | Top diameter | 83.72 | 0.001 | *** |
| | Height | 74.9 | 0.002 | ** |
| | Decay state | 19.02 | 0.361 | |
| | Volume ($m^3$) | 83.86 | 0.001 | *** |
| | STUMP PC1 (positively correlated with all the STUMP variables, explaining 74% total variance) | 81.19 | 0.001 | *** |

**Fig. S1** - Species coefficients for the model species abundance vs. elevation. Multivariate species distribution model which predicts the abundance of each of the 17 most abundant species (>5 individuals) based only on plot elevation.

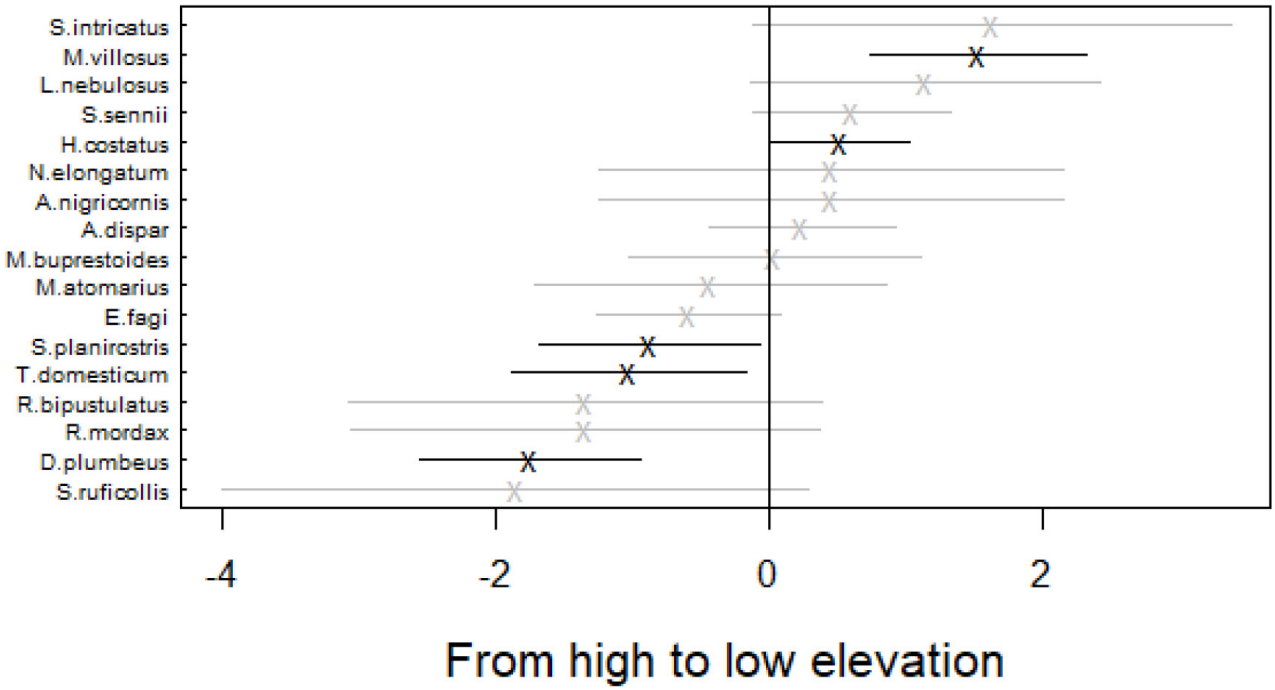

**Fig. S2** - Species coefficients for the model species abundance vs. exposure. Multivariate species distribution model which predicts the abundance of each of the 17 most abundant species (>5 individuals) based only on slope exposure.

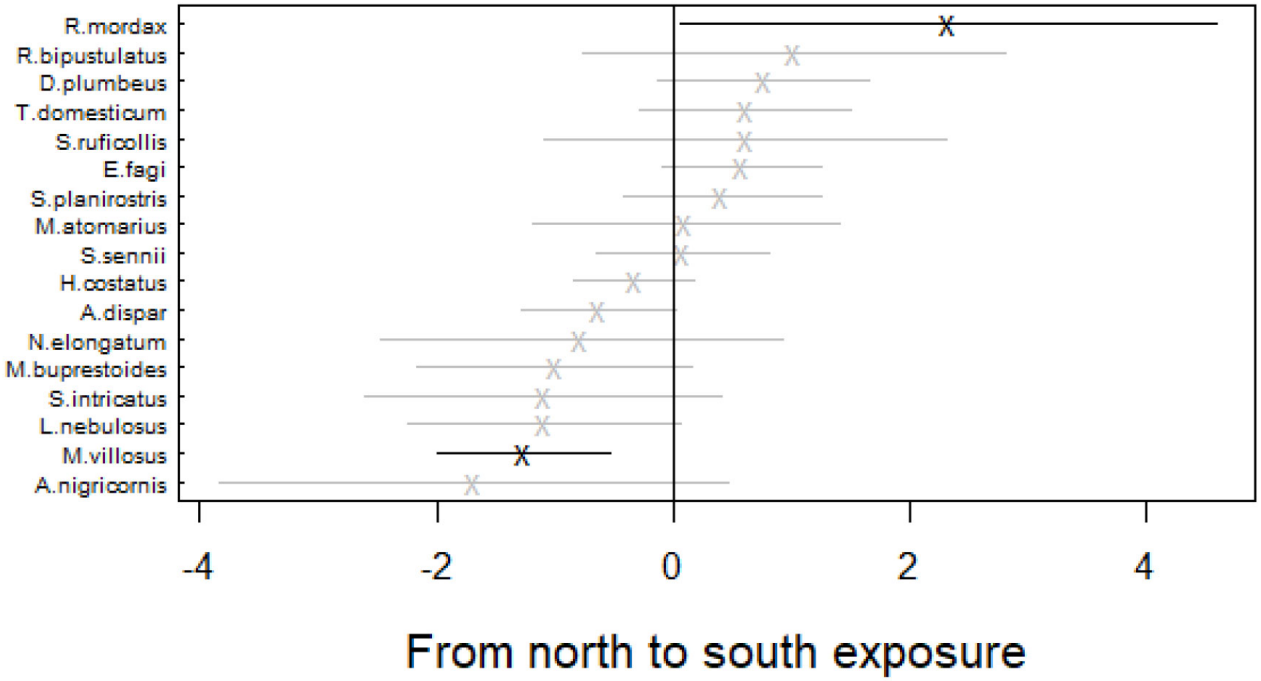

**Fig. S3** - Species coefficients for the model species abundance vs. insect galleries. Multivariate species distribution model which predicts the abundance of each of the 17 most abundant species (>5 individuals) based only on insect galleries.

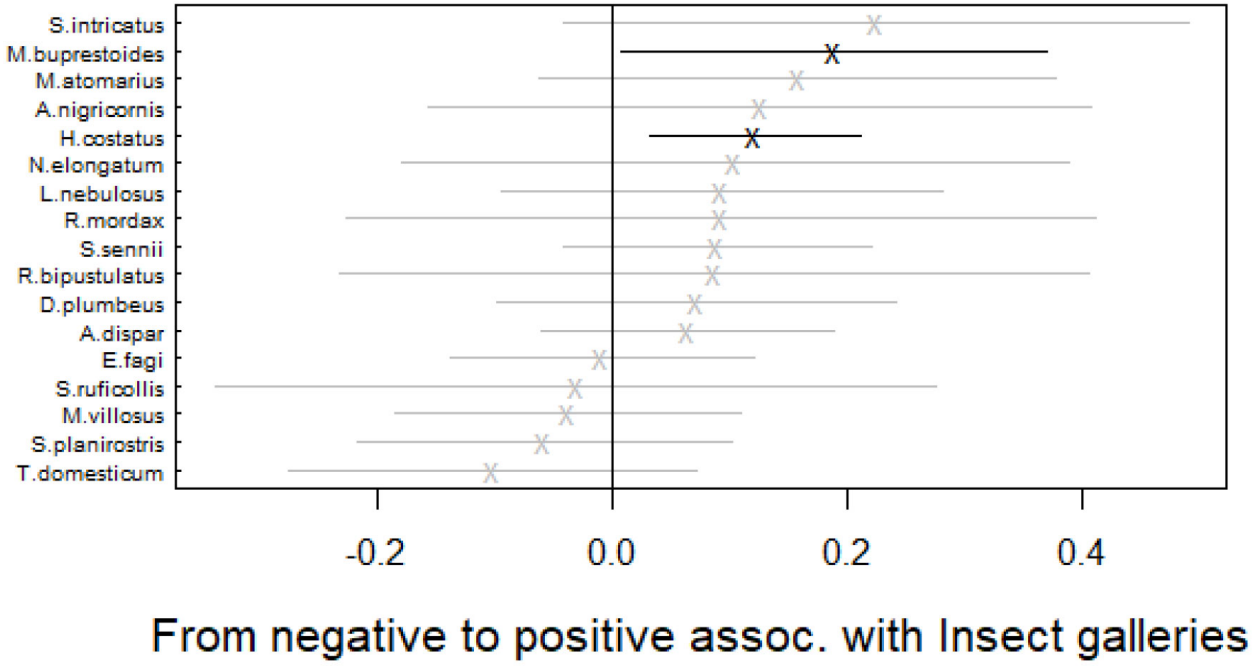

**Fig. S4** - Species coefficients for the model species abundance vs. perennial fungi. Multivariate species distribution model which predicts the abundance of each of the 17 most abundant species (>5 individuals) based only on perennial fungi.

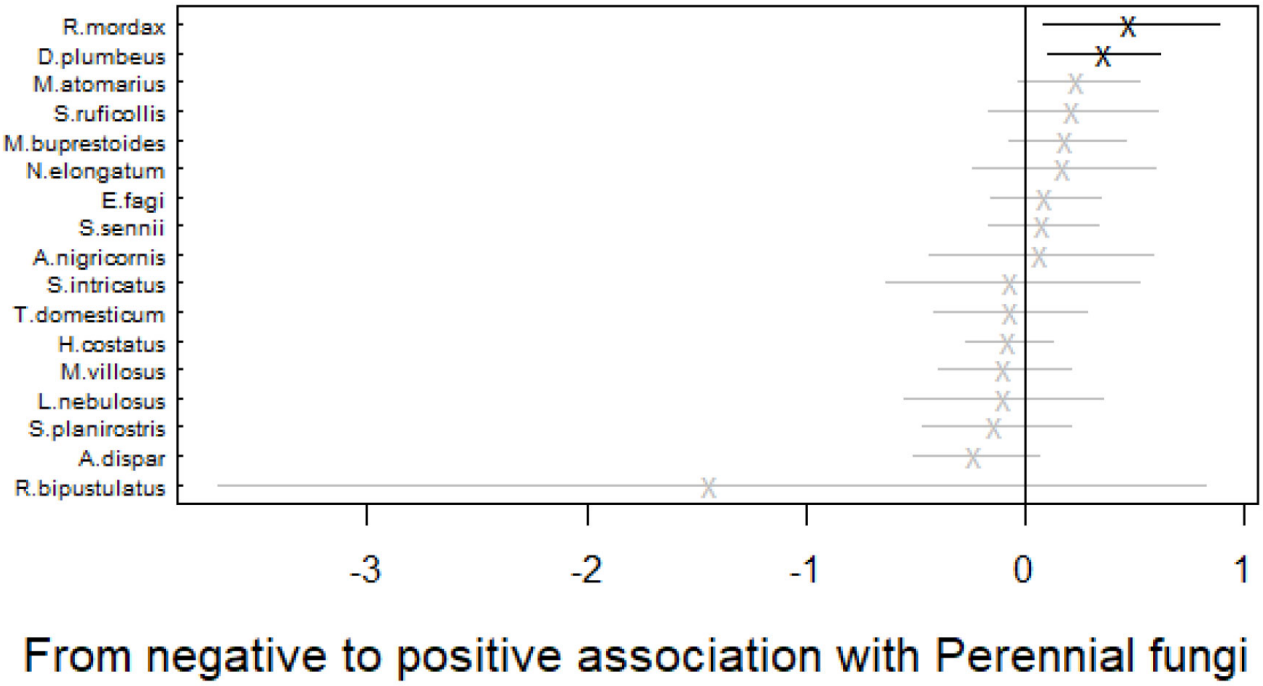

**Fig. S5** - Species coefficients for the model species abundance vs. CWD PC1. Multivariate species distribution model which predicts the abundance of each of the 17 most abundant species (>5 individuals) based only on CWD PC1.

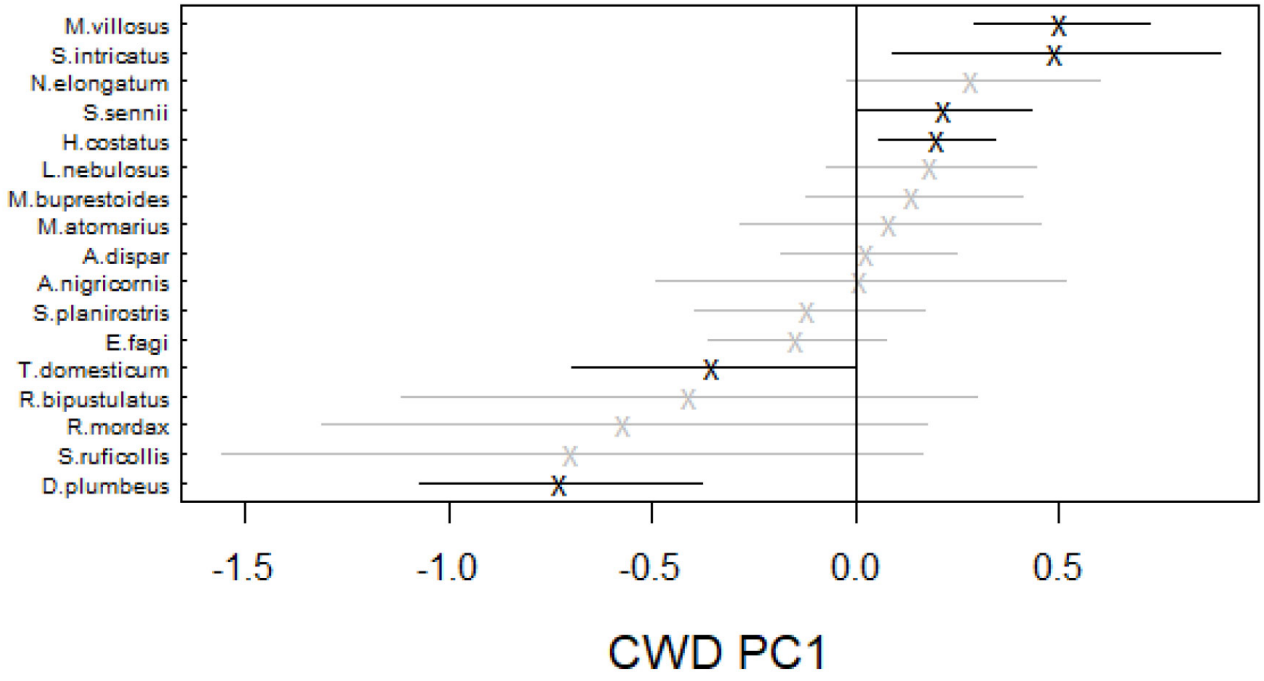

**Fig. S6** - Species coefficients for the model species abundance vs. STUMP PC1. Multivariate species distribution model which predicts the abundance of each of the 17 most abundant species (>5 individuals) based only on STUMP PC1.