# Trait–Service Links

A compact summary linking plant functional traits to ecosystem services.

| Ecosystem Service (Category) | Key Plant Traits (examples) | Typical Effect (direction) | Why it matters (short rationale) |
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| Biomass (Provisioning) | Specific leaf area (SLA); Leaf N; Leaf dry matter content (LDMC); Max height; Wood density; Leaf area/LAI | SLA ↑, Leaf N ↑, Max height ↑ → biomass ↑; LDMC ↑ → biomass ↓; Wood density ↑ → standing biomass ↑ | Leaf “economic” traits control photosynthesis/growth; height and canopy capture light; dense wood stores C longer. |
| Net Primary Productivity (Provisioning) | Leaf N; SLA; LDMC; Max height; Leaf P; Stomatal conductance | Leaf N ↑, SLA ↑, Leaf P ↑, Stomatal conductance ↑, Max height ↑ → NPP ↑; LDMC ↑ → NPP ↓ | Higher nutrient content and gas exchange boost photosynthesis; tall canopies intercept more light. |
| Soil Organic Carbon (Regulating) | Wood density; Litter quality (C:N, lignin, tannins, LDMC); Root depth/biomass/fineness | Wood density ↑, lignin/tannins ↑, Leaf C:N ↑, LDMC ↑ → SOC ↑; Root depth/biomass ↑ → SOC ↑ | Slow-turnover tissues and deeper roots increase carbon residence time and belowground C inputs. |
| Water Regulation (Regulating) | Canopy architecture/LAI/height; Root depth/length density/SRL; Stomatal conductance; SLA; Phenology | Canopy/roots ↑ → infiltration/baseflow ↑, peak runoff ↓; High conductance/SLA → ET ↑ (cooling, but water yield can ↓) | Structure intercepts rain and improves infiltration; ET traits modulate water flux and cooling. |
| Temperature Regulation (Regulating) | Canopy architecture/LAI/height; SLA; Stomatal conductance | Canopy ↑, ET traits ↑ → stronger cooling (air/surface temps ↓) | Shading and evapotranspiration dissipate heat and reduce local temperatures. |
| Soil Retention (Regulating) | Root tensile strength; Root length density; Specific root length (SRL); Root depth; Fibrous roots; Ground cover/life form | Strong/fibrous/deep roots ↑, ground cover ↑ → erosion ↓, soil stability ↑ | Roots bind soil and resist shear; cover reduces raindrop impact and overland flow. |
| Biocontrol (Regulating) | Floral traits: flowering time/duration; flower height/density; nectar type/access; flower shape/symmetry; color/UV; Canopy complexity | Better floral resource timing/access/visibility ↑ → natural enemies & parasitoids ↑ → pests ↓ | Floral resources and structure support enemies of pests (and pollinators), enhancing top-down control. |
| Soil Fertility (Supporting) | Litter quality: Leaf N, Leaf P, LDMC, lignin/tannins; Root traits; Mycorrhiza | Leaf N/P ↑, LDMC/lignin/tannins ↓ → decomposition/mineralization ↑ → fertility ↑ | Nutrient-rich, labile litter cycles faster; roots and fungi accelerate nutrient turnover. |
| Pollination (Supporting) | Flowering phenology (timing/duration); Flower height/density; Nectar type/access; Flower shape/symmetry; Color/UV reflectance | Alignment of phenology + accessible/attractive flowers ↑ → pollinator visits ↑ → pollination ↑ | Timing and accessibility drive pollinator attraction and effectiveness. |

## Notes and Trade-offs

* Faster nutrient cycling vs carbon storage: Leaf N/P ↑ and LDMC/lignin ↓ speed decomposition (fertility ↑) but can reduce SOC storage.
* Cooling vs water yield: Traits that increase ET (SLA, stomatal conductance) enhance temperature regulation but can lower downstream water yield.
* Growth vs longevity: Low wood density species grow fast (NPP ↑) but store less long-lived carbon than high-density wood species.