Relationships between NPP and mean Ellenberg N

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Outline

1. What is NPP?
2. What is Ellenberg N?
3. What use is this?

What is NPP?

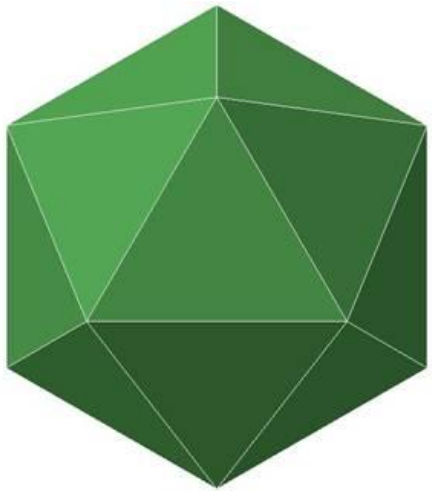
Net Primary Productivity

= the carbon or energy flux into the ecosystem

= Photosynthesis (GPP) – Plant Respiration (R_{plant})
i.e. not including heterotrophic 'respiration'

= A rate, so theoretically measured in amount per time...
... but unmeasurable.

= A platonic concept



What's this stuff then?

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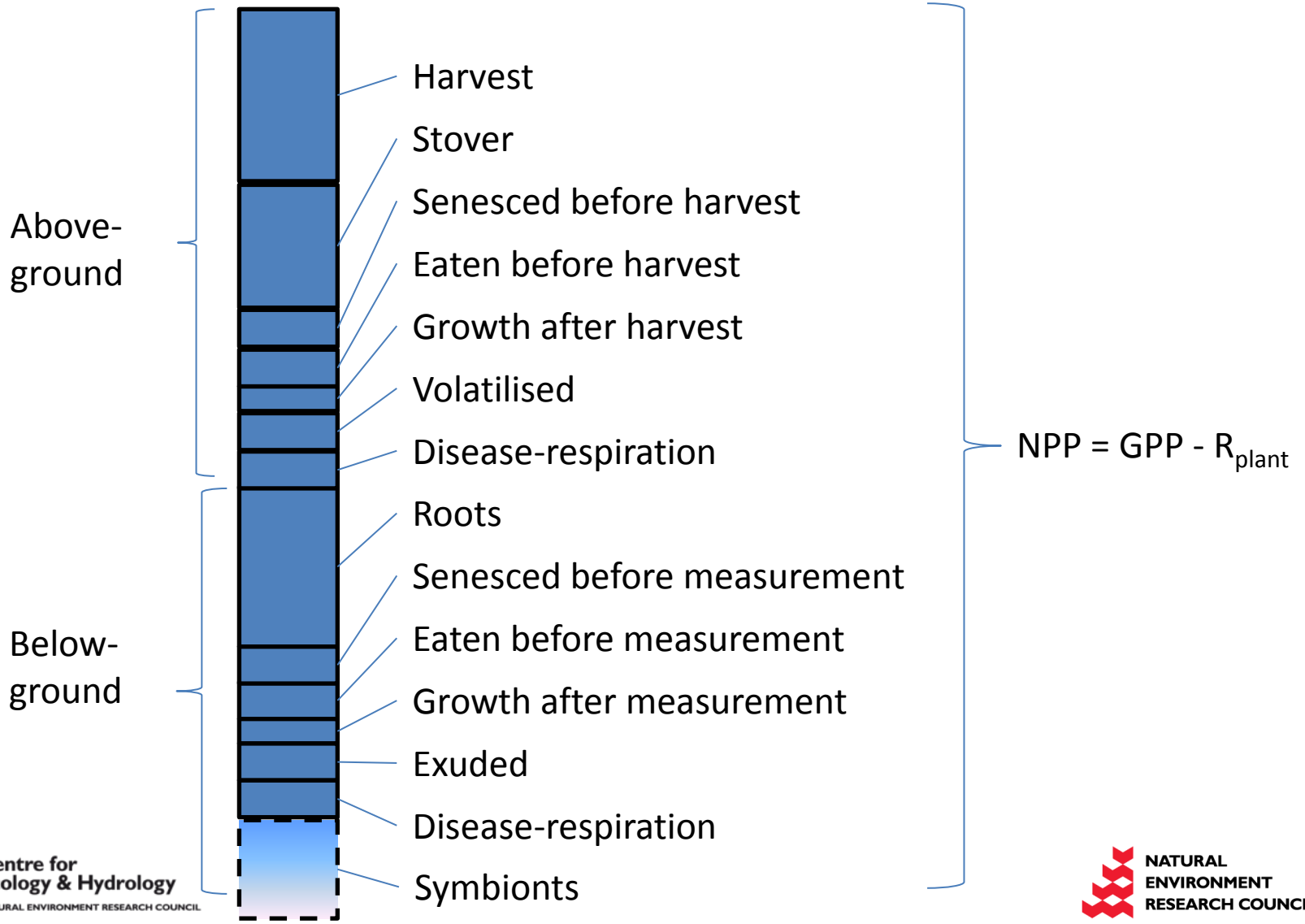

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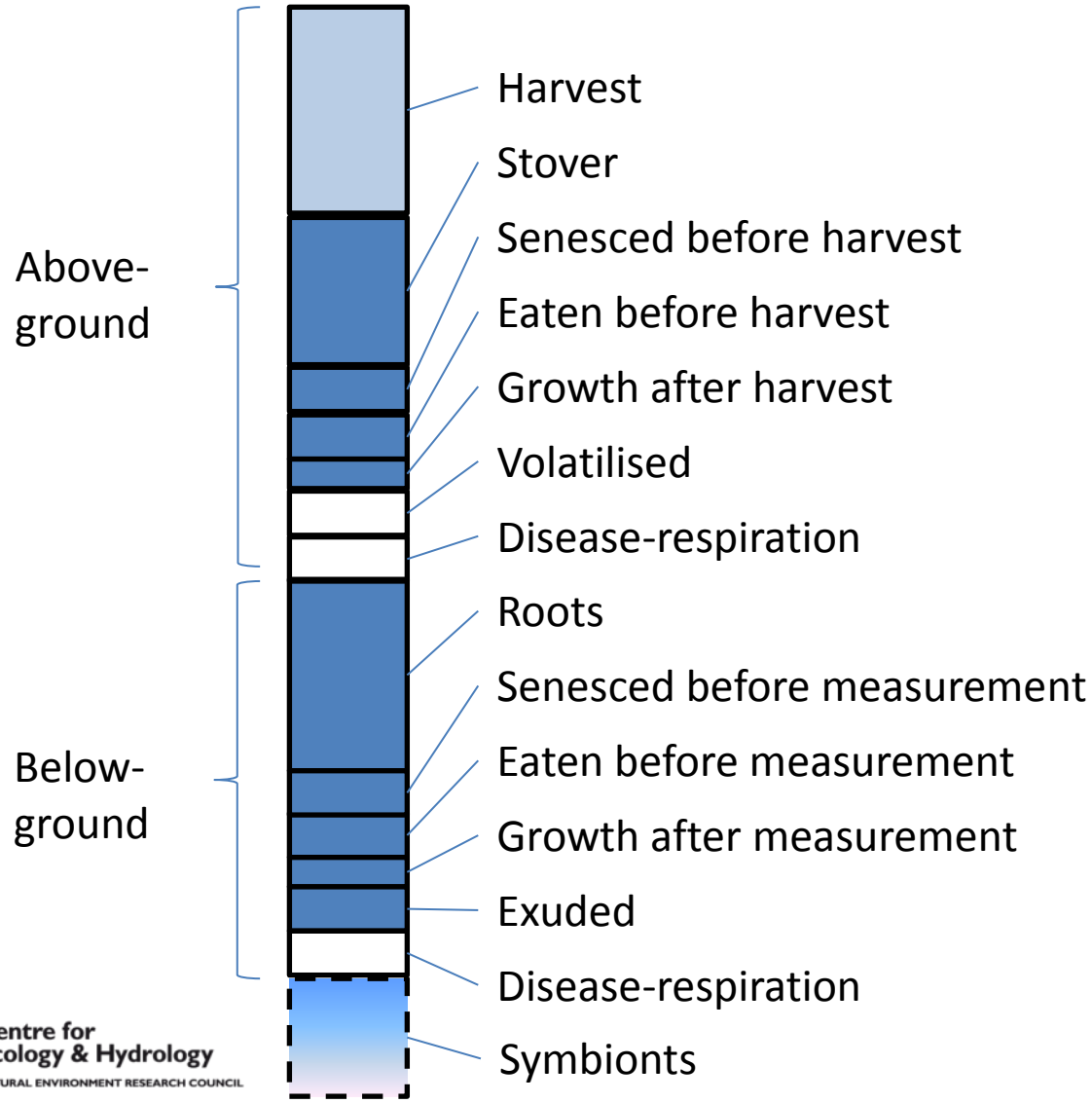
From partial NPP to total NPP

Proportions of total NPP entering different plant pathways

(recalculated from Chapin III 2002 Principles of Terrestrial Ecosystem Ecology)

	Woody mycorrhizal	Herbaceous mycorrhizal	Woody non-mycorrhizal	Herbaceous non-mycorrhizal
	Allocation %			
Herbaceous	33.0	37.0	38.6	44.2
Woody	10.9	0.0	12.7	0.0
Root	25.4	28.5	29.7	34.0
Exudates	14.5	16.3	16.9	19.4
Mycorrhizae	14.5	16.3	0.0	0.0
Volatile emissions	1.8	2.0	2.1	2.4

How much of the NPP gets into soil?



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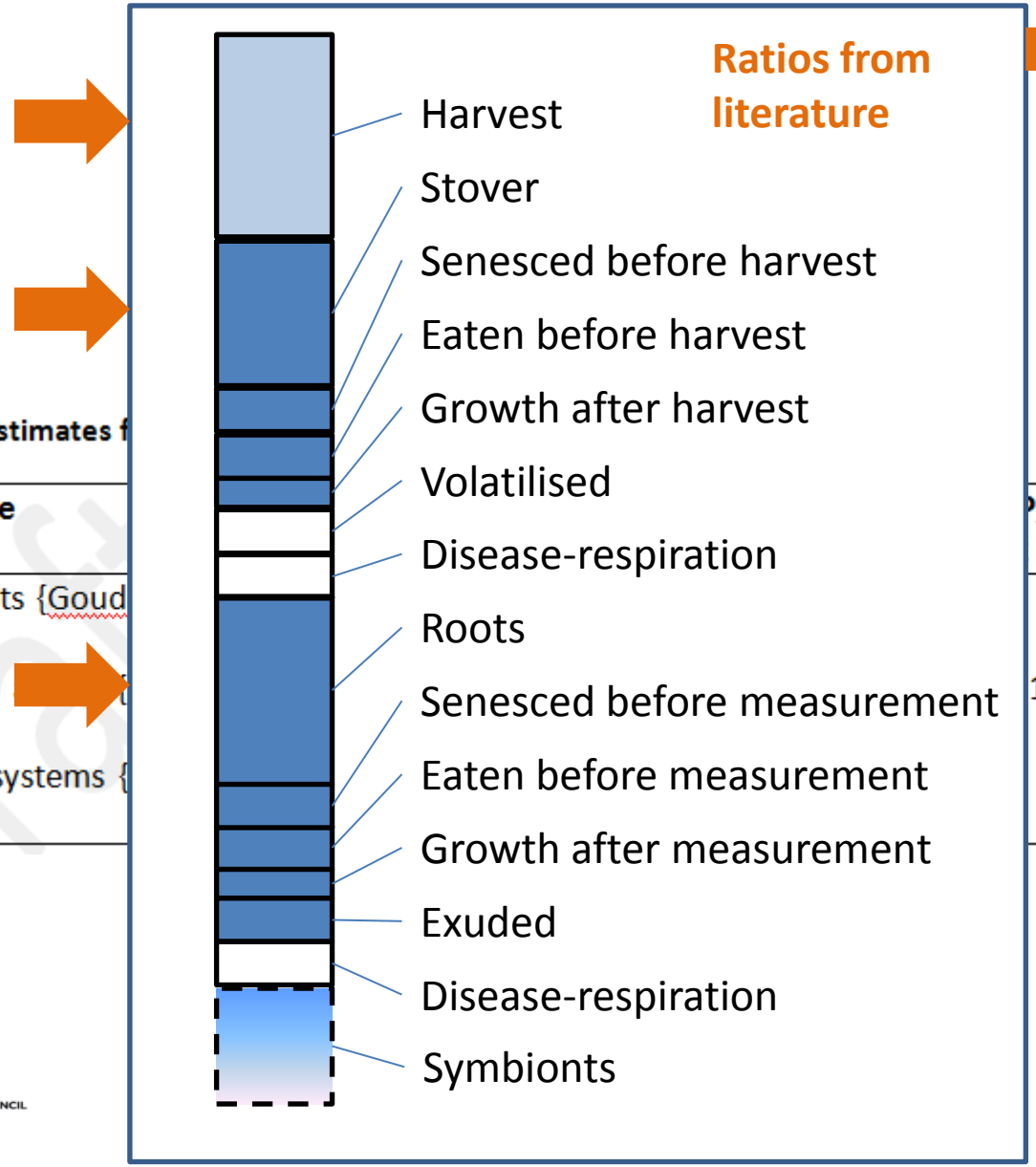
What data do we have? What do we need?

Partial measurements



Ratios from literature

Output indicators
- **C flux into soil**
- **Ground-level light availability**

Table 1. Literature estimates f

System / Reference	, Mol total m^{-2} mo^{-1}
Temperate C3 plants {Goud #2240}	24
Fertilised, irrigated #2231}	18 – 42
Global natural ecosystems { #2128}	53

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NPP from flux measurements

$NPP = GPP - R_{plant}$

- leaf-scale gas exchange
- chambers
- Eddie Towers
- ^{13}C & ^{14}C tracing

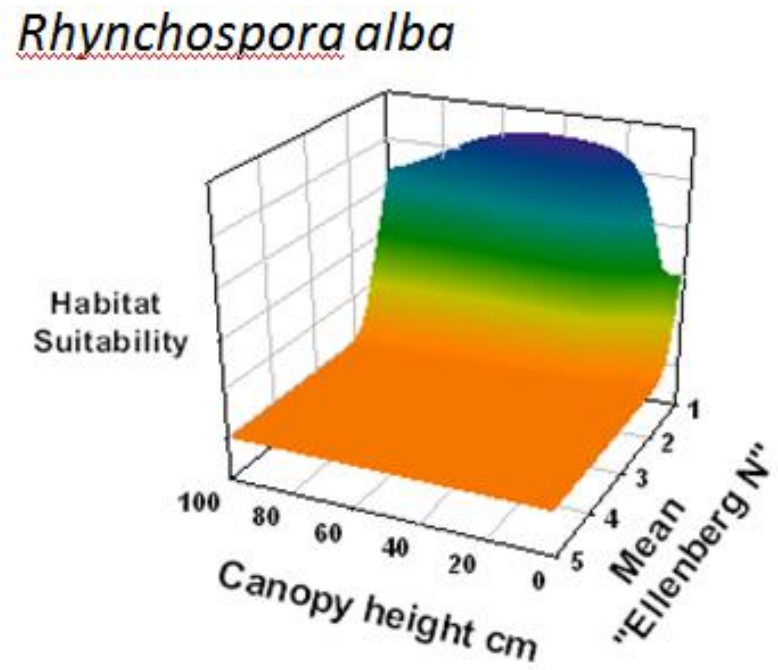
→ not easy
→ partial measurements

NPP from plant traits?

Plant species have environmental requirements...
so, the species that thrive indicate site conditions.

Environmental indicators based on species occurrence:

- provide an integrated measure of preceding conditions
- can be measured cheaply and
- with less error than physicochemical measurements



What is Ellenberg N?

Prof Ellenberg assigned indicator-values to Central European plant species (modified for UK species by Mark Hill *et al.*)

Ellenberg ‘F’ = water availability
Ellenberg ‘L’ = light availability
Ellenberg ‘R’ = reaction to HCl, ~ alkalinity
Ellenberg ‘S’ = salinity
Ellenberg ‘T’ = annual temperature
Ellenberg ‘C’ = continentality, ~ annual temperature range
Ellenberg ‘N’ = “nutrient” or “nitrogen” availability

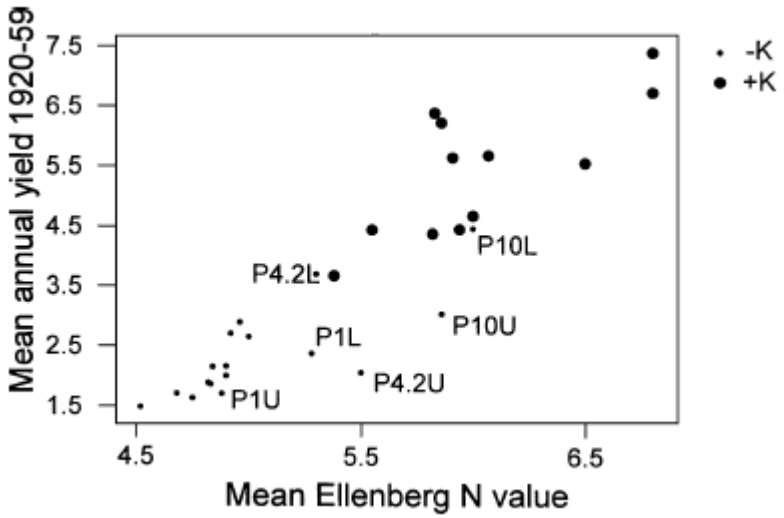
What is Ellenberg N?

Journal of Vegetation Science 8: 579-586, 1997

Prediction of yield in the Rothamsted Park Grass Experiment by Ellenberg indicator values

Hill, M.O. & Carey, P.D.

Fig. 1. Annual yield of herbage (t/ha) in relation to mean Ellenberg N and potassium fertilizer additions.



"Annual yield of hay varied from 1.5 to 7.4 t/ha and was well predicted by the unweighted mean Ellenberg N-values (*r = 0.91). ...* The fact that Ellenberg N-values correlated better with yield than with applied nitrogen suggests that they might rather be called productivity values."

What use is this?

NPP is a fundamental and distinctive property of ecosystems

Proxies for NPP:

- Mean Ellenberg N score
- Mean typical Specific Leaf Area (e.g. m^2 leaf g^{-1} C)
- NDVI
- Biomass and flux measurements