SUPPORTING INFORMATION
for *in silico Plants*, *diab015*

A short explanation of C-S-R plant strategy theory as applied to Cellular Automaton modelling

A presentation by r.hunt@exeter.ac.uk

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“ The external factors which limit the amount of living and dead plant material present in any habitat may be classified into two categories ”

Opening sentence from Grime JP, 1979.
Plant Strategies and Vegetation Processes
London: John Wiley

Category 1: Stress

Pre-hoc phenomena which ***restrict*** plant production

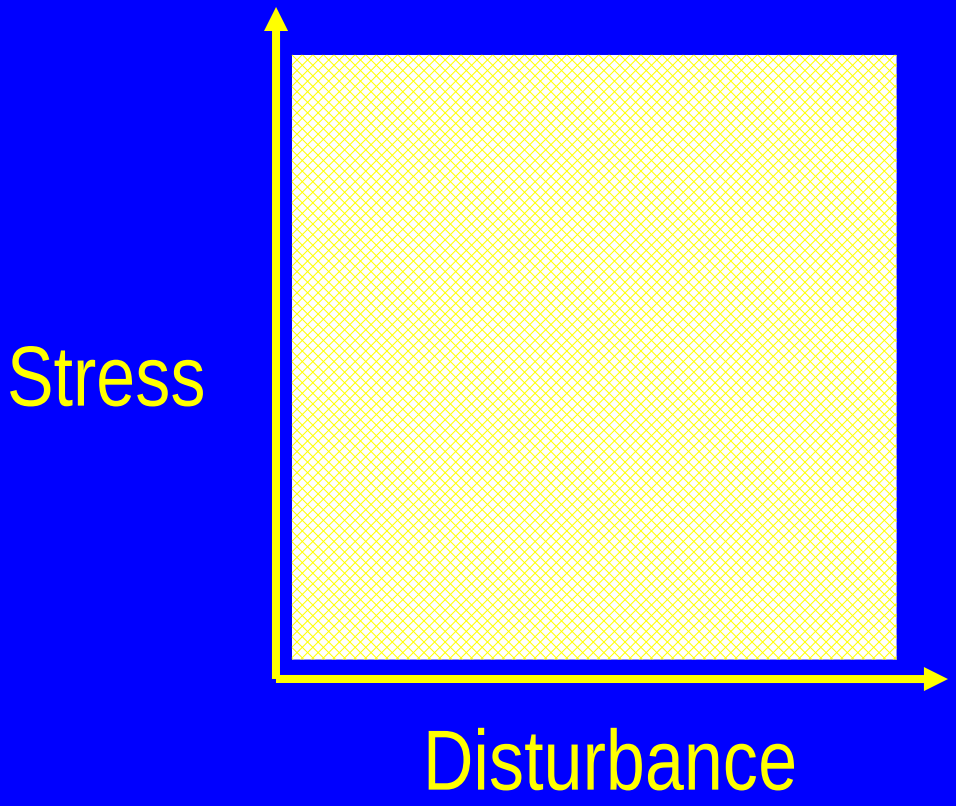
e.g. shortages of light, water, mineral nutrients, or non-optimal temperature

Category 2: Disturbance

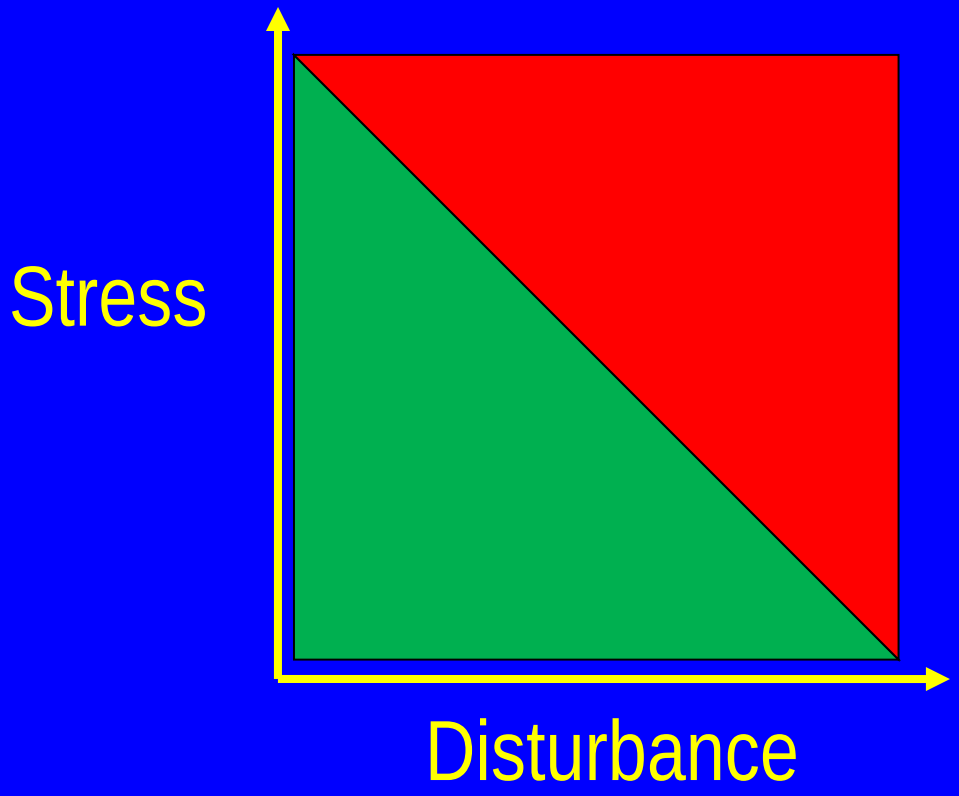
Post-hoc phenomena which ***destroy*** plant production

e.g. herbivory, pathogenicity, trampling, mowing, ploughing, wind damage, frosting, droughting, soil erosion, burning

Individual habitats may exhibit stress and disturbance to any degree and in any combination

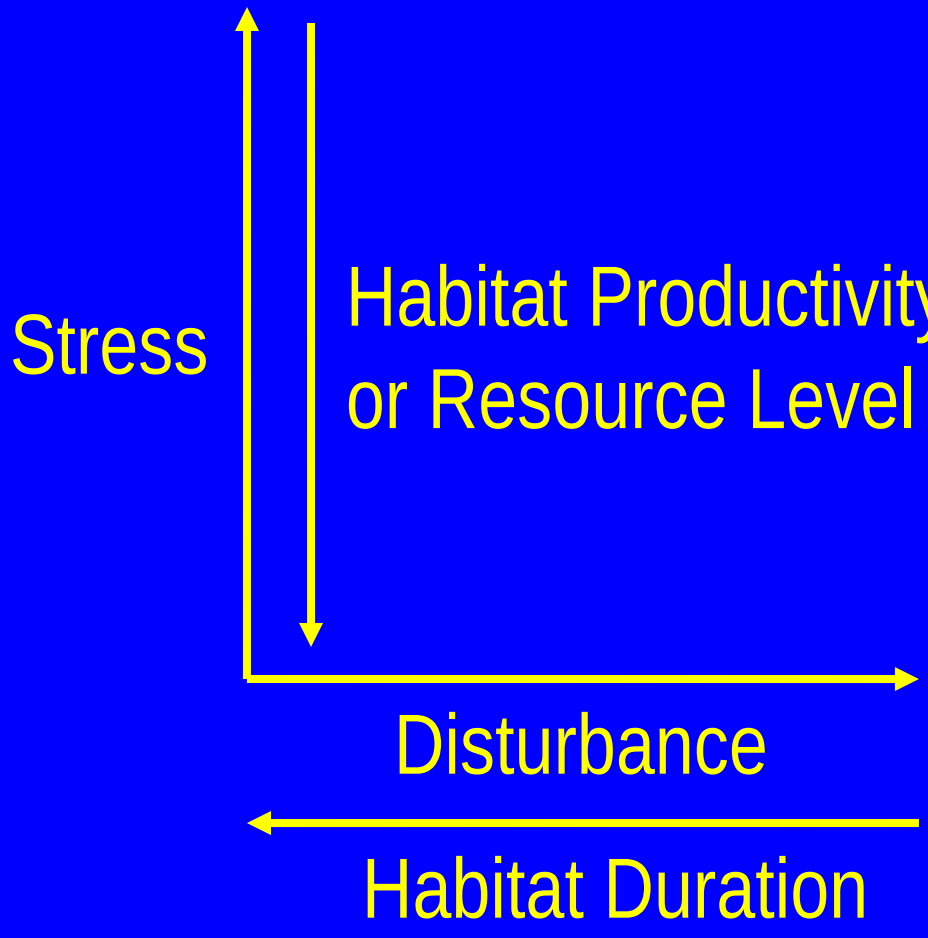


Combinations of low or moderate stress and disturbance can support vegetation …

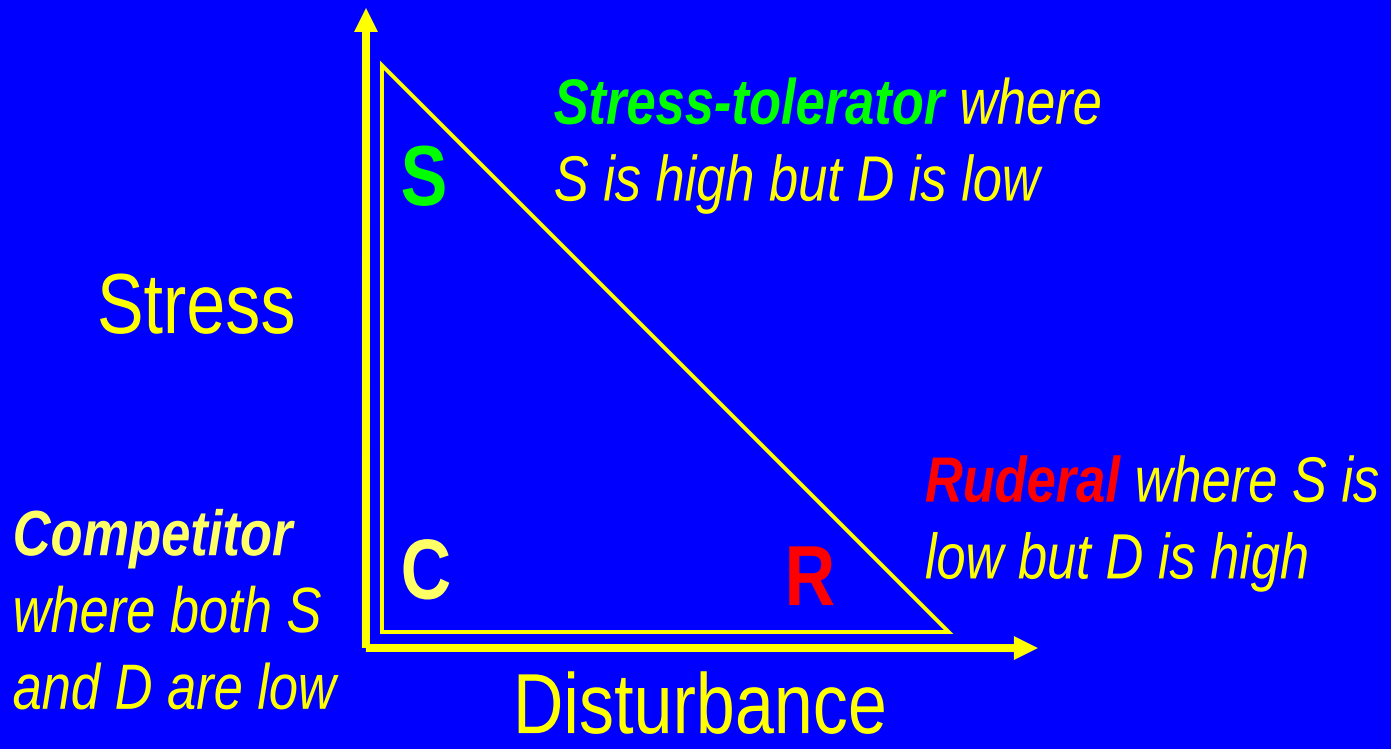


… but extreme combinations of stress and disturbance cannot

There are other ways of describing stress and disturbance

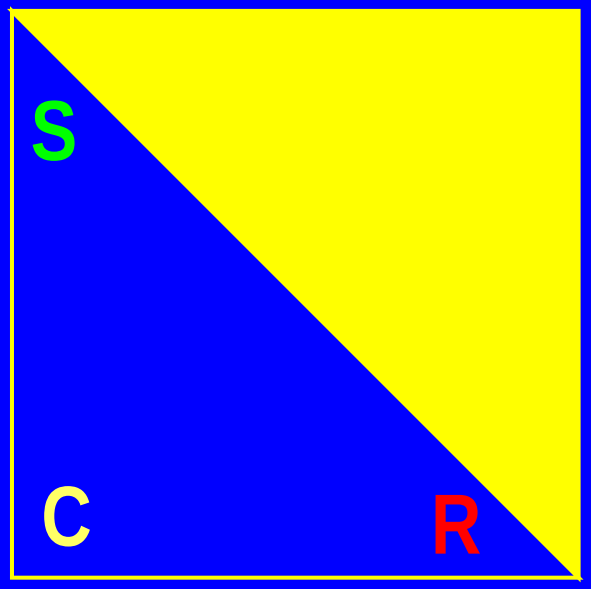


In the domain where vegetation is possible …



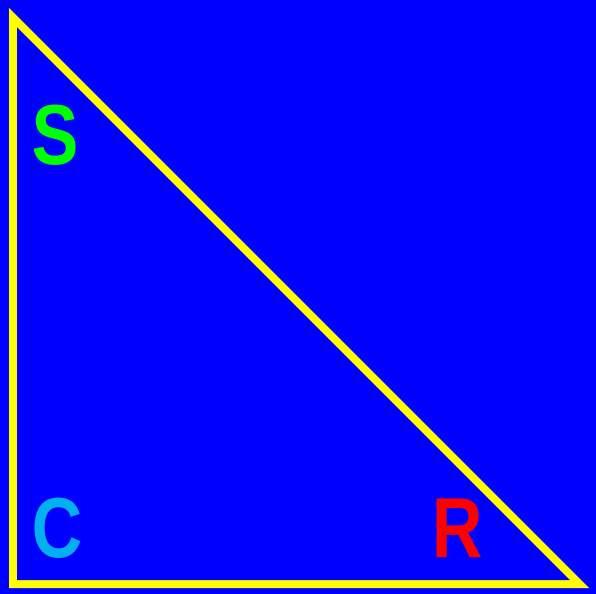
… plant life has evolved distinct strategies for dealing with each combination

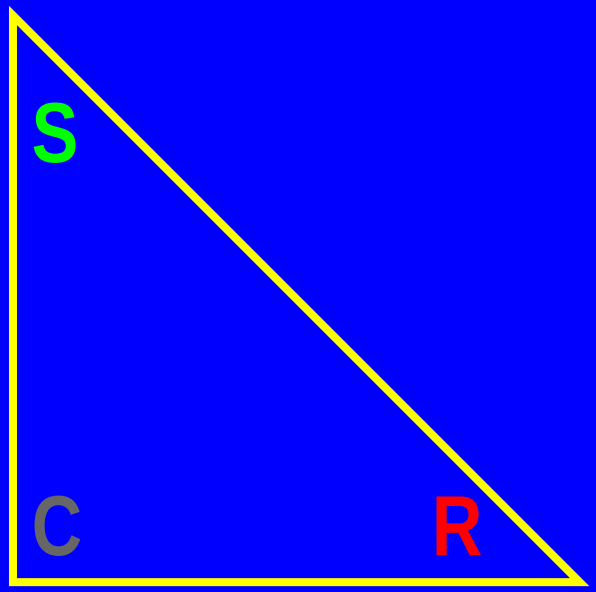
No plant strategies succeed in the ‘impossible domain’

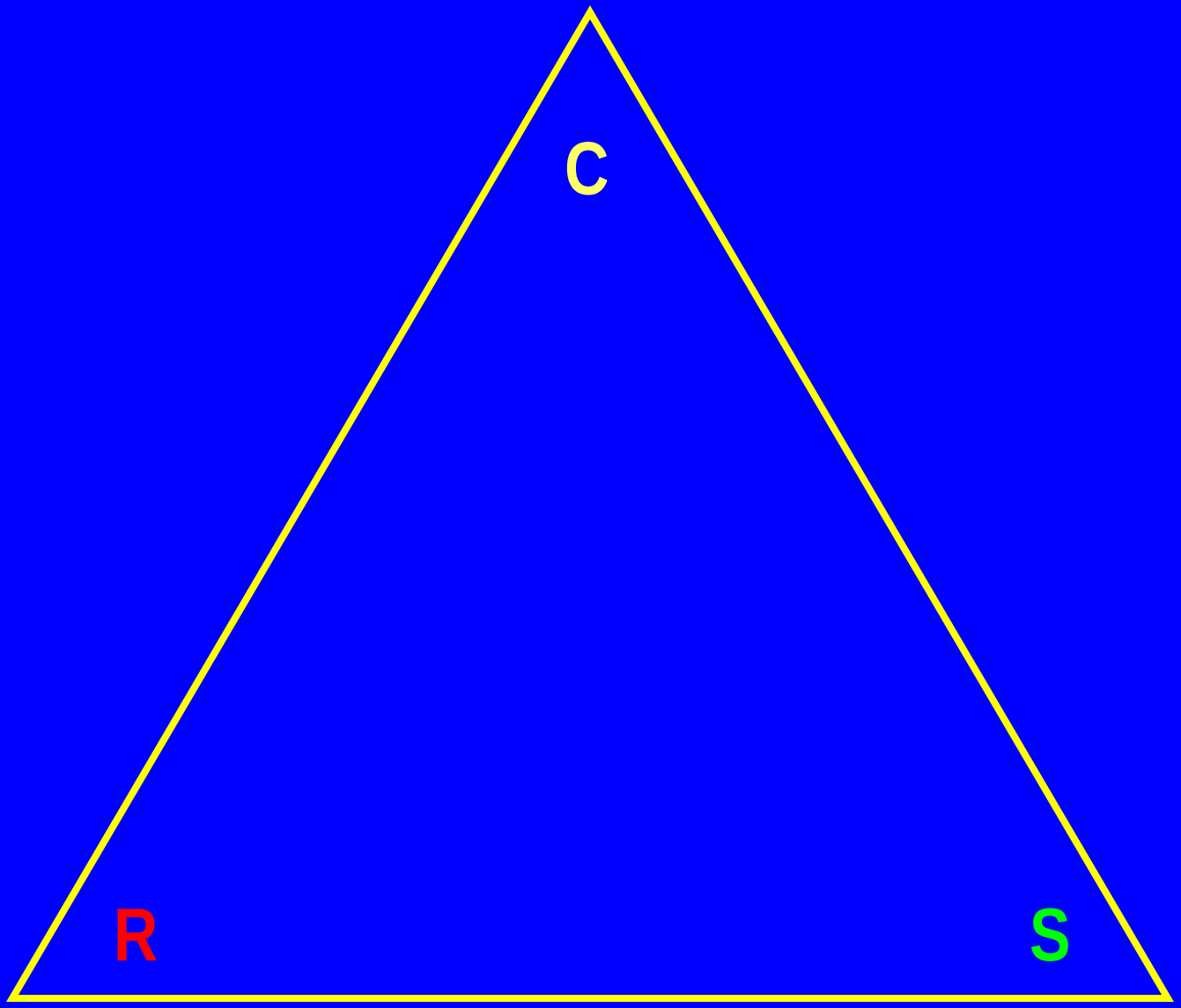


(Different parts of this domain are devoid of vegetation for different reasons, but that is another story)

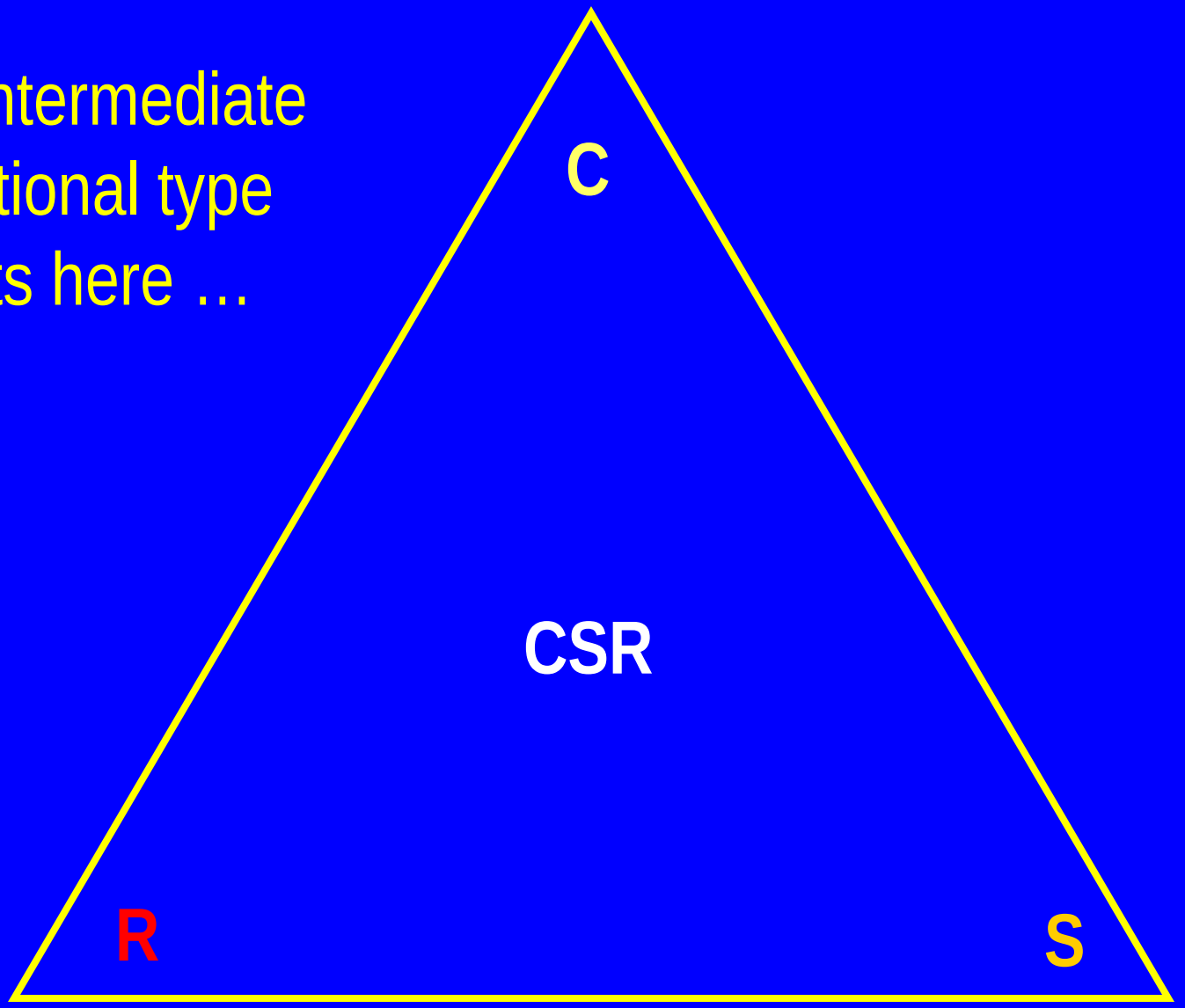
To facilitate quantitative work it is necessary to rearrange the shape of the vegetated domain a little …



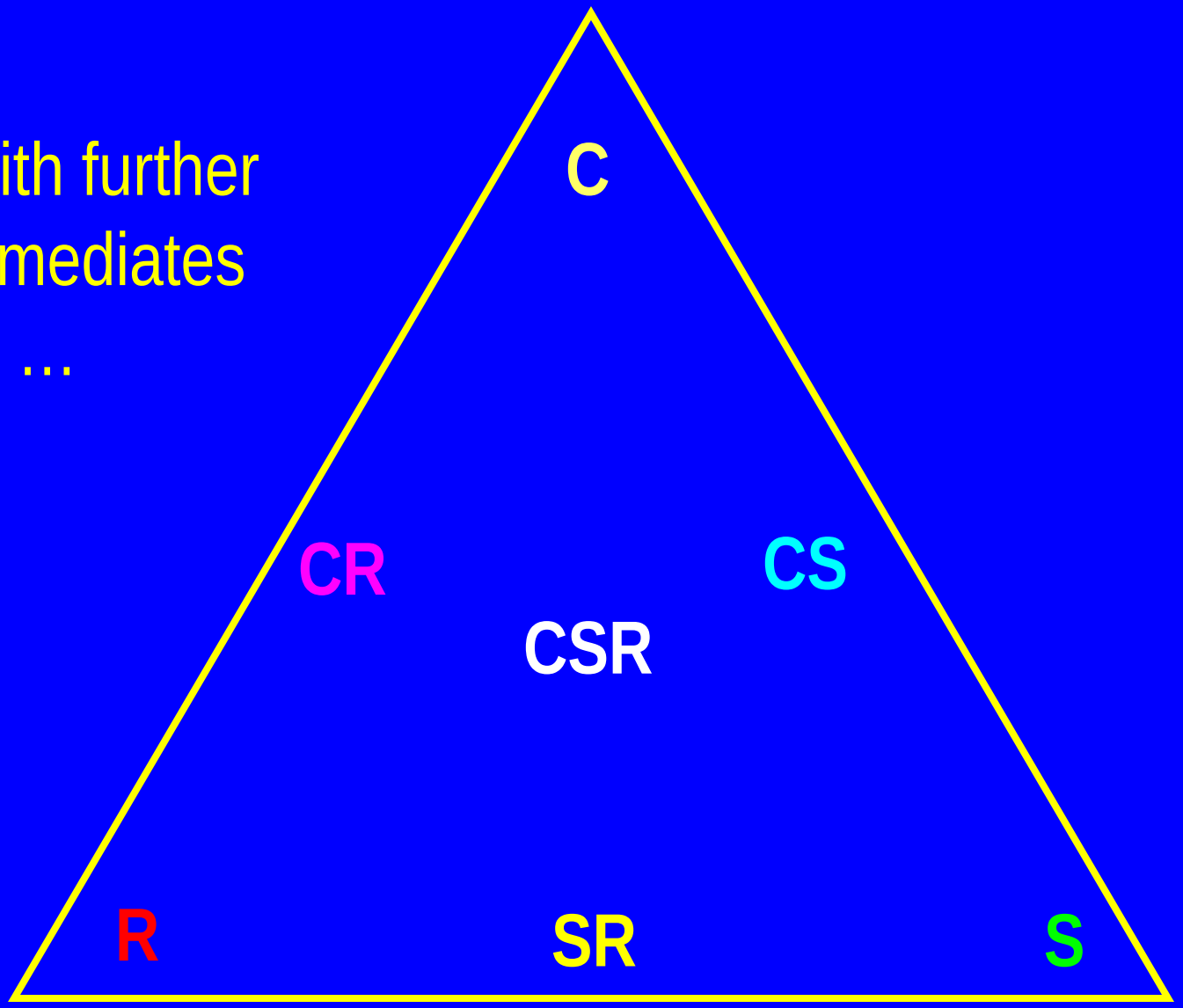

S
C
R


C
R
S

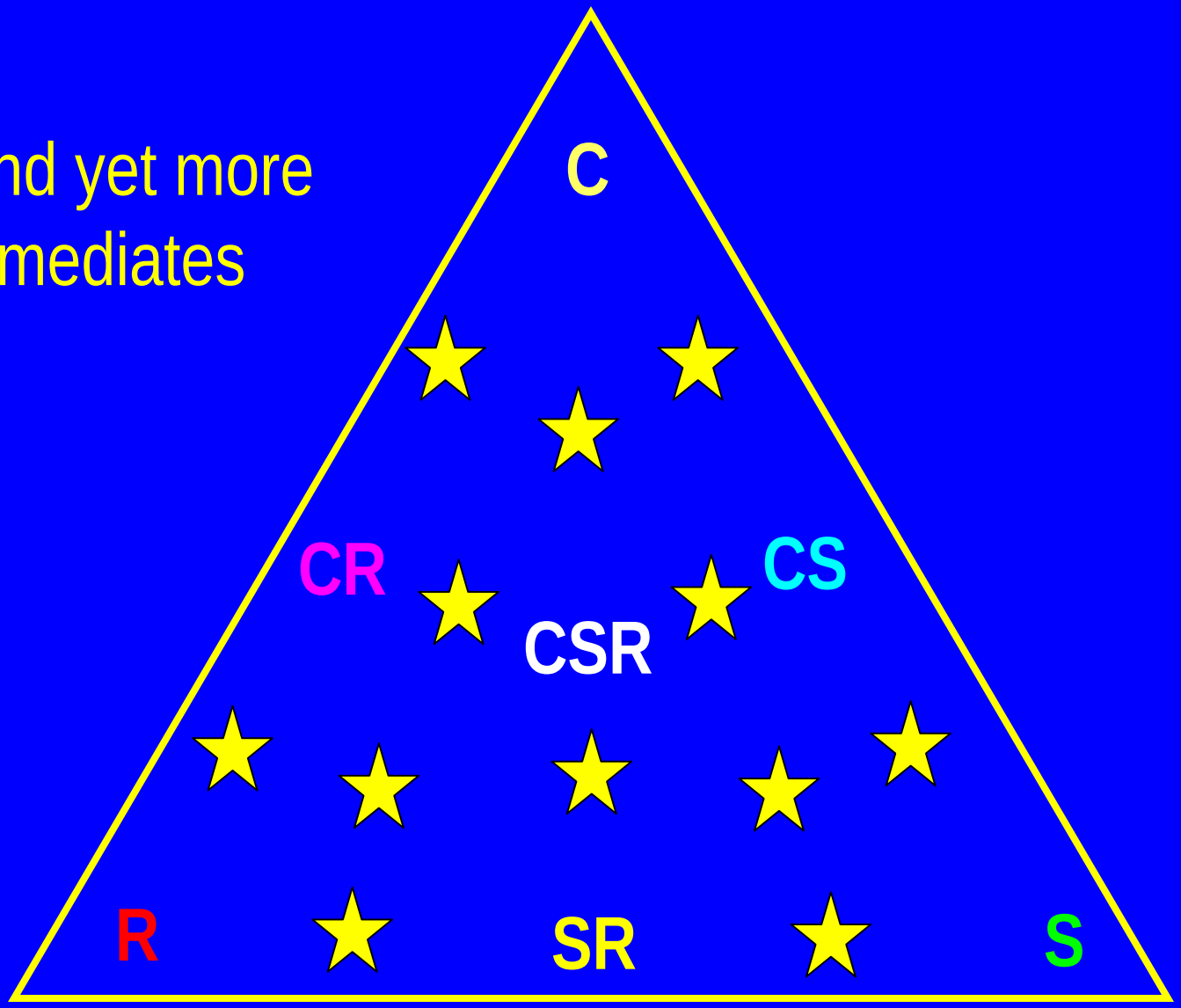
An intermediate functional type exists here …



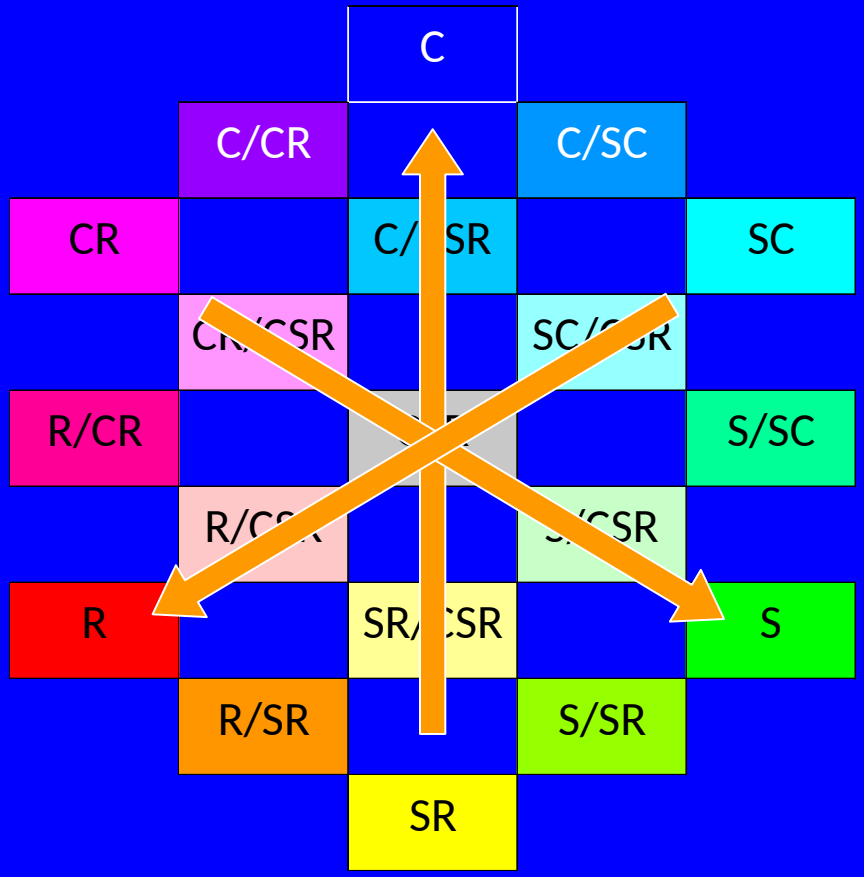
… with further intermediates here …



… and yet more intermediates here



For quantitative work with nineteen functional types we re-model the triangular shape into a hexagon with three symmetrical axes

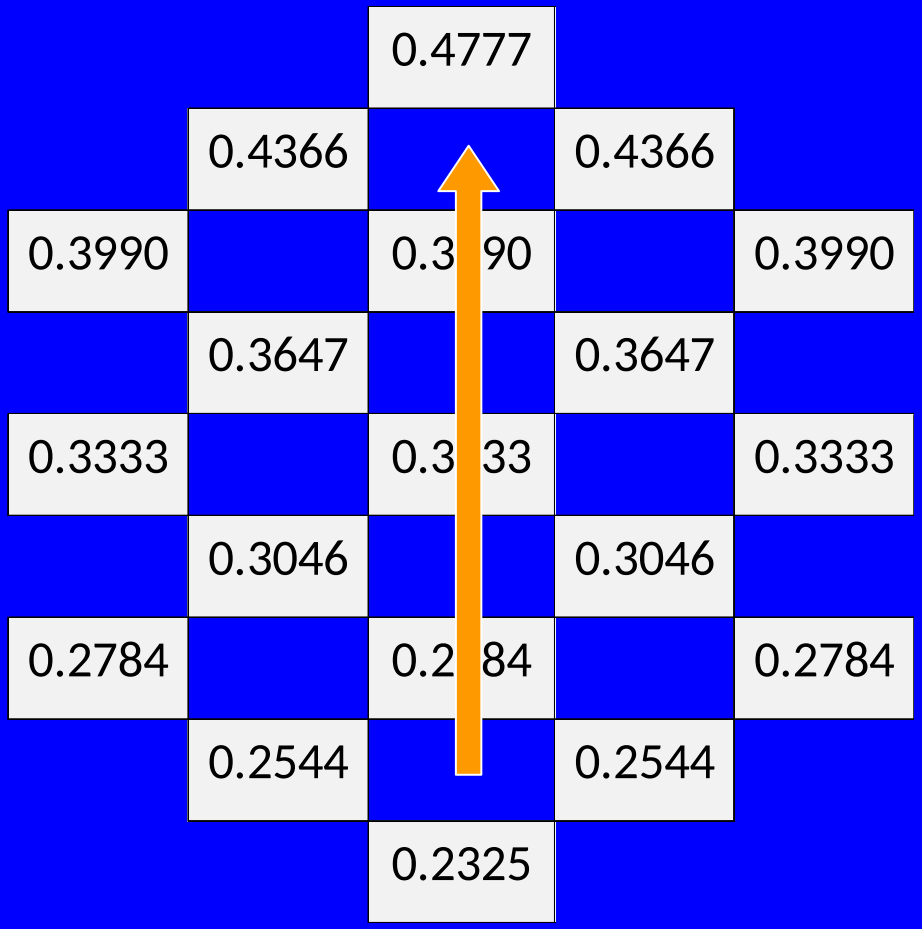


To recreate C-S-R plant functional types within the CA model …

… we flex the specifications controlling the modules' relative ***growth & morphology***, ***maintenance physiology*** and ***reproductive behaviour***

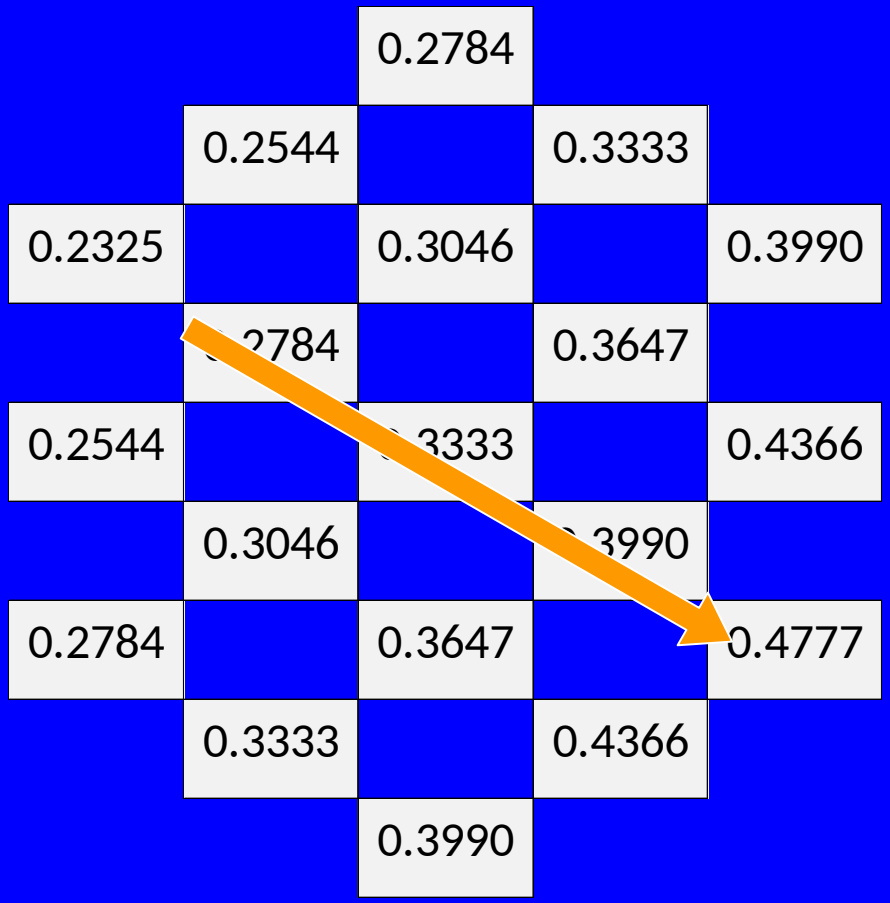
Growth & morphology

These graduated values are probabilities of state change within each iteration of the CA model



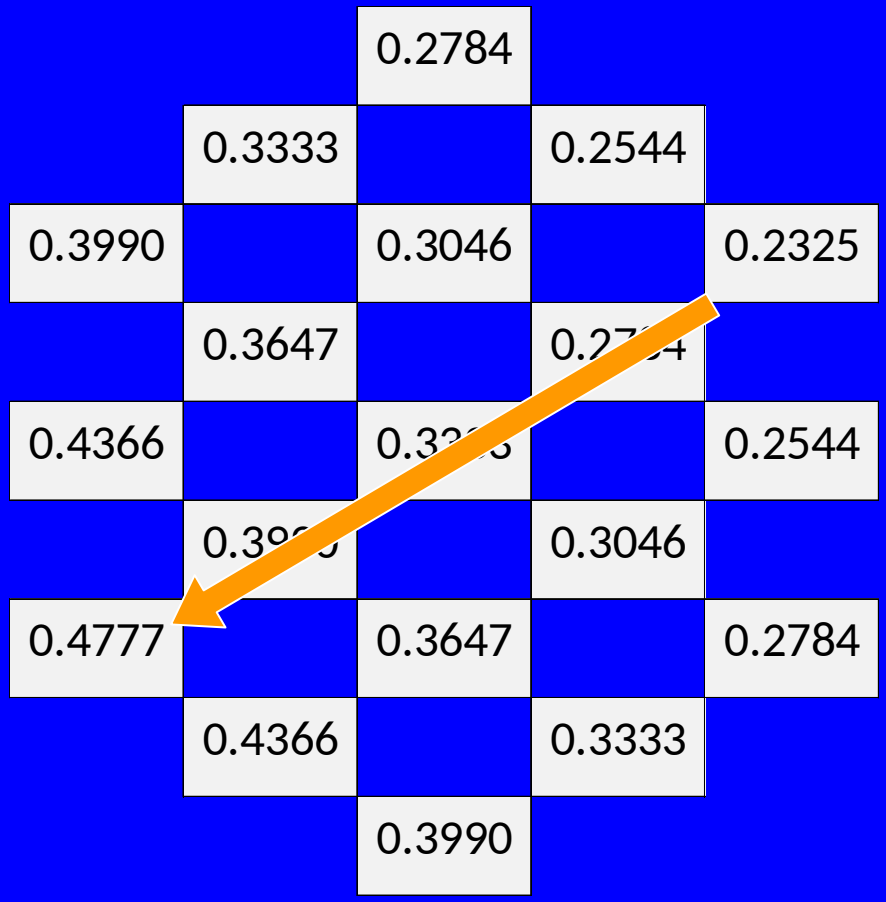
Maintenance physiology

Ditto



Reproductive behaviour

Ditto



One morphological, one physiological, and one reproductive specification describes each of the nineteen plant functional types

However, each specification really represents a ***super-trait***, e.g. tissue longevity in the absence of resource uptake is entrained with relative growth rate, specific leaf area, palatability and decomposability

Nine levels are available within each of the three traits, so a total of 729 different functional types ***could*** be constructed

But we respect evolutionary tradeoffs within each type by requiring values of the three traits to ***sum to unity***. This avoids ***Darwinian demons.*** The modelling is thus restricted to the types seen in real life.

How does all this represent real vegetation?

The high dimensionality of real plant life is reduced to combinations of plant functional type, many of which are duplicated within natural communities

“ There are many more actors on the stage than roles that can be played ”

So what does functional-typing deliver?

Analyses involving functional types provide continuity when the relative abundances, and even the identities, of the constituent plant species are in flux

This makes it possible to link communities which are separate in time and space into one conceptual framework