



Multi-species grasslands: diversity enhances multi-functionality

Guylain Grange, John Finn, Caroline Brophy

Irish context

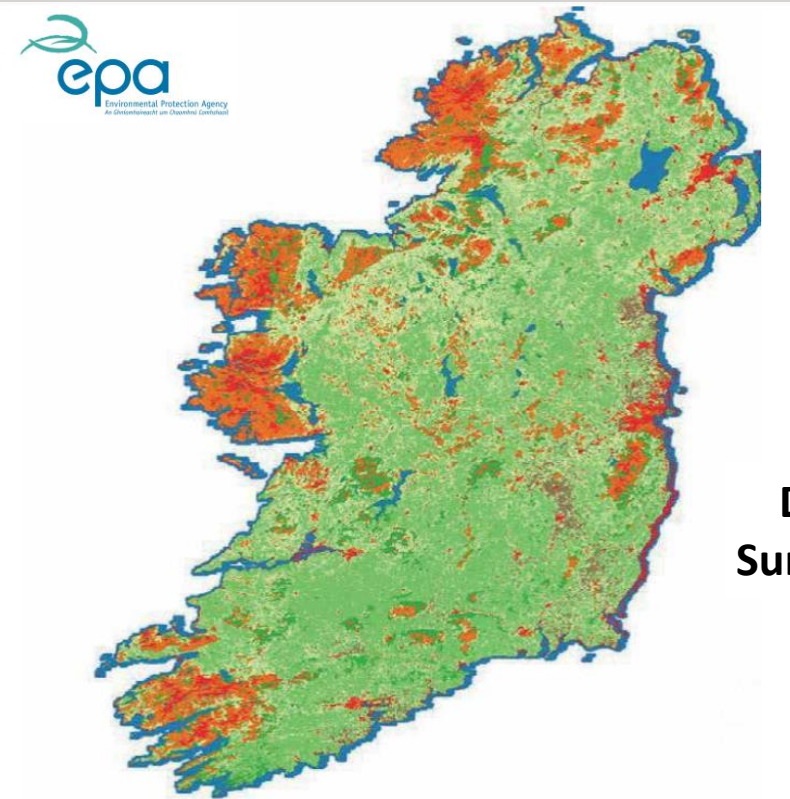
Grassland dominated

Low biodiversity

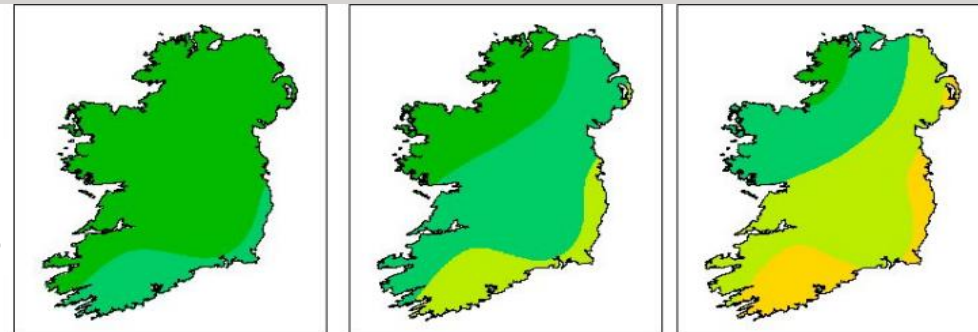
High fertiliser inputs

Ryegrass = 95% of grassland seeds

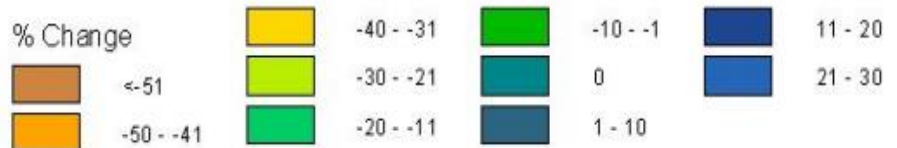
N fertiliser use in dairy: 185 kg of N / ha



Drier Summers



Precipitation (% Change)



Percent changes in precipitation by Fealy and Sweeney (2008). Results based on a mean ensemble of output from three GCMs forced with two emissions scenarios.



Objectives



Plant diversity + intensive management ?=?

- Productivity
- Stability
- Sustainability (biodiversity, chemical inputs, risk reduction, etc.)

Common forage species for Irish climate

- Grasses



- Legumes



- Herbs



2-species analysis

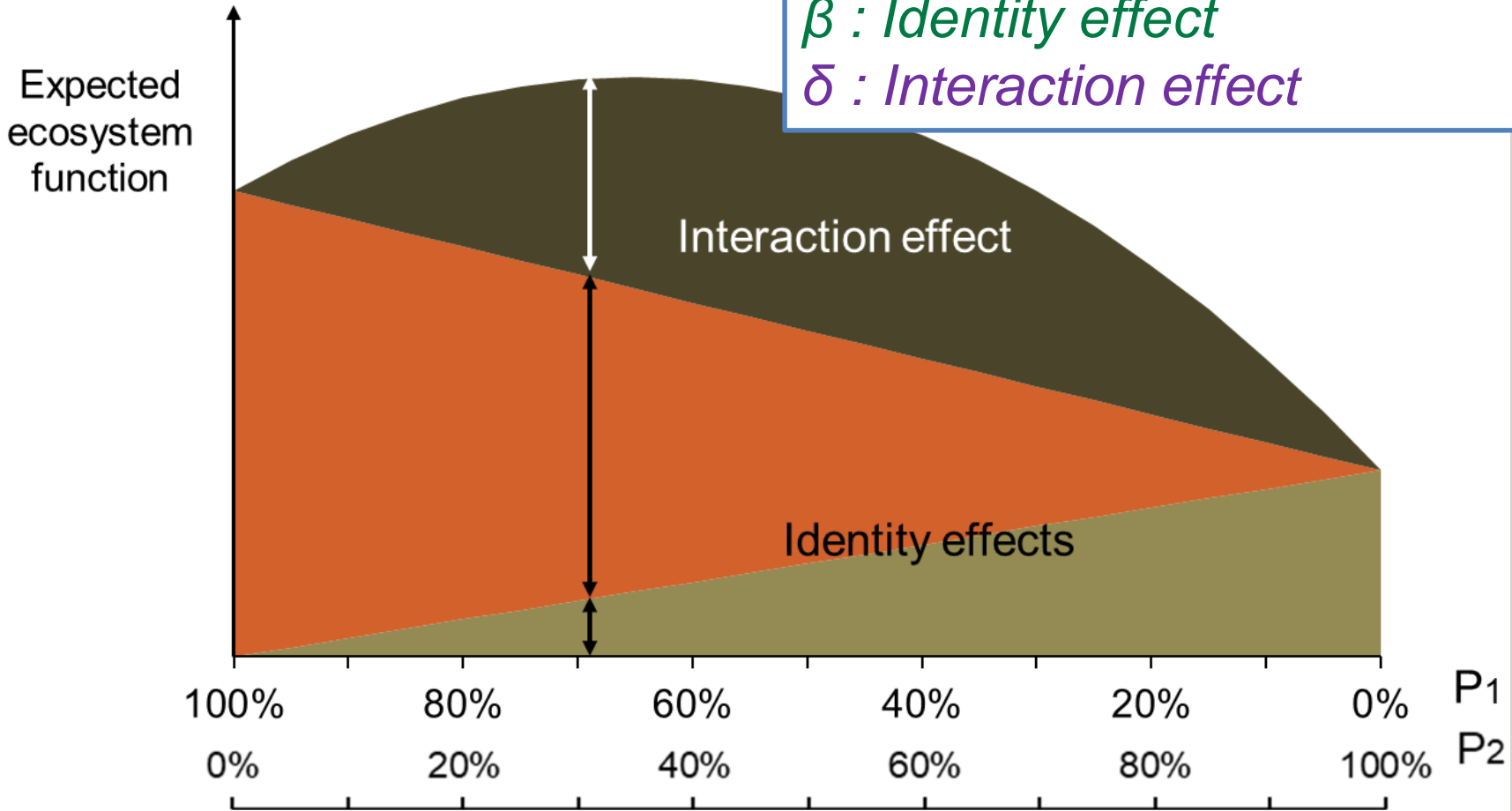
$$y = \beta_G P_G + \beta_L P_L + \delta_{GL} P_G P_L + \varepsilon$$

P : sown proportion

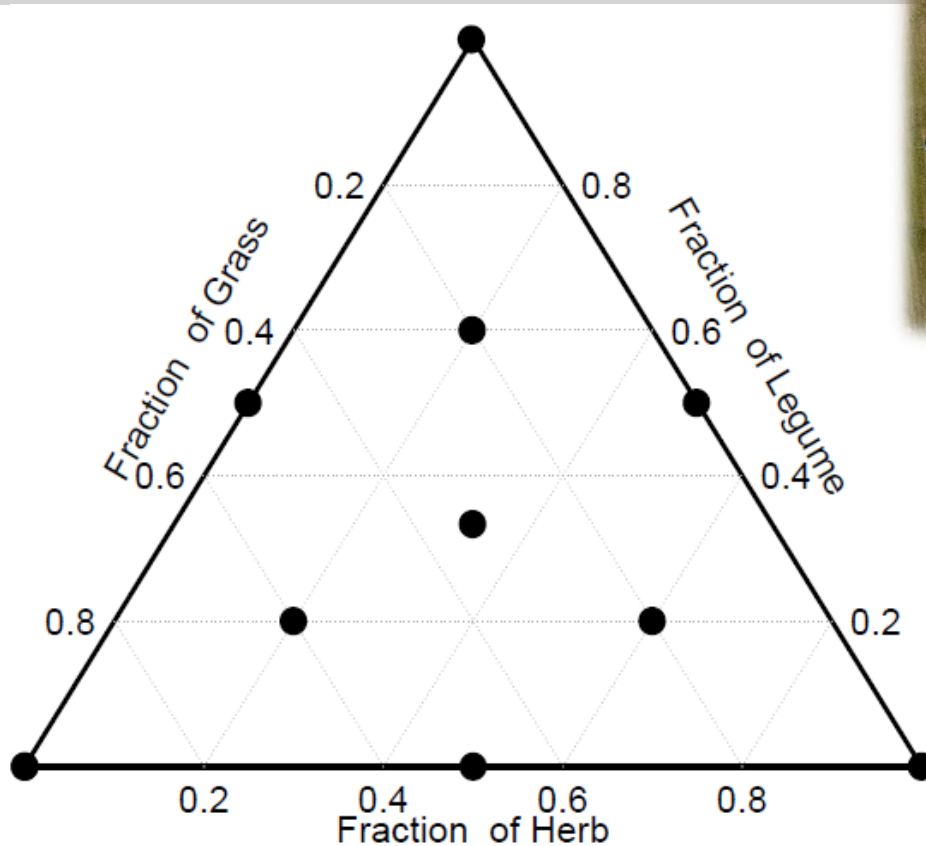
G, L : Grass, Legume

β : Identity effect

δ : Interaction effect



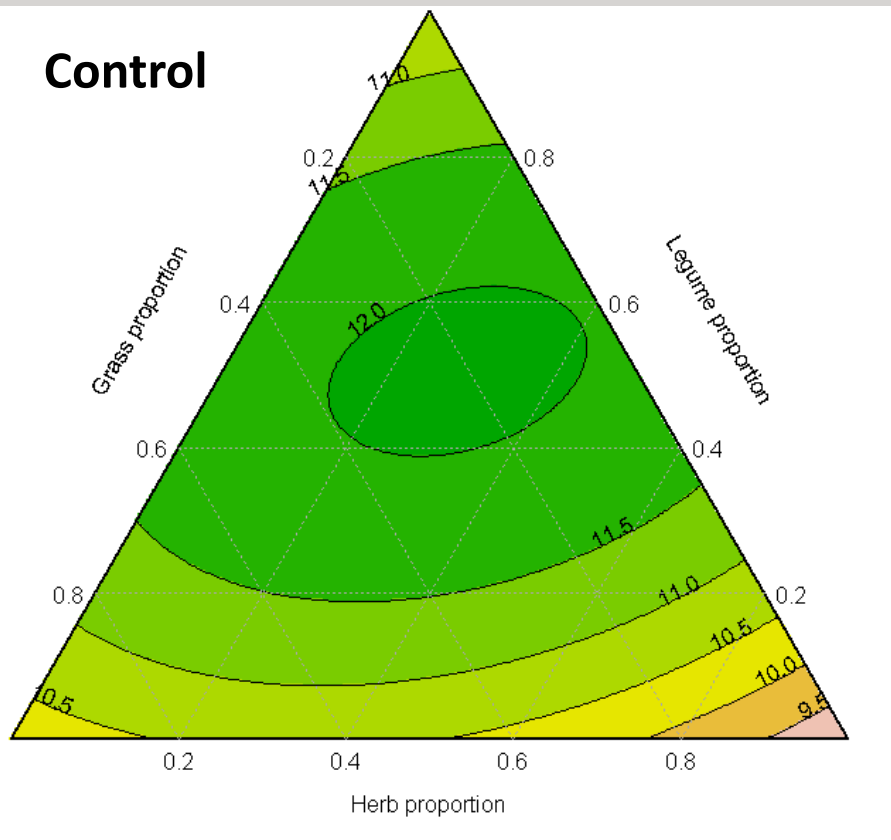
Johnstown Castle experiment



- 6 species
- Monocultures
- 2 to 6-sp. Mixtures
- A high N comparison
- 2 climatic treatments

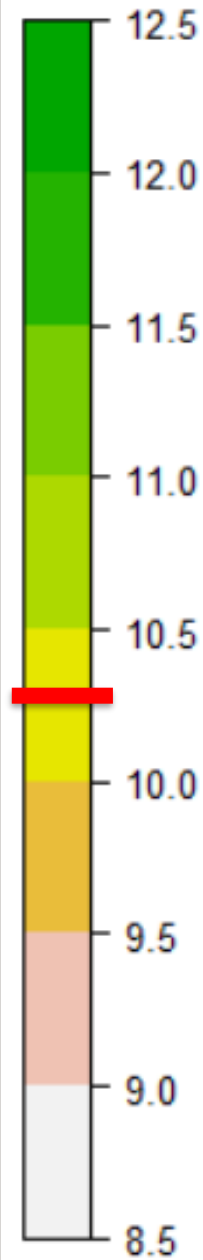
Annual yield (2-years average)

Control



Ryegrass with double N – Control

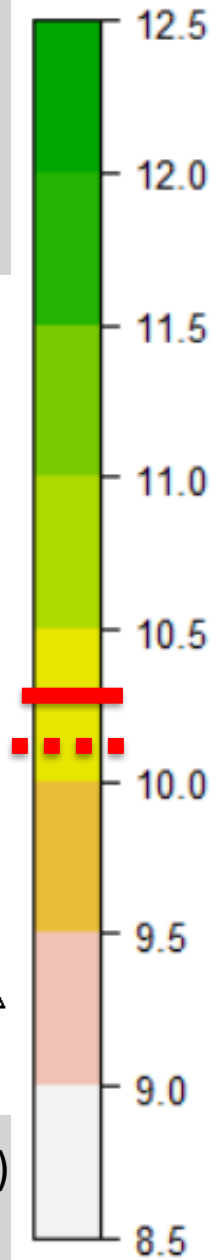
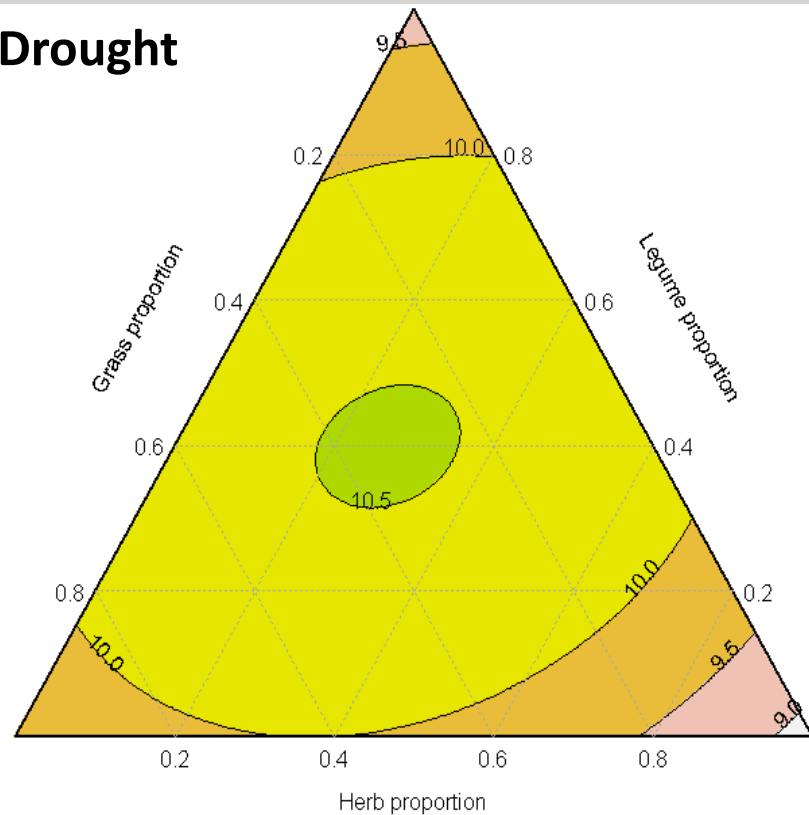
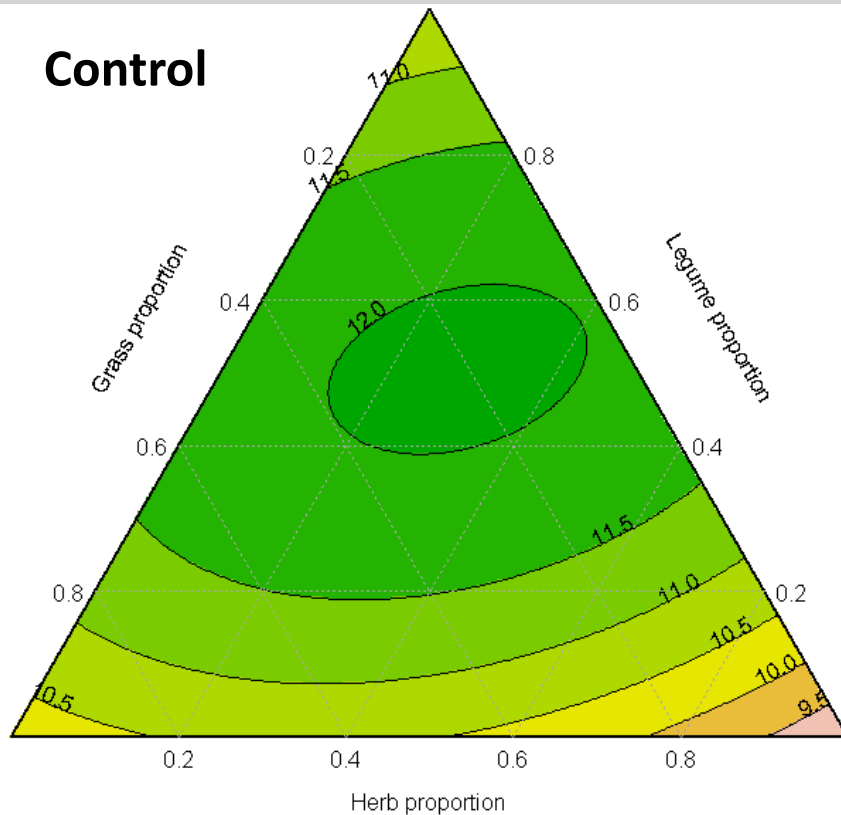
Annual yield (Tonnes of DM ha⁻¹ yr⁻¹)



Annual yield (2-years average)

Control

Drought

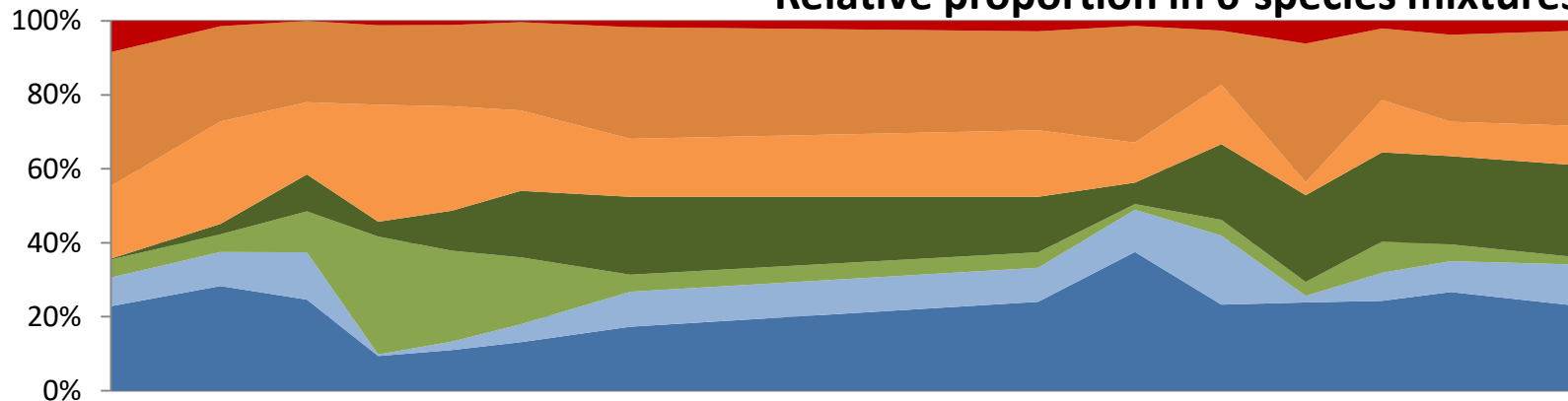
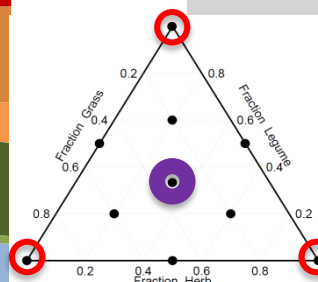


- Ryegrass with double N – Control
- ■ ■ Ryegrass with double N – Drought

Annual yield (Tonnes of DM ha⁻¹ yr⁻¹)

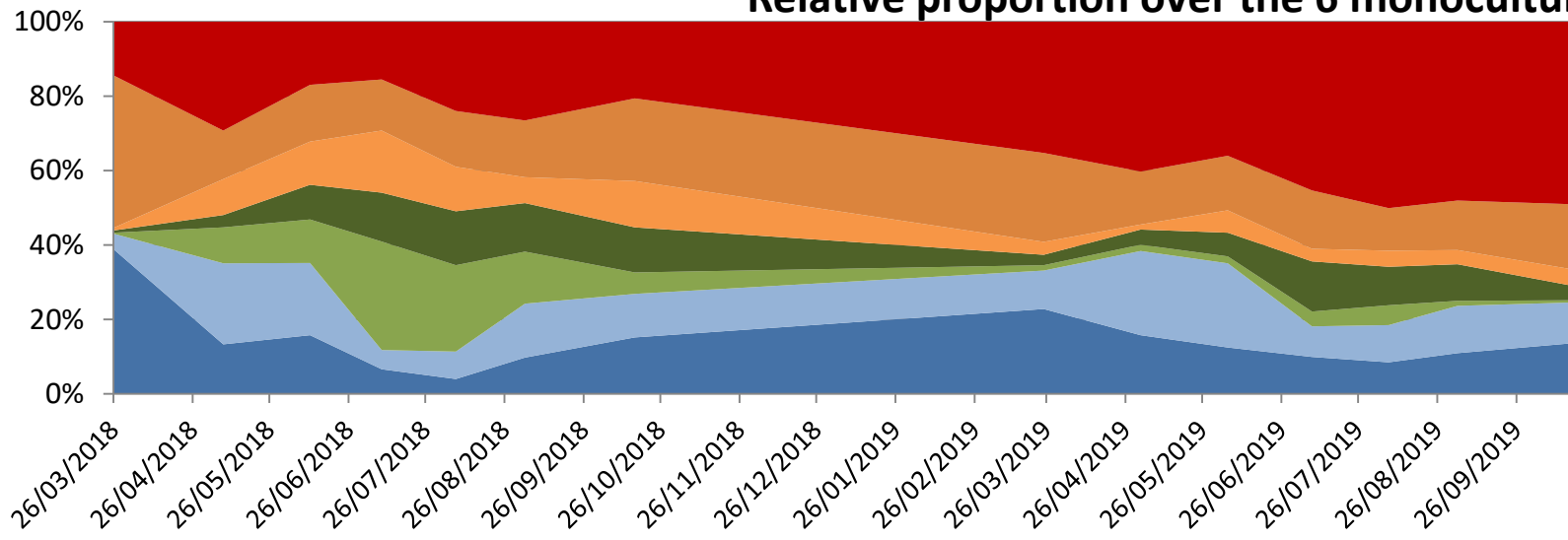
Species proportions

Relative proportion in 6-species mixtures



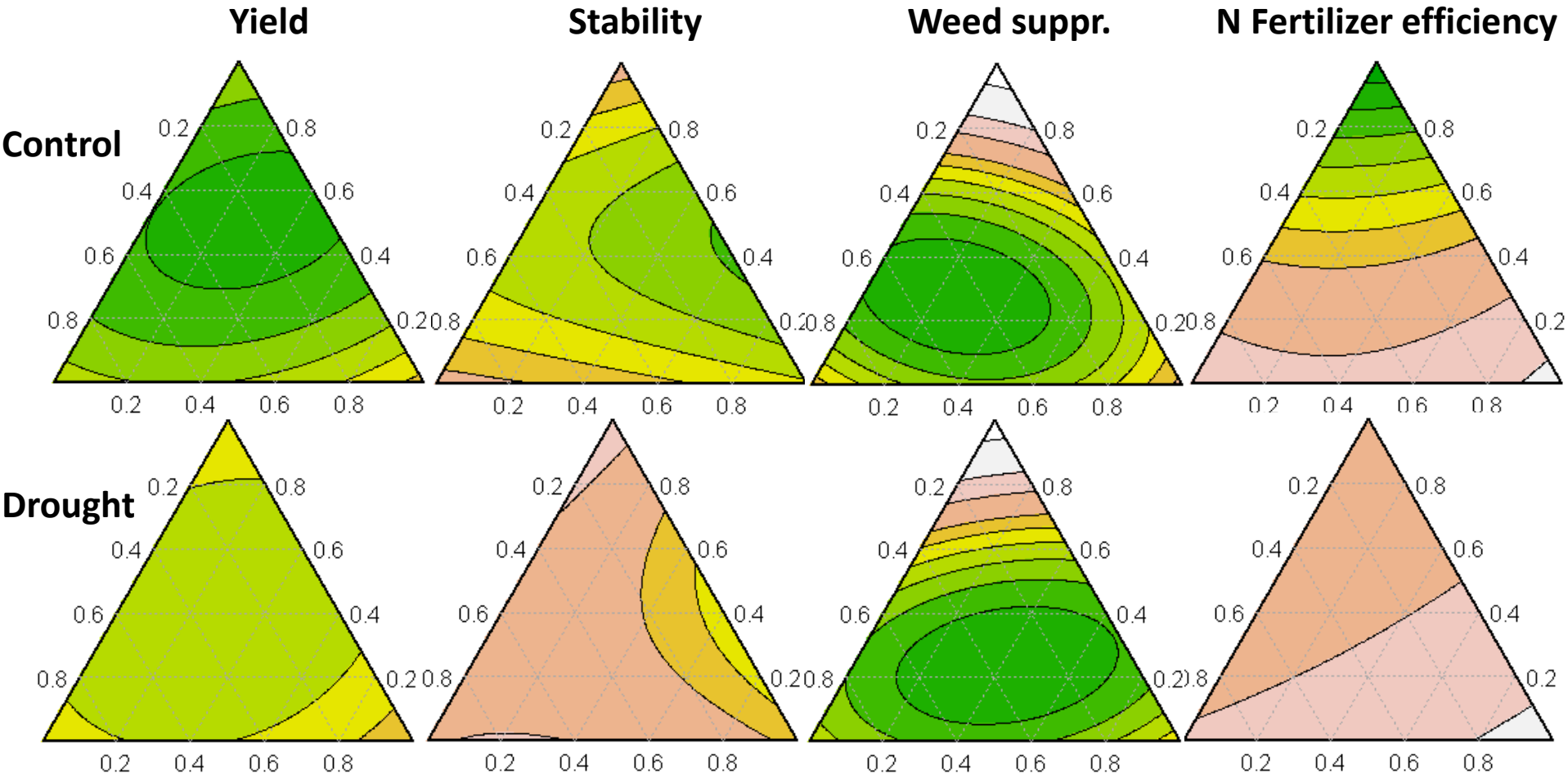
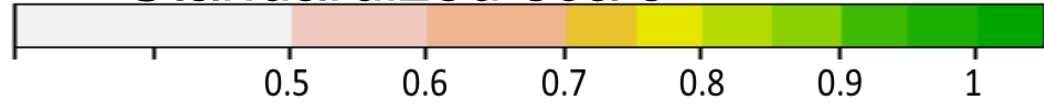
Relative proportion over the 6 monocultures

- Weed
- Plantain
- Chicory
- White Cl.
- Red Cl.
- Timothy
- Ryegrass



Multi-functionality

Standardized scale



Results

Plant diversity in intensive grasslands can:

- Increase biomass production
- Displace Nitrogen fertilizer and herbicide
- Mitigate summer drought effect

Next

- Global indicator for multi-functionality
- Deeper exploration of interaction term

Thank you for your attention

grangeg@tcd.ie