Future feedbase for mixed systems in southern Australia

Hayley Norman, Belinda Hackney, Chao Chen, Jessica Rigg, Tom Edwards, Andrew Fletcher, Matt Wilmot, Ron Yates, Rob Harrison, Tyson Wicks and John Howieson

Transformational Feedbase Project (2022-2027)

Moving beyond biomass to transform the feedbase in mixed farming systems


Establishing shrubs under a wheat crop (WA)


Drilling cereals into pastures to fill the winter feed gap (WA)


Soil C and robust perennials (NSW)


Filling the winter gap with summer sowing (NSW)

Mixed farming zones – the hub of red meat & crop production

- 50 M ha ~ 19,000 producers
- Crop production
- Primary production zones for livestock grains and conserved fodder
- Major breeding & finishing area for sheep and cattle
- Supply livestock genetics to all regions

Farm stocking rates drive profitability of the livestock system[1]

[1] Moore et al 2009

Farm stocking rates drive profitability of the livestock system[1]

Inability to meet livestock nutrient requirements ‘feed gaps’

- Constrains stocking rate (profit)
- Flow-on effects for supply chains
- Negative consequences for animal welfare and environment

[1] Moore et al 2009

Livestock production complements crop production

Economic reasons

- Pasture legumes for nitrogen/weed/disease benefits
- Risk management
- Market for grains, crop byproducts and failed crops

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AND

Ecological benefits

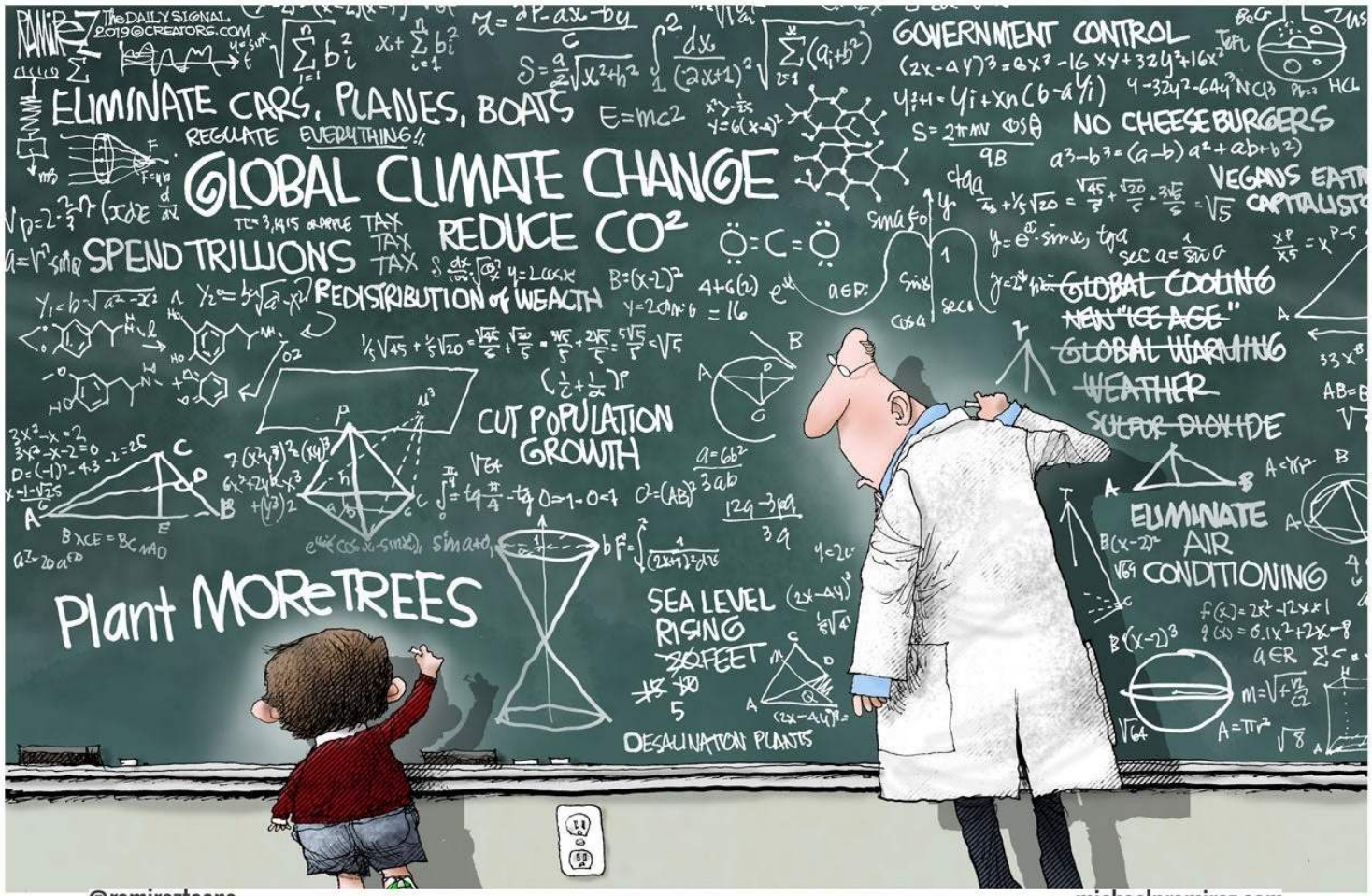
- Diversity and ecosystem services
- Perennials for salinity management

Challenges to these farming systems

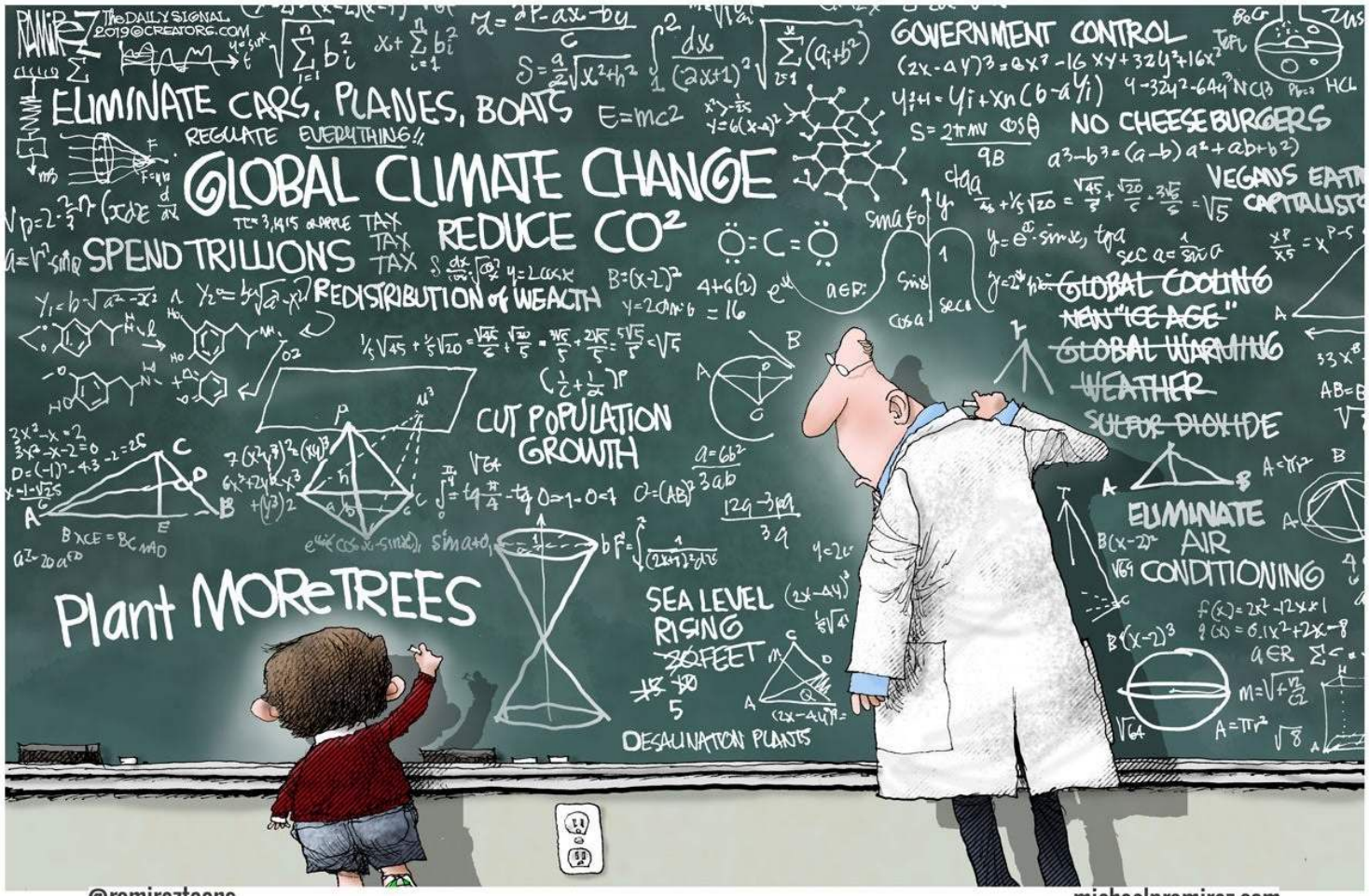
- Soil health – acidity, salinity, erosion
- Climate change – rainfall, heatwaves and farm water
- Pasture legume seedbank failure
- Societal expectations/policy drivers

We need to evolve to meet challenges

So what do future feedbase systems for the mixed farming zones look like … and how do we get there?



So what do future feedbase systems for the mixed farming zones look like … and how do we get there? …its complex



~~Live ex~~

Plant more crops

Fill the gaps

Carbon farming

+/-

Nature positive

Another b**@#$ subclover!!!

Methane mitigation

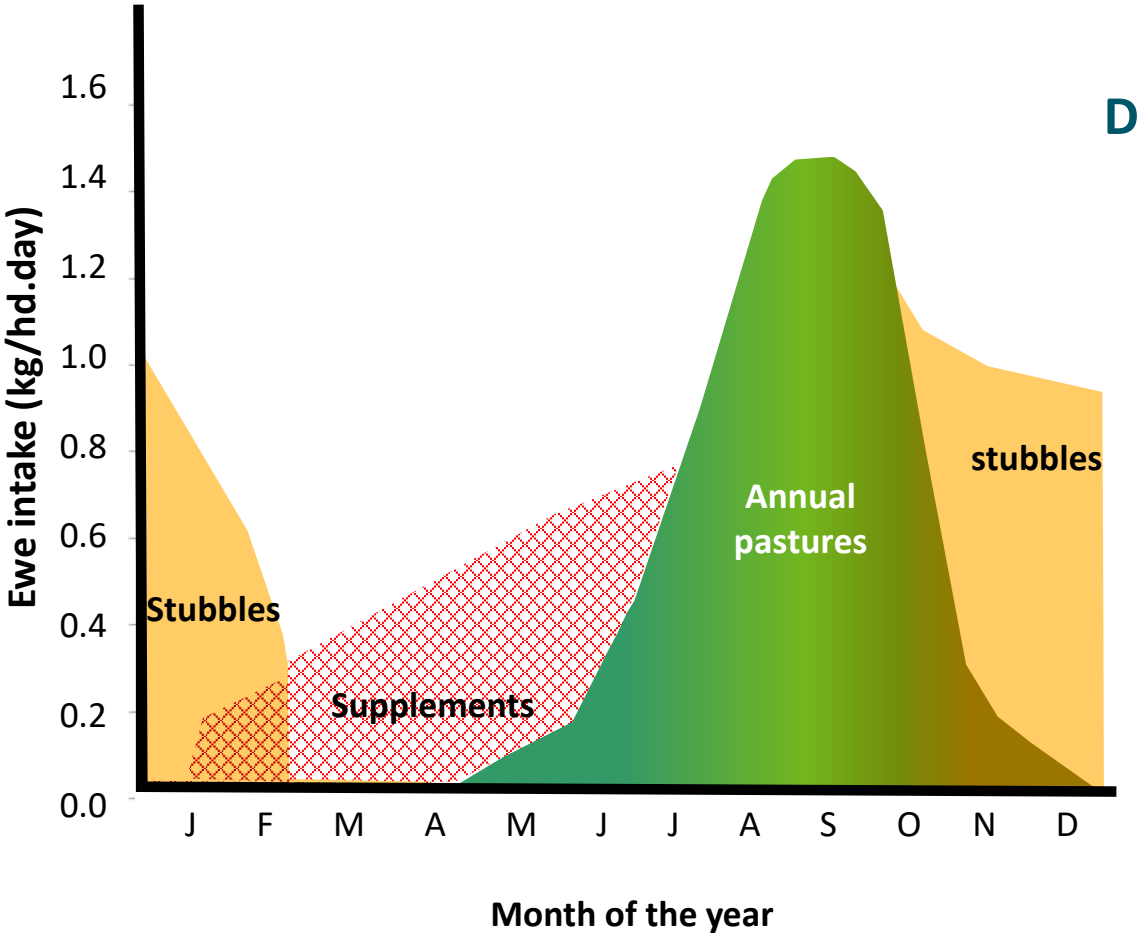
Regen???

More fallow

Silage

Future feedbase systems must broaden nutrient supply, complement cropping and de-risk seasonal variation

Future feedbase systems must broaden nutrient supply, complement cropping and de-risk seasonal variation



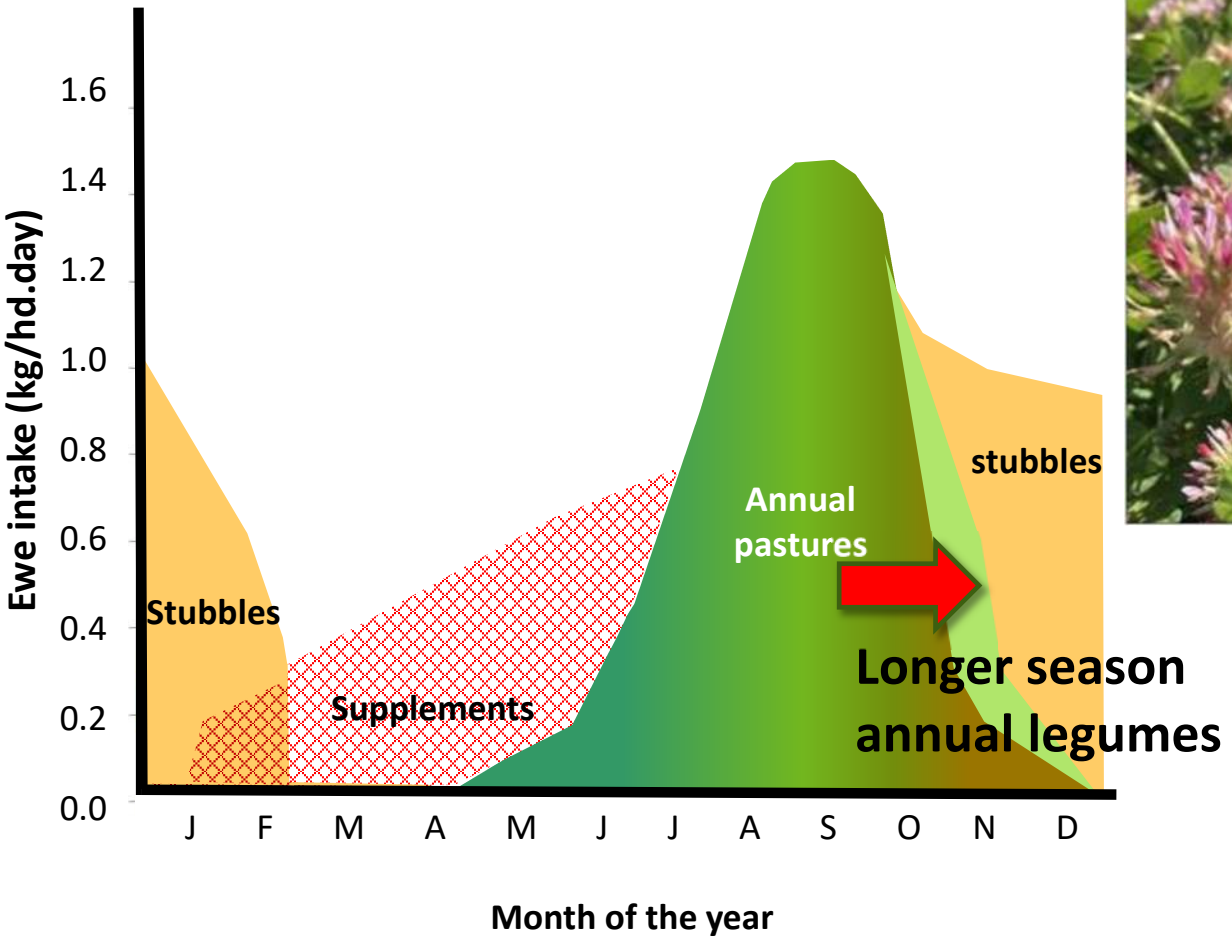
Diet of a 'typical' ewe in the medium rainfall mixed farming zone of WA

We suggest 6 focus areas…

AUSFARM modelling, Dean Thomas 2021

Better legumes

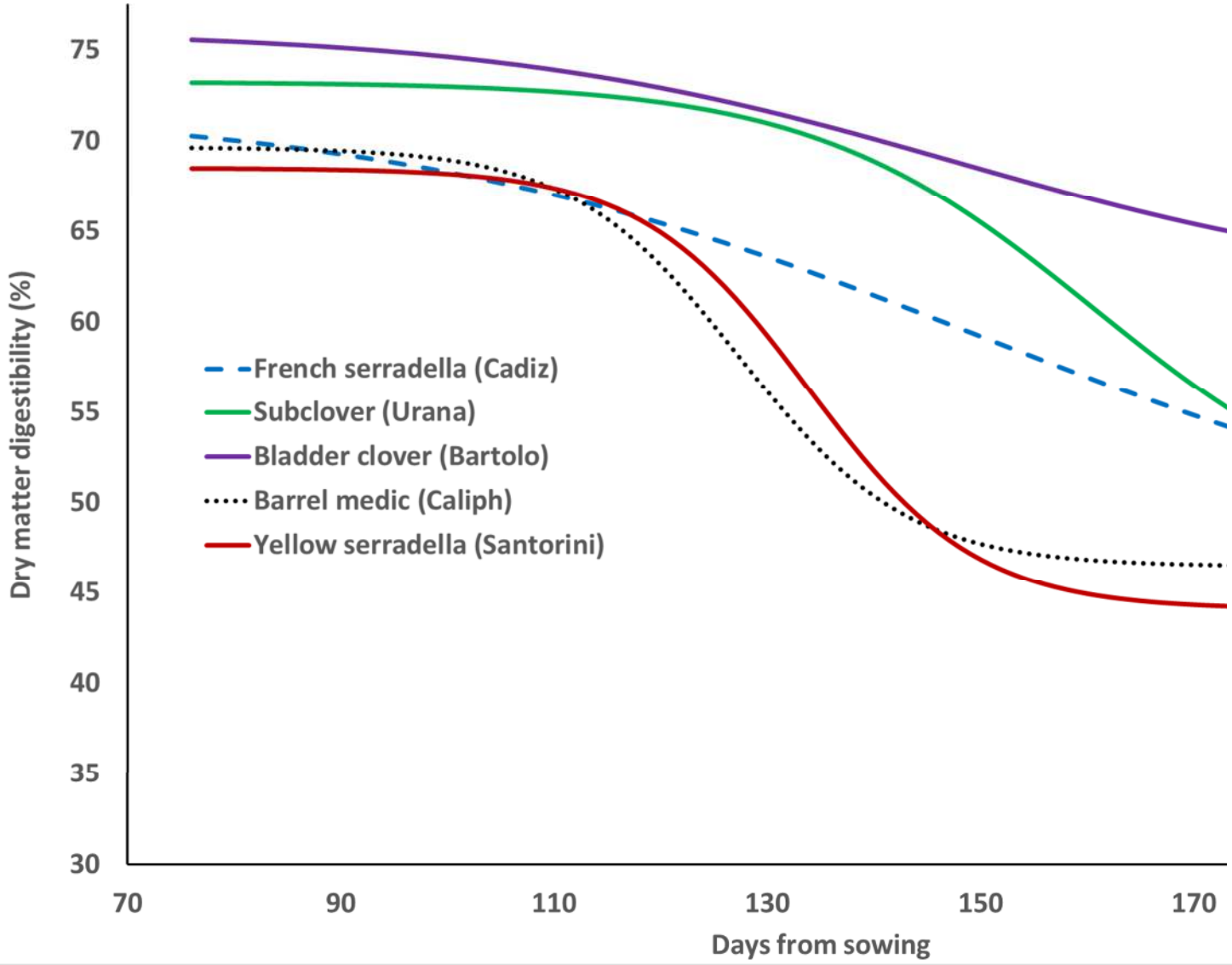
1. High quality, deep-rooted, self-regenerating (or easy to harvest) annual legumes to extend the pasture growing season



Bladder clover
High quality

Serradella
Indeterminate

Energy value of 5 annual legumes grown in the same experiment



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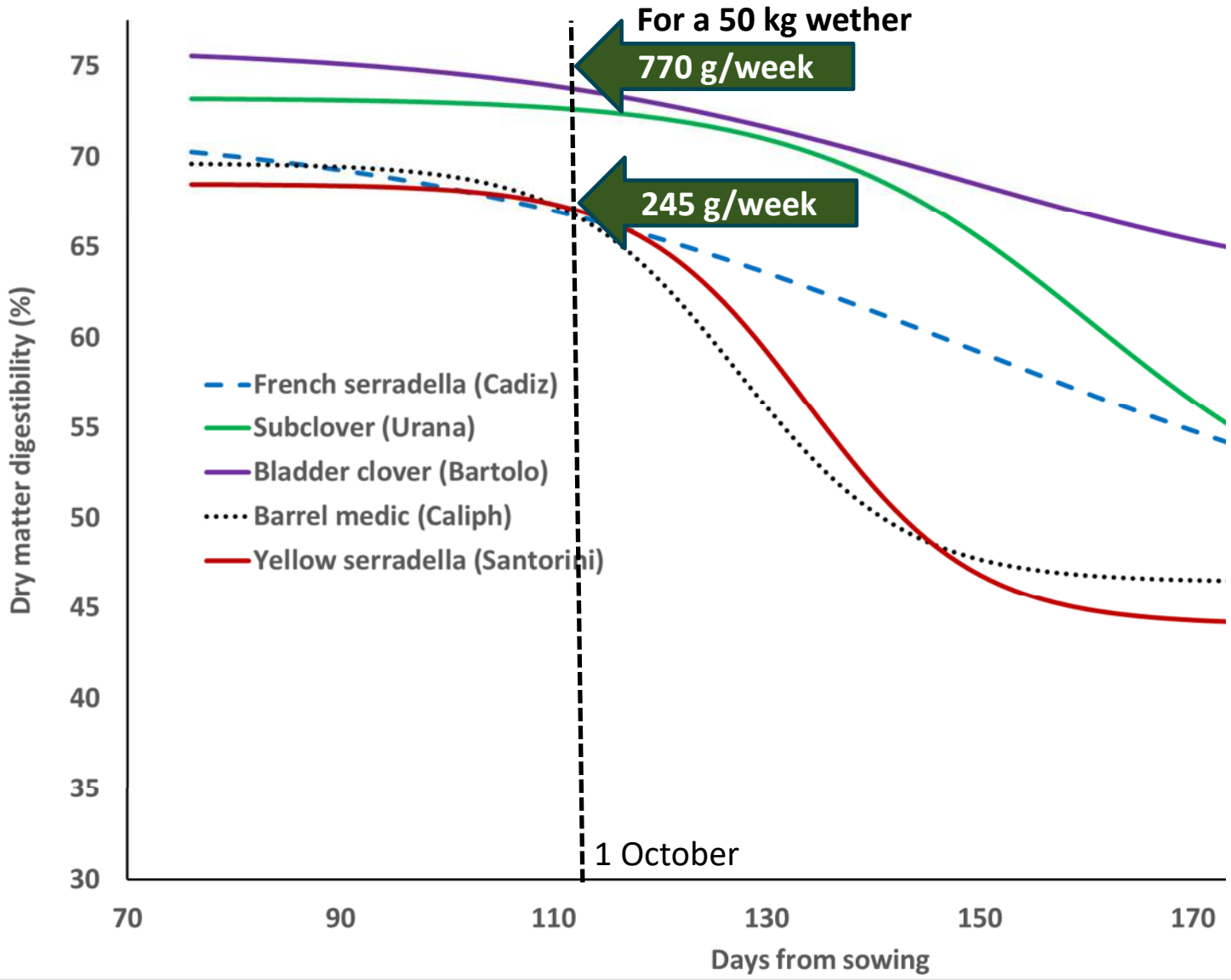


Predicted using GrazFeed (Freer et al 1997)

Energy value of 5 annual legumes grown in the same experiment

Predicted using GrazFeed
(Freer et al 1997)

Quality may be more important than quantity … but we don’t even measure it!

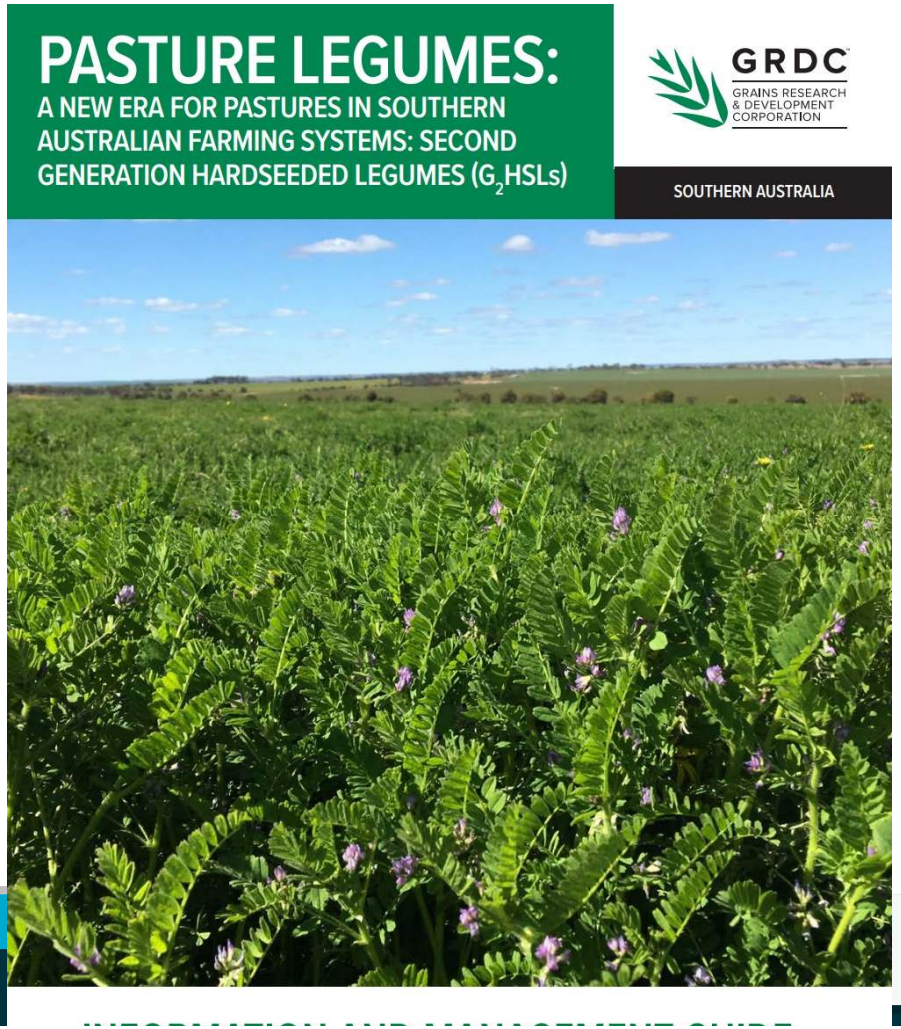
Web of Science

	# papers	
Forage OR pasture improvement AND Australia	2741	
+ Intake, or	144	5%
+ Feeding value, or	137	5%
+ Digestibility, or	101	4%
+ Nutritional value	40	**1%**

We are missing huge opportunities to improve the feedbase simply by measuring and considering quality of forage over a plant lifecycle

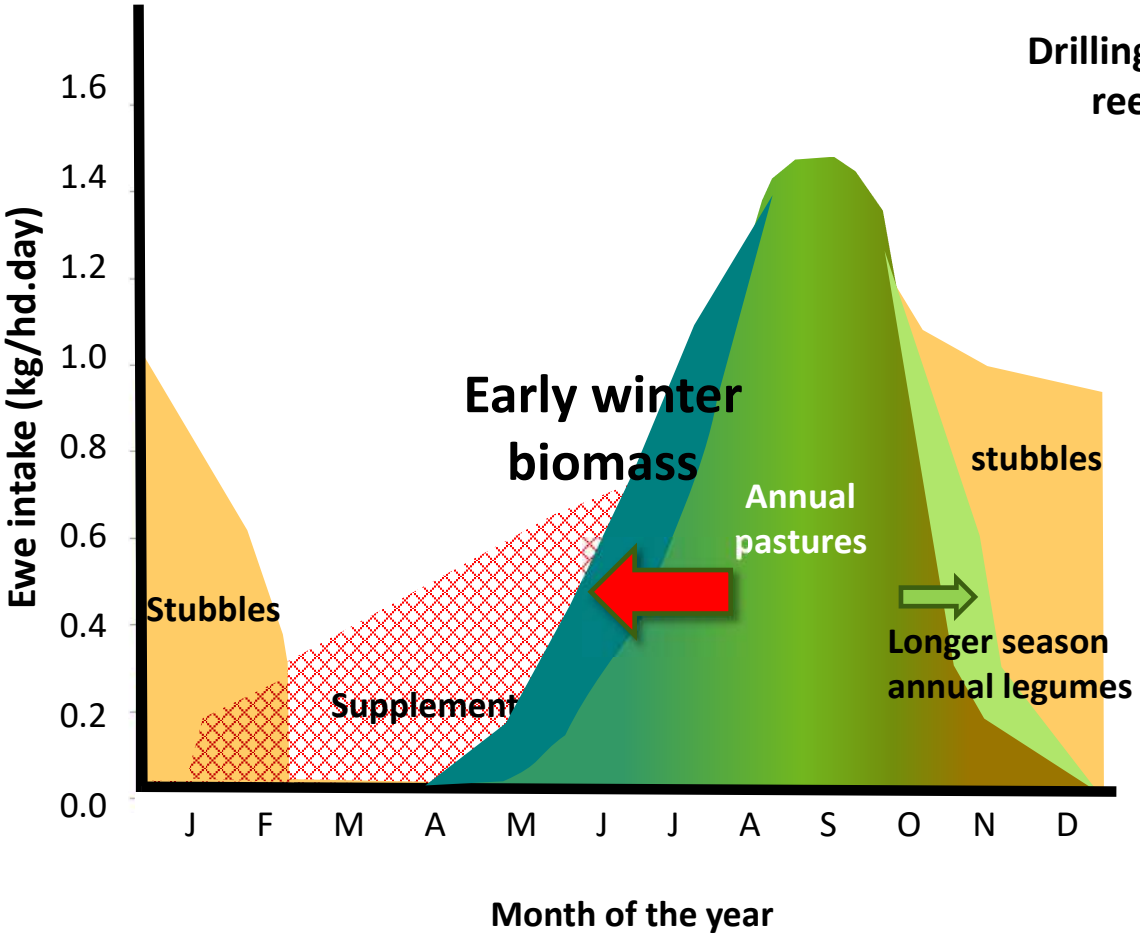
Forage legumes need to fix N for crops, regenerate after a cropping sequence – and we can improve nutritional value

https://grdc.com.au/resources-and-publications/all-publications/publications/2023/pasture-legumes-manual



Crop grazing

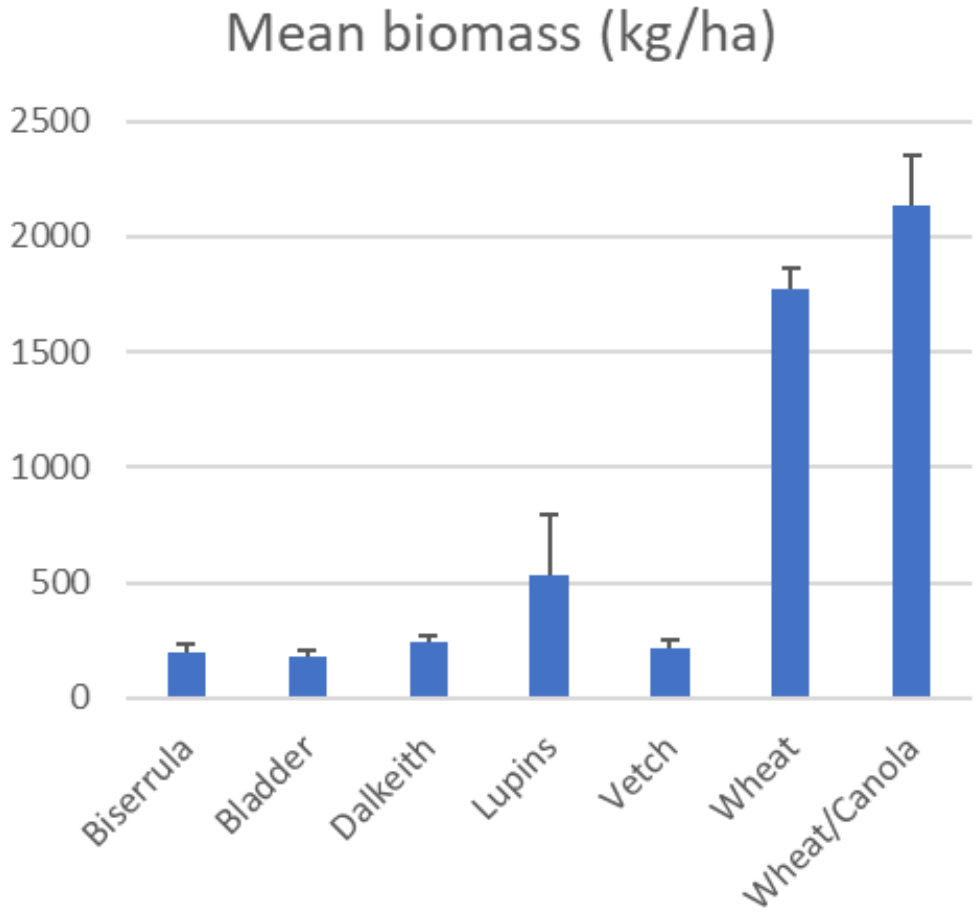
2. More winter biomass through crop grazing or summer sowing establishing pastures

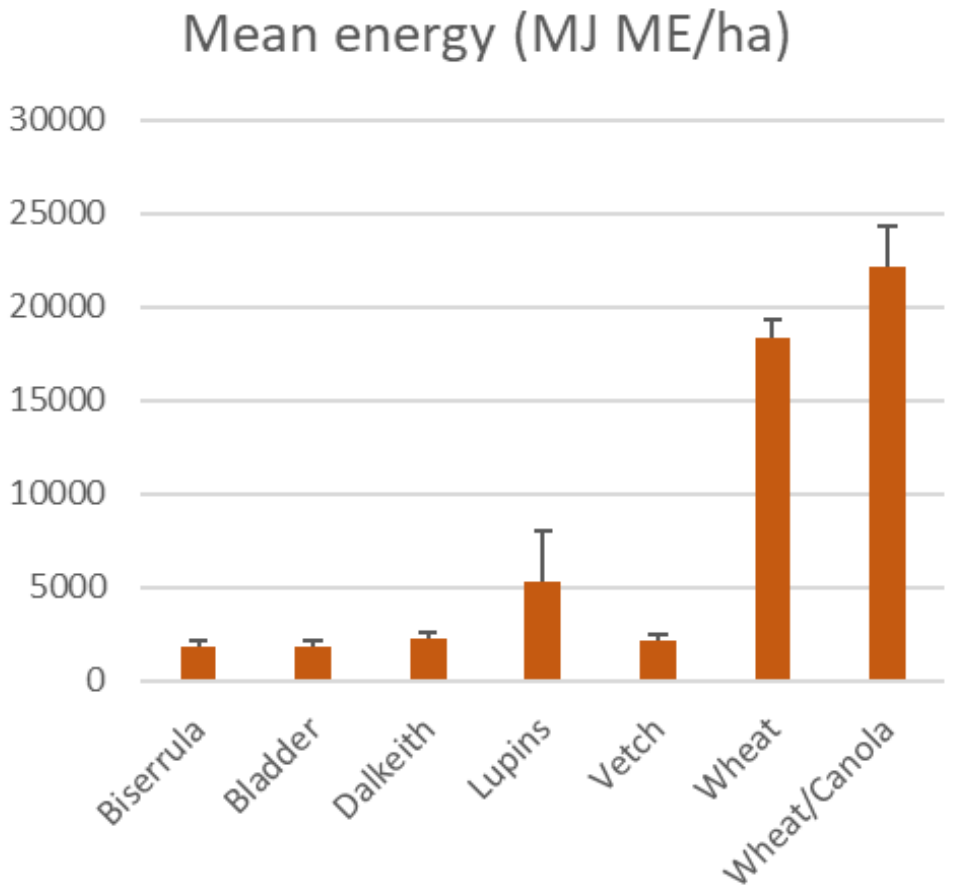


Drilling crops into reestablishing pastures

Crop grazing (pic credit Nick Eyres)

Quantity and quality of biomass on 14 August (Kellerberrin, WA)

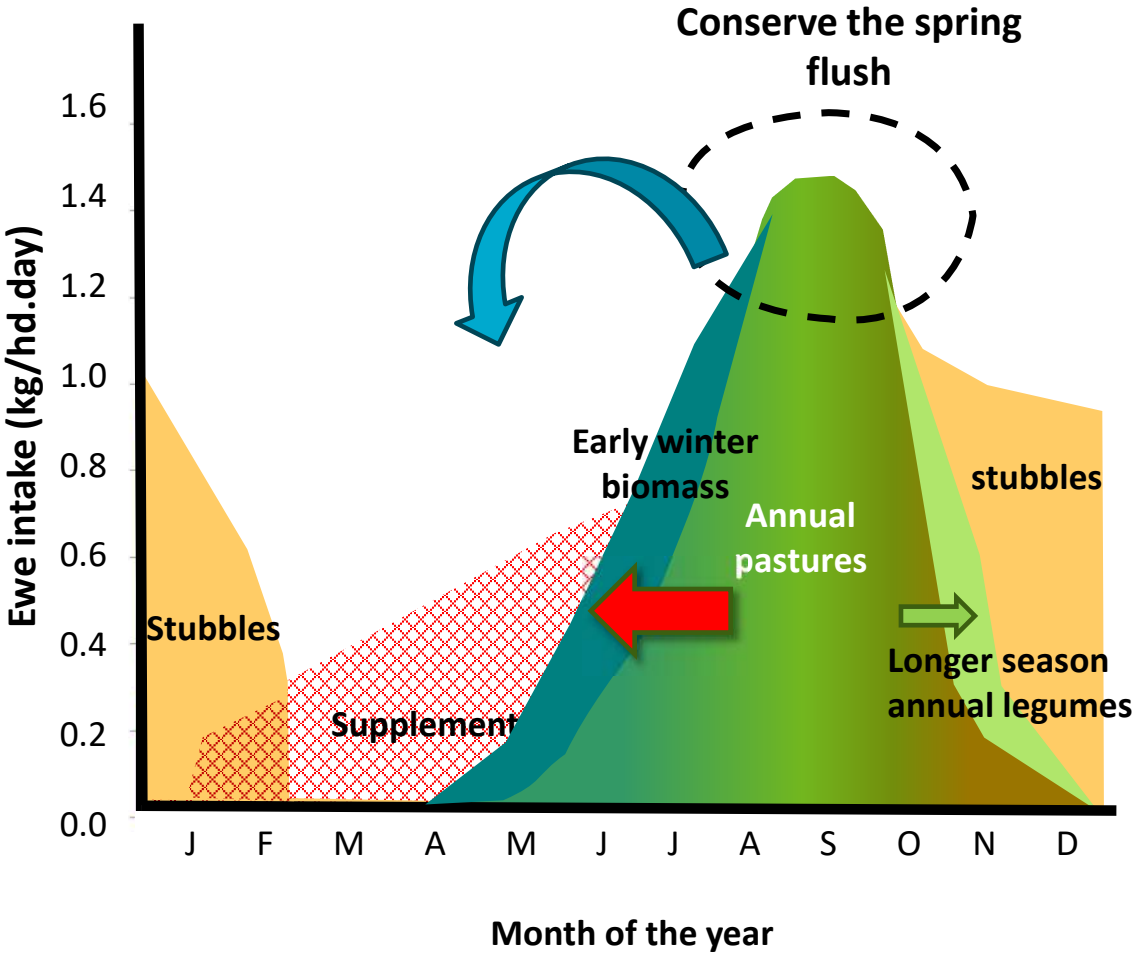




At the start of the season, most annuals have high quality but quantity is a problem

Conservation

3. Forage conservation



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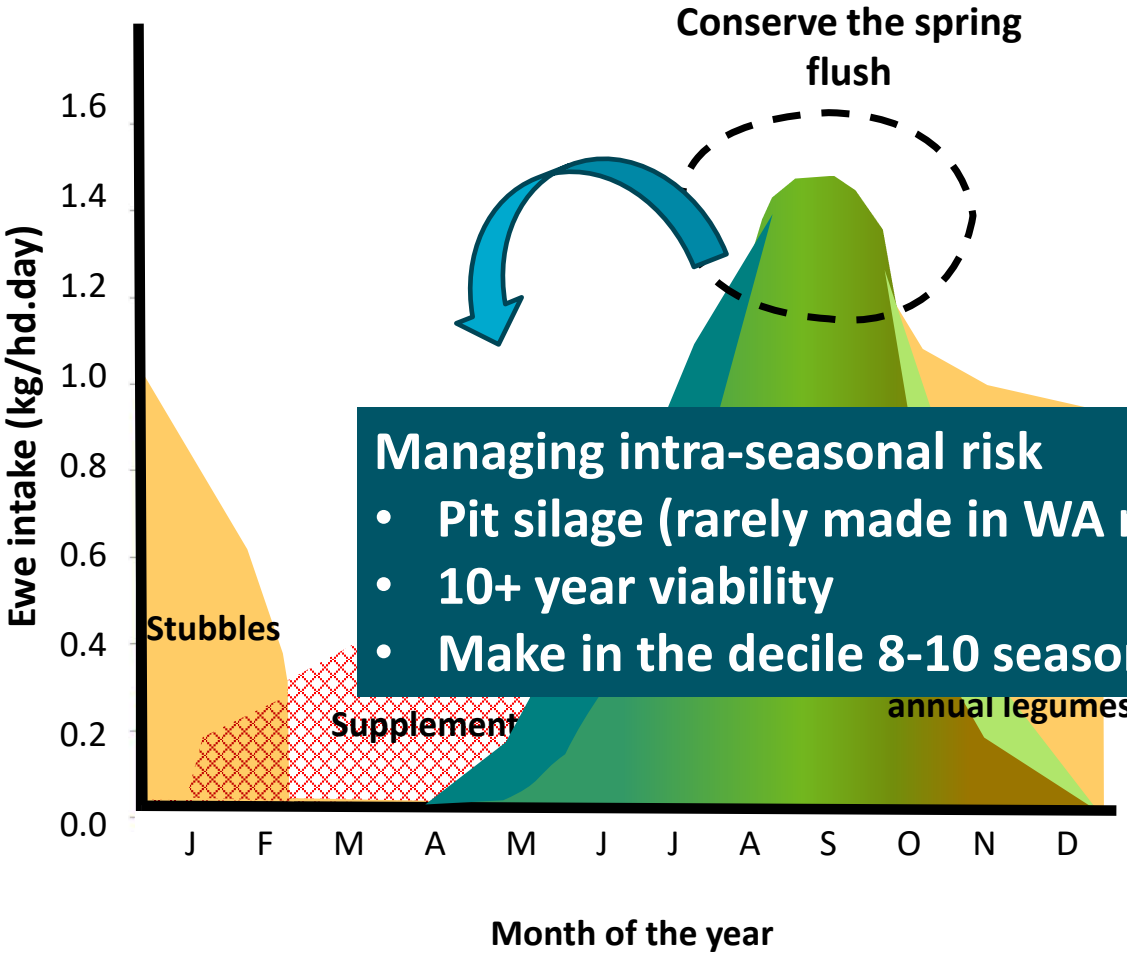
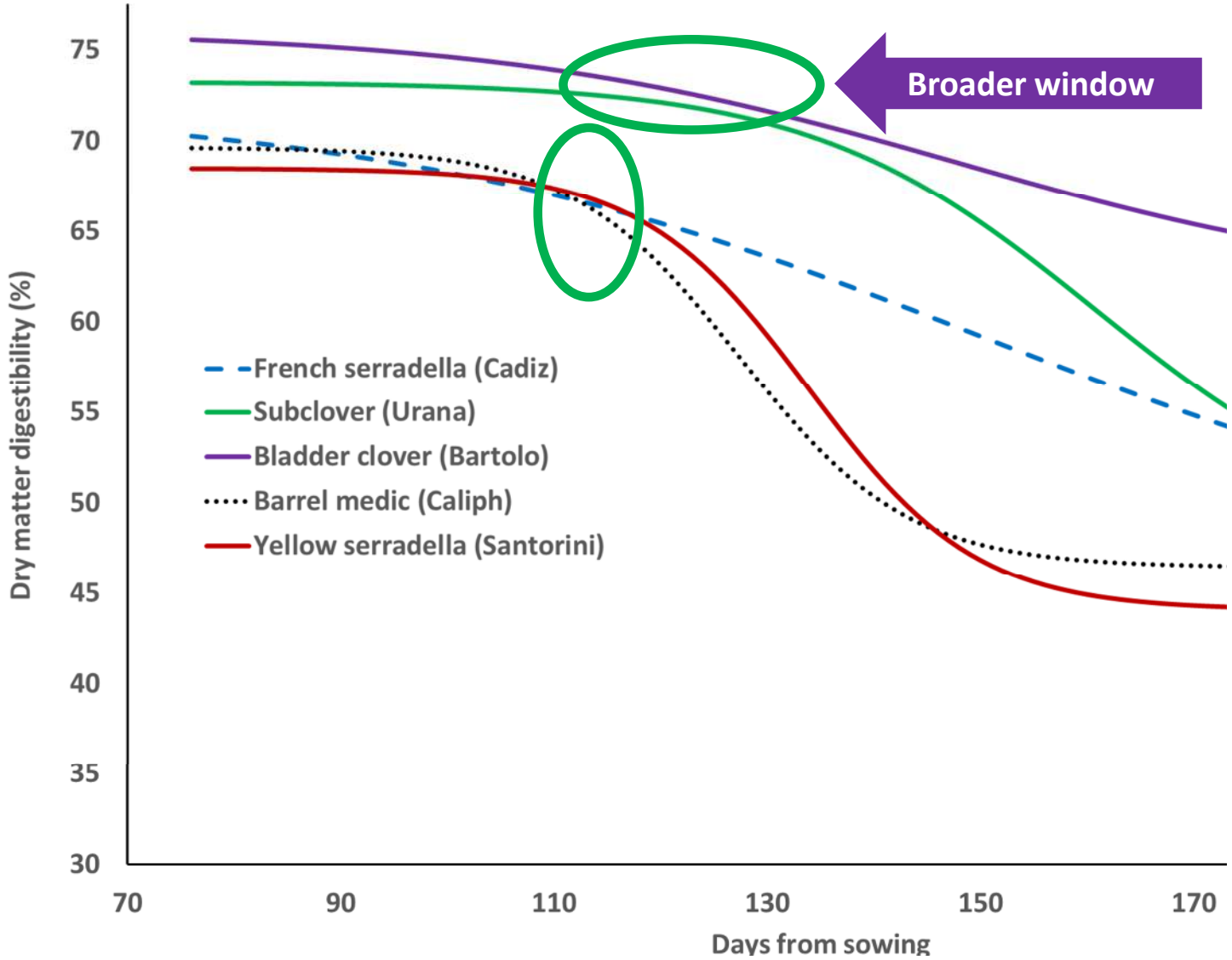


Managing intra-seasonal risk

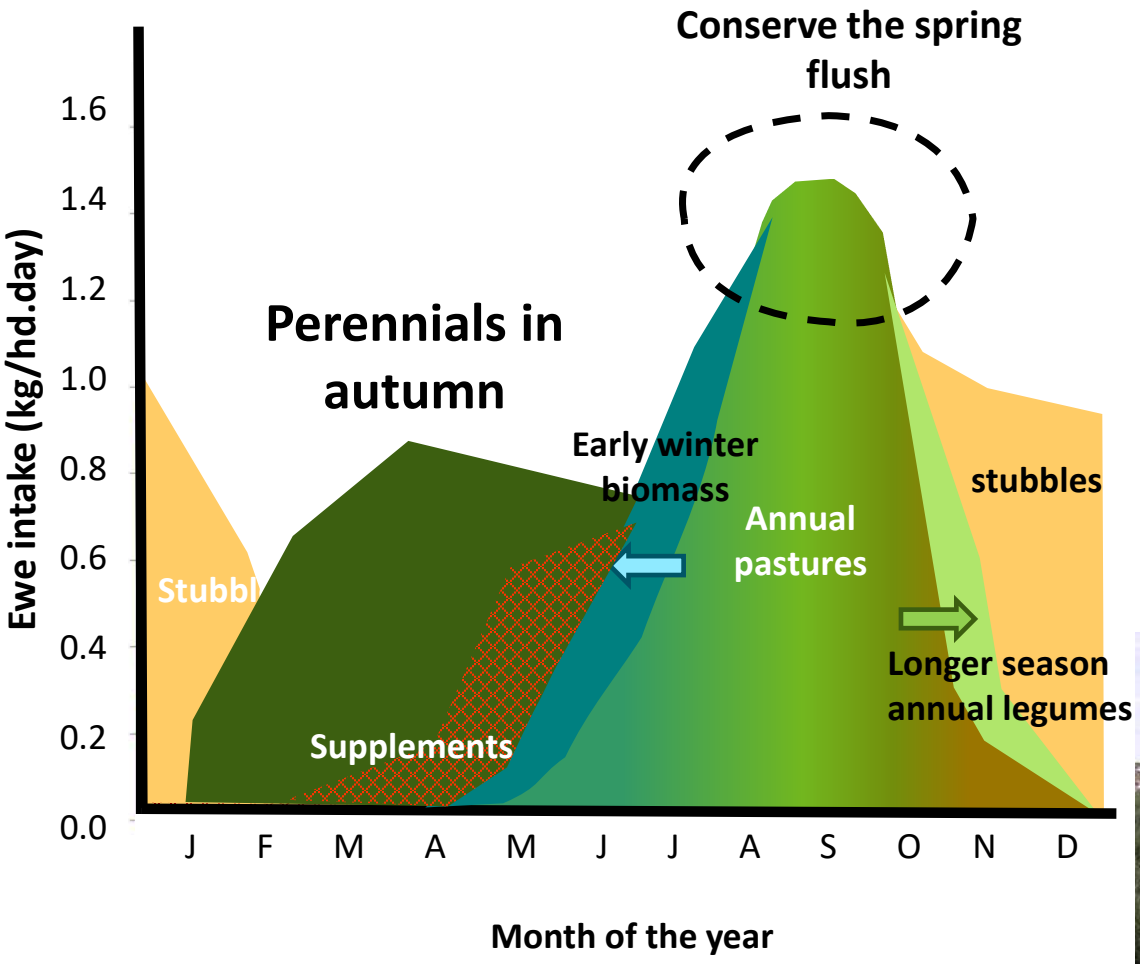
- Pit silage (rarely made in WA mixed systems)
- 10+ year viability
- Make in the decile 8-10 seasons for the decile 1-2

Energy value of 5 annual legumes grown in the same experiment



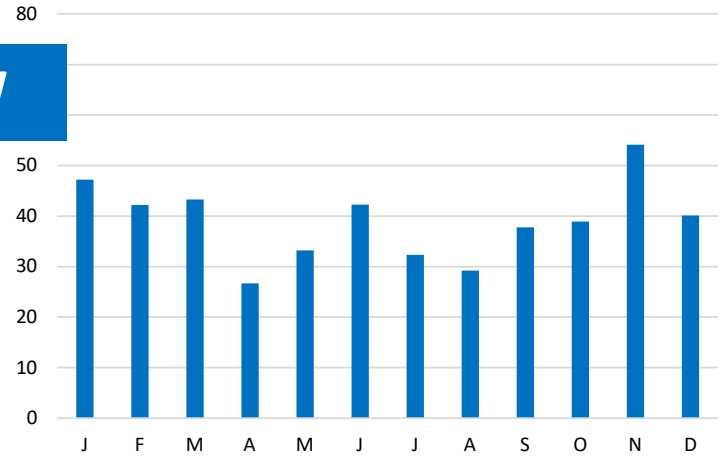
Perennials
…where you can’t crop

4. Perennials on soils that are marginal for cropping

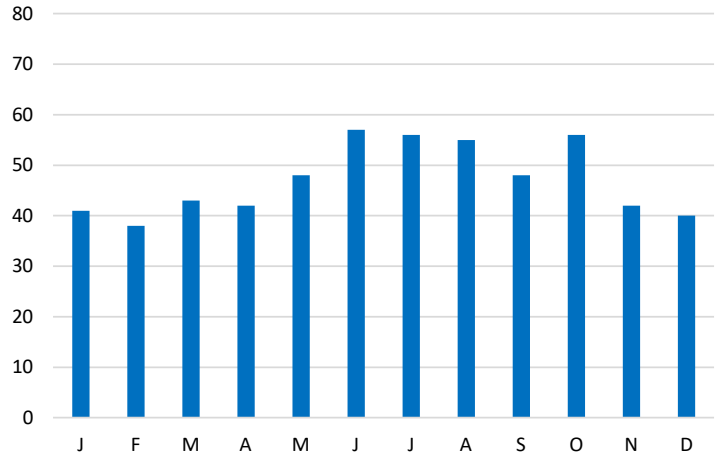


NSW

Condobolin, NSW (mean annual 467 mm)

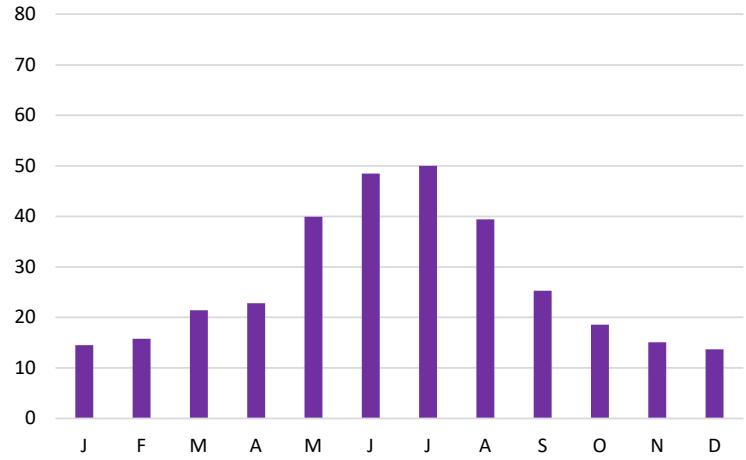


Wagga Wagga, NSW (mean 566 mm)

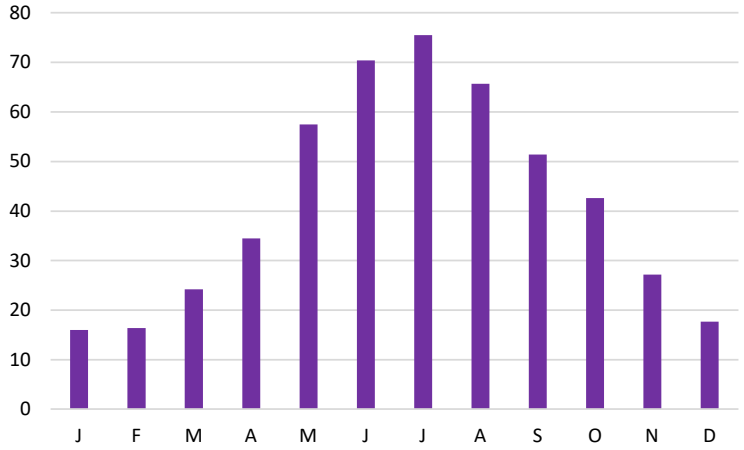


WA

Merredin, WA (mean 325)



Cranbrook, WA (mean 499)



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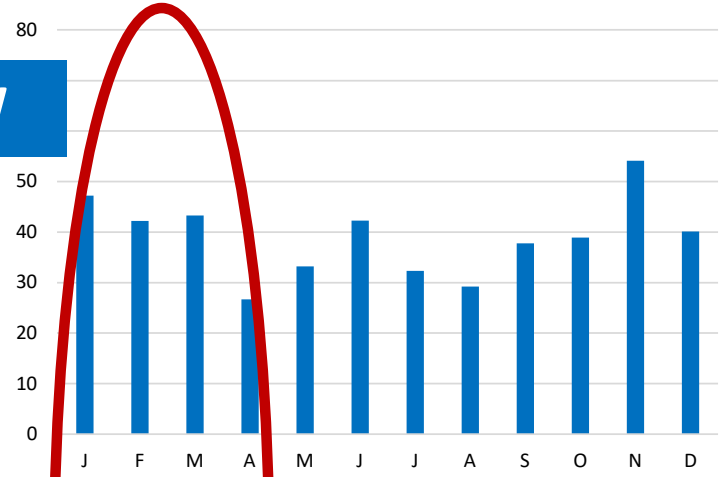

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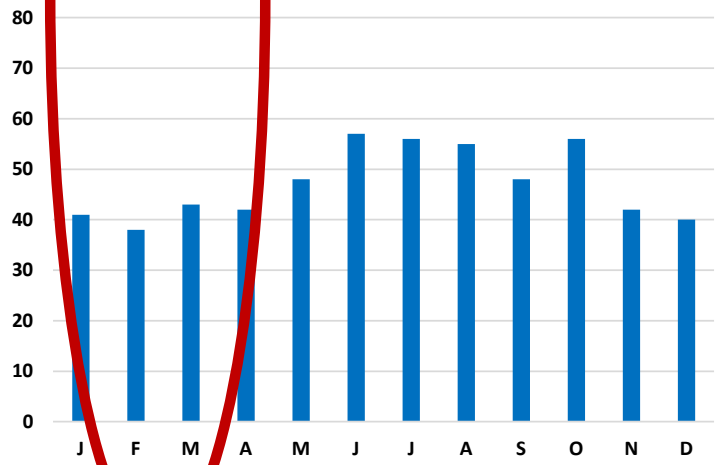

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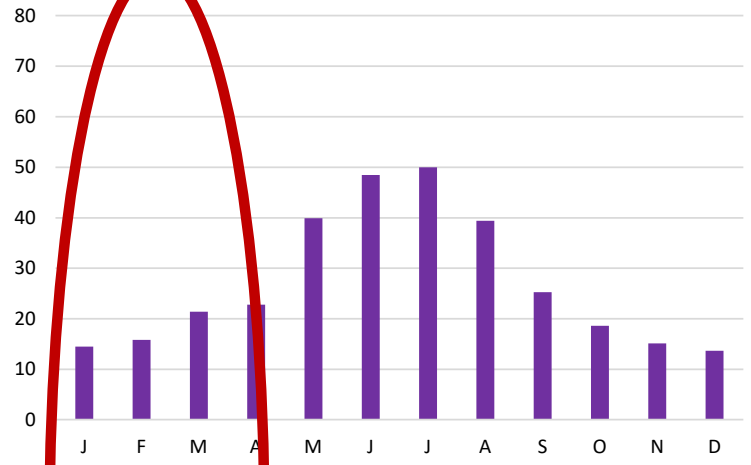

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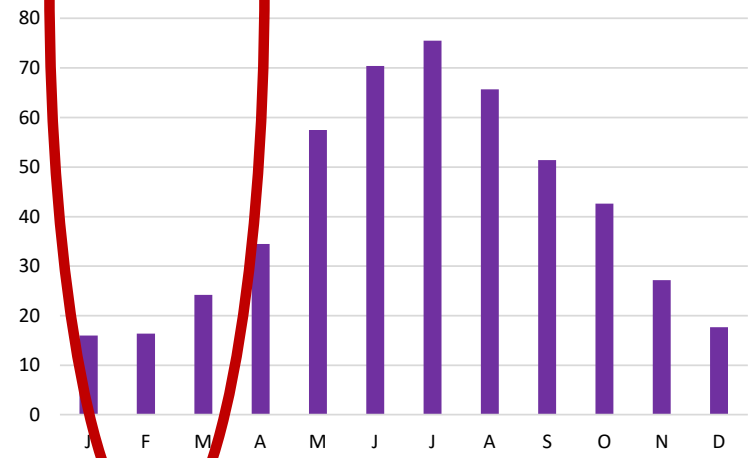

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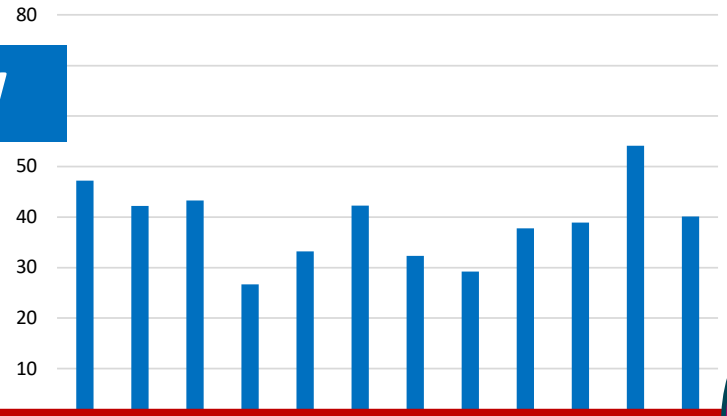

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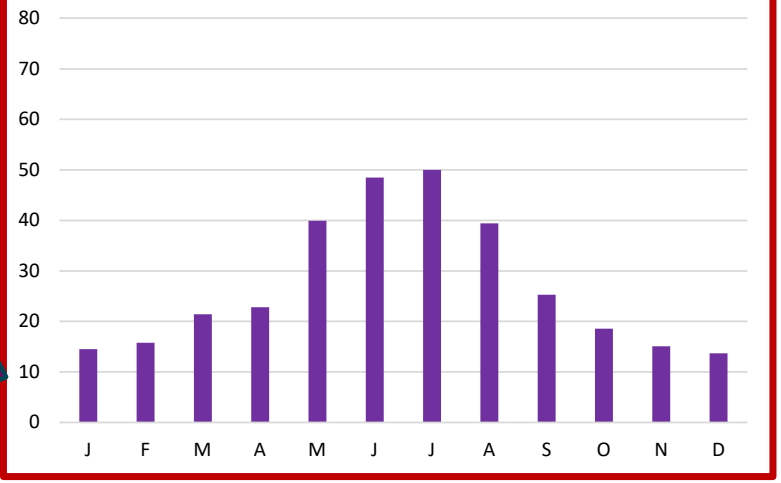
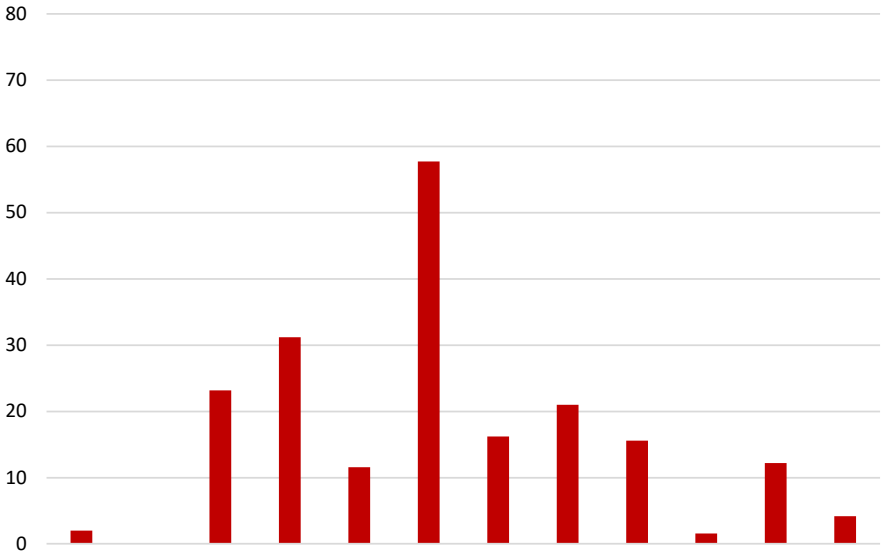


2023

Merredin 2023 (196 mm)



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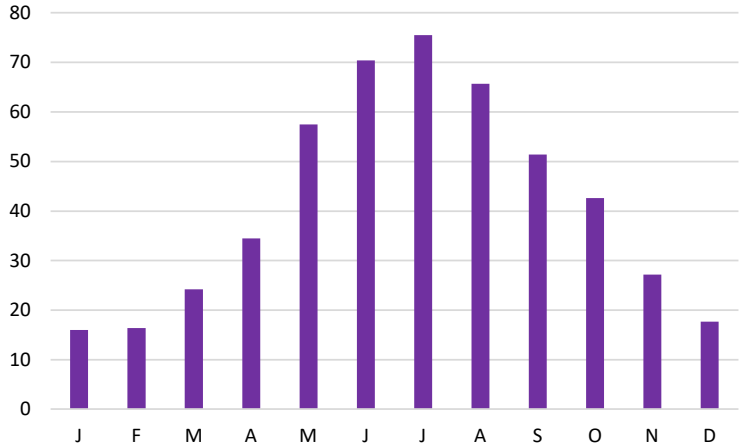

Temperate - Native grasslands

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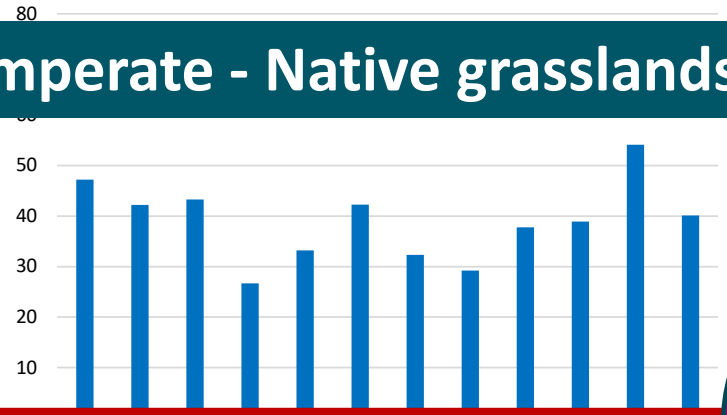

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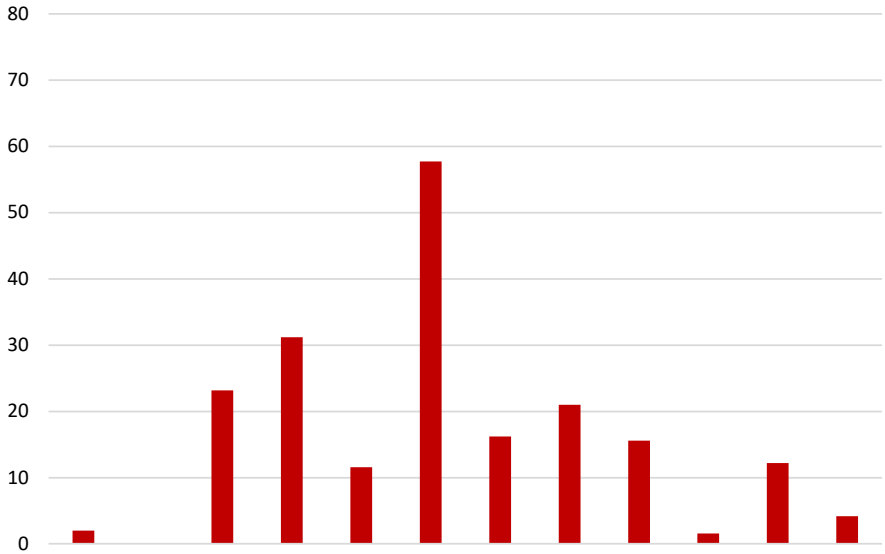

Dry mediterranean - Native shrublands

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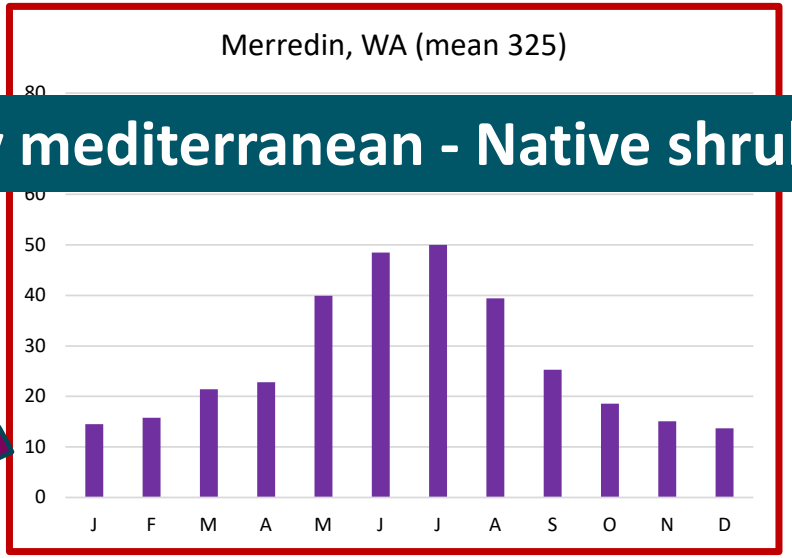

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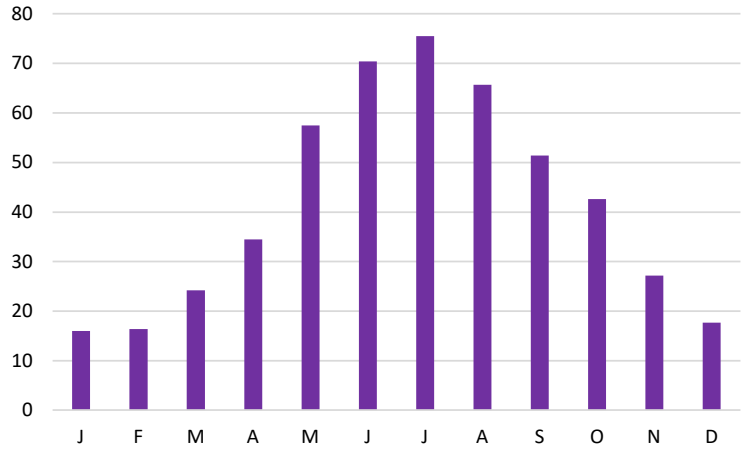


Perennial legumes – highly productive OR tolerate ‘marginal soils’

Lucerne

Tagasaste

Lebeckia

Perennial grasses that are adapted to ‘marginal’ soils

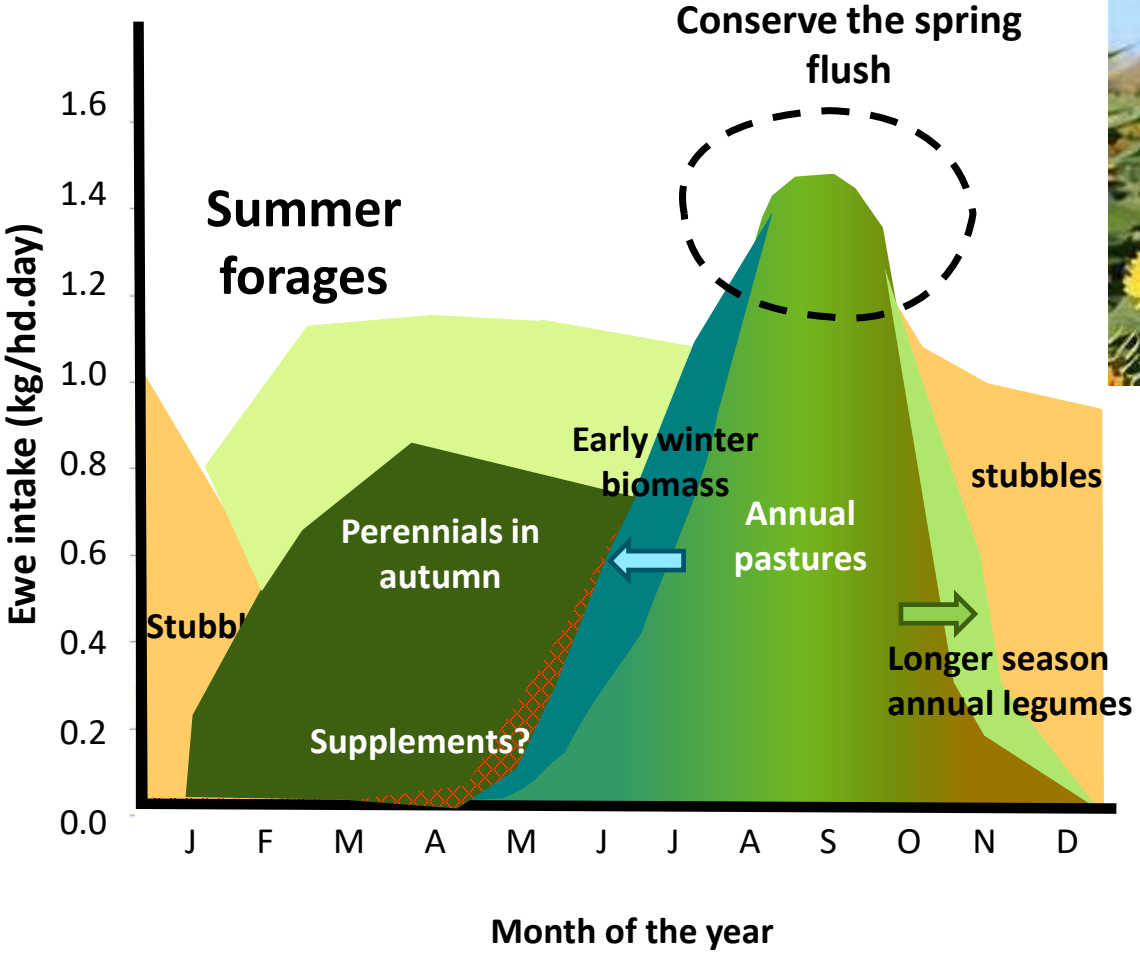
Perennial shrubs – chenopods

Saline or arid

Sandy and infertile

Summer forages

5. Summer forages where summer rainfall occurs



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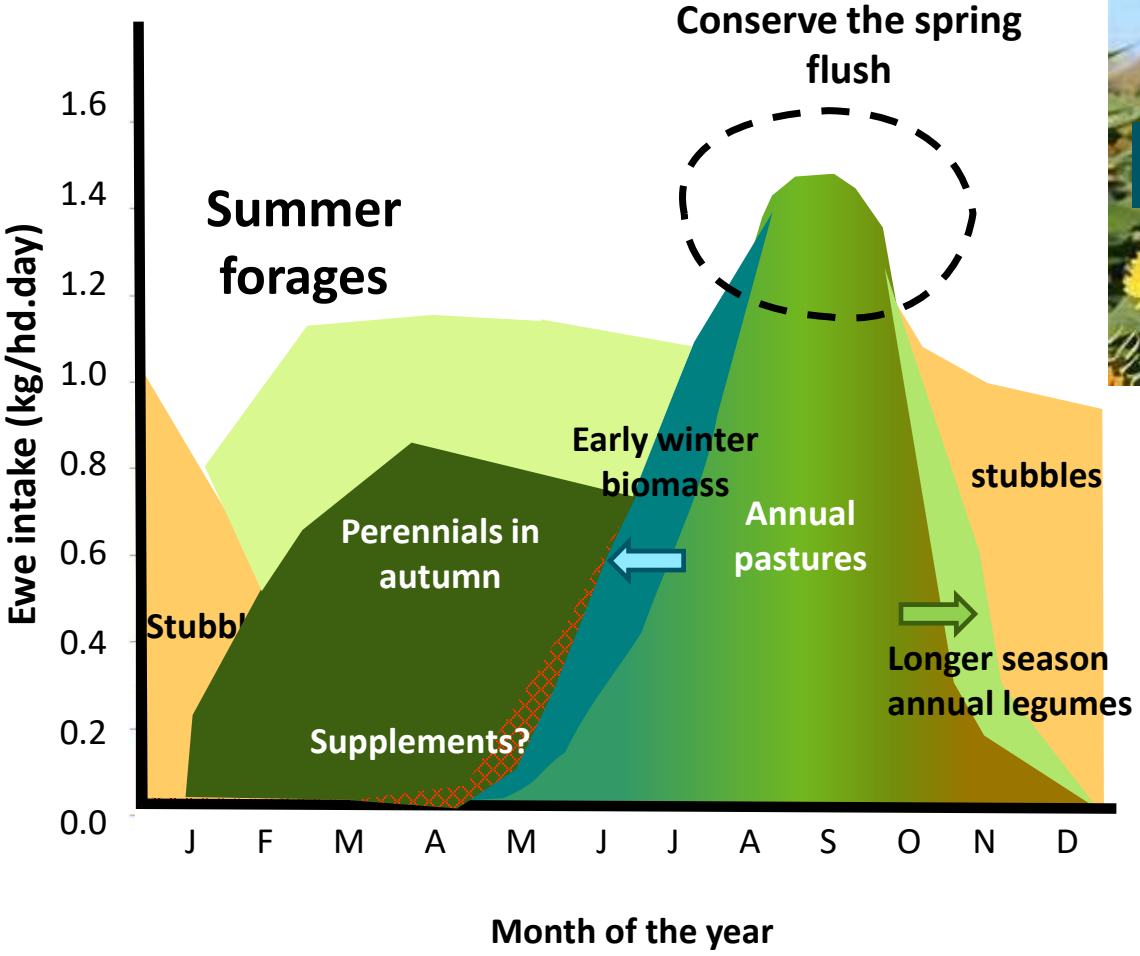
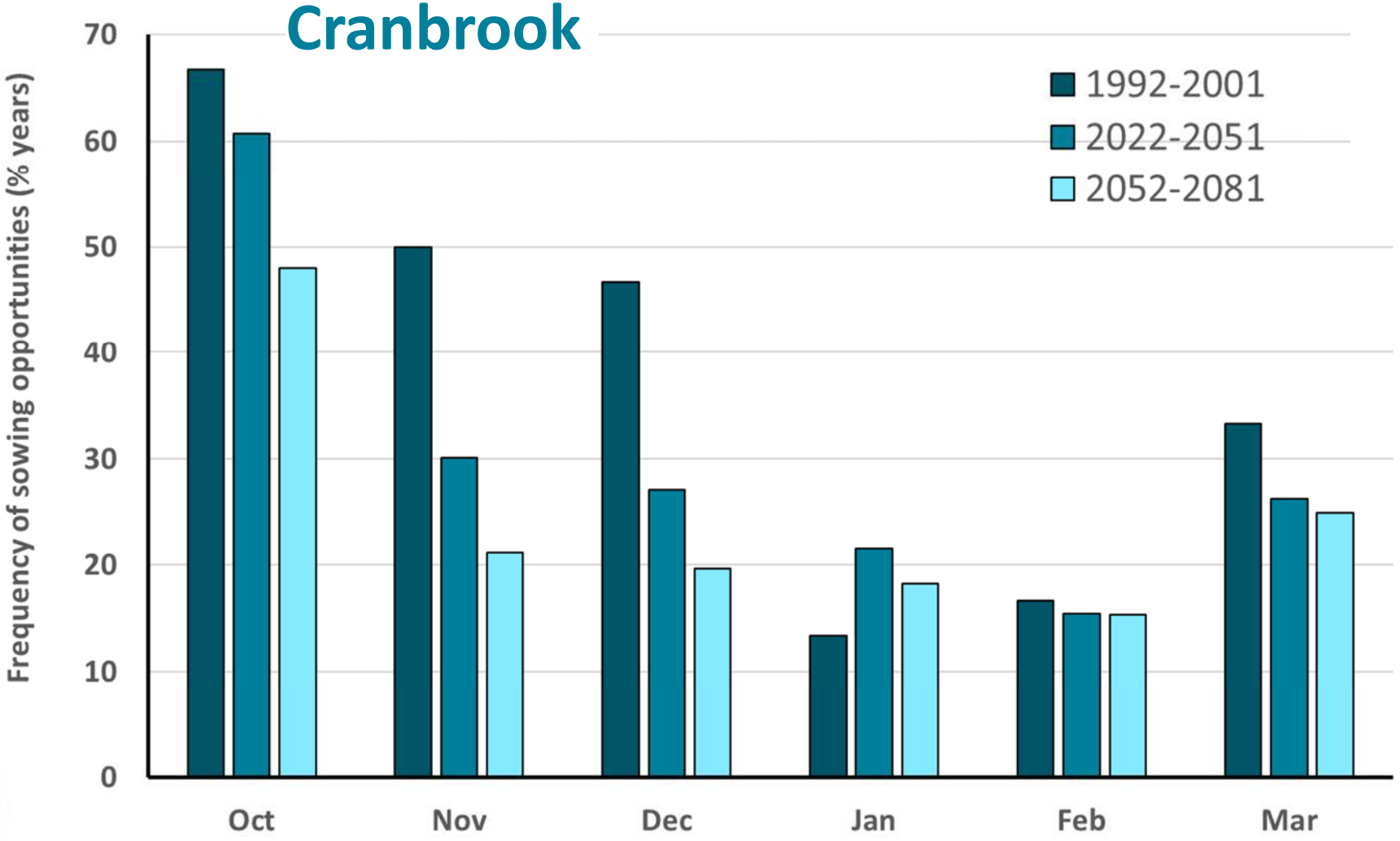


What about WA in a changing climate?

Future summer sowing opportunities in WA



Sowing opportunity was defined as rainfall was ≥25 mm in the month.

Future climate obtained from downscaled Global Carbon Model daily data under high emission scenario

Chen et al. 2022

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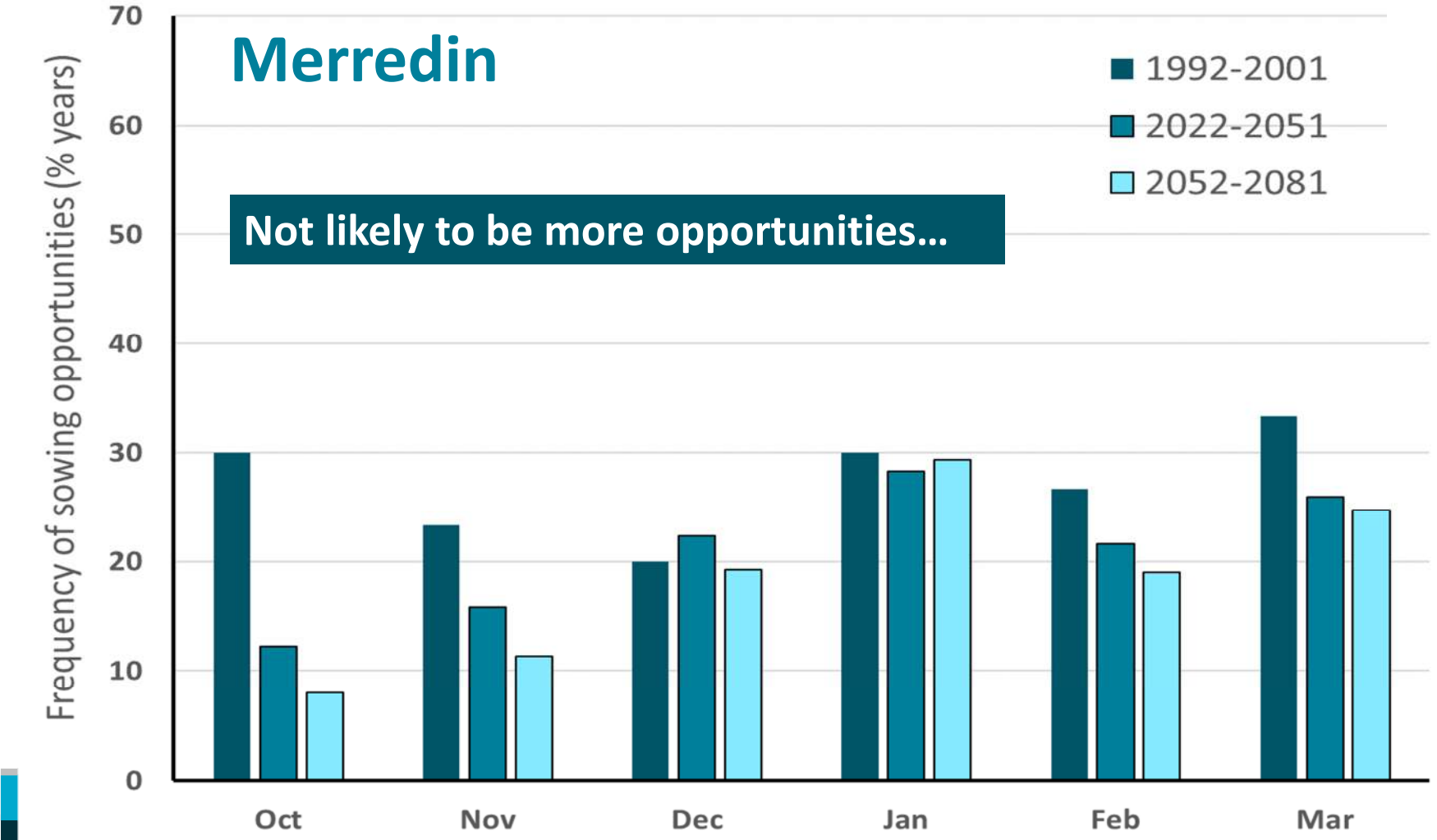

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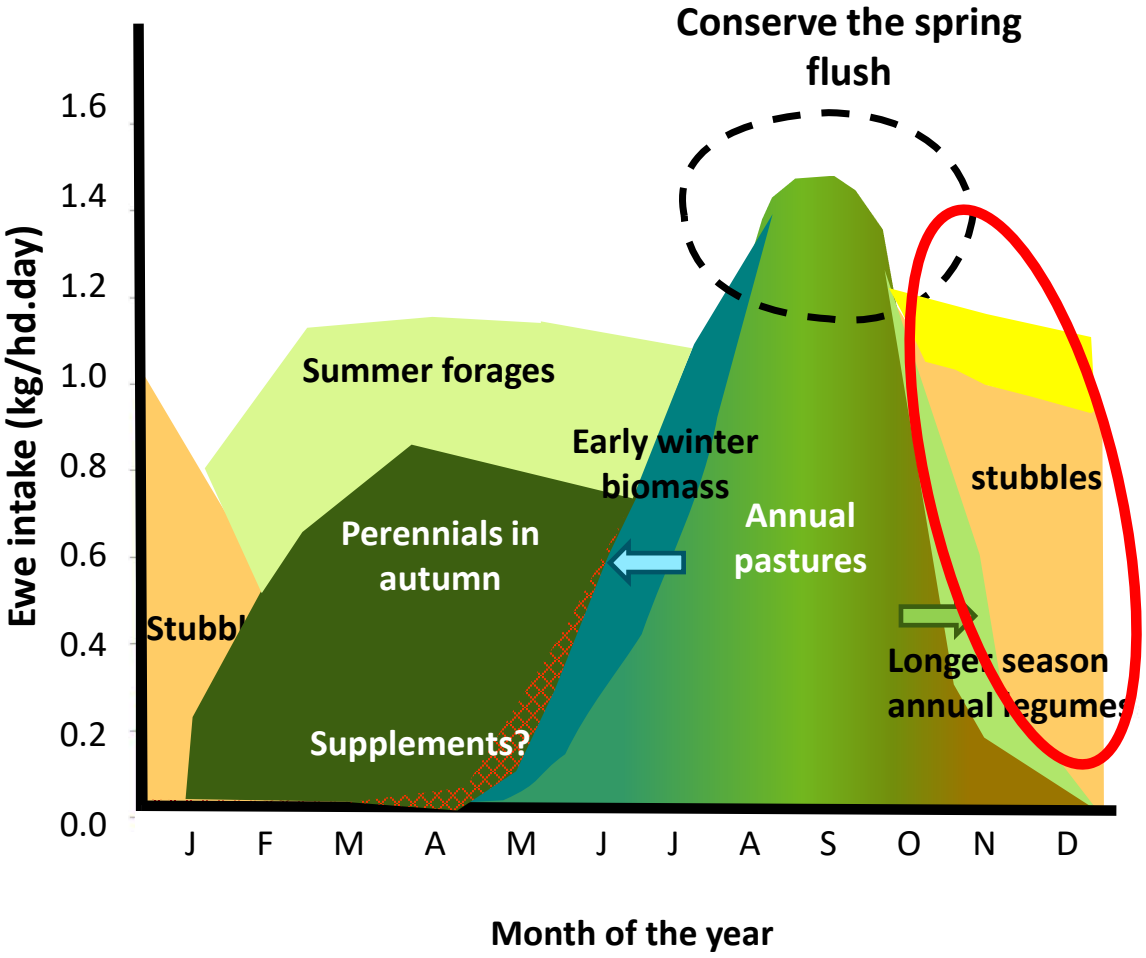
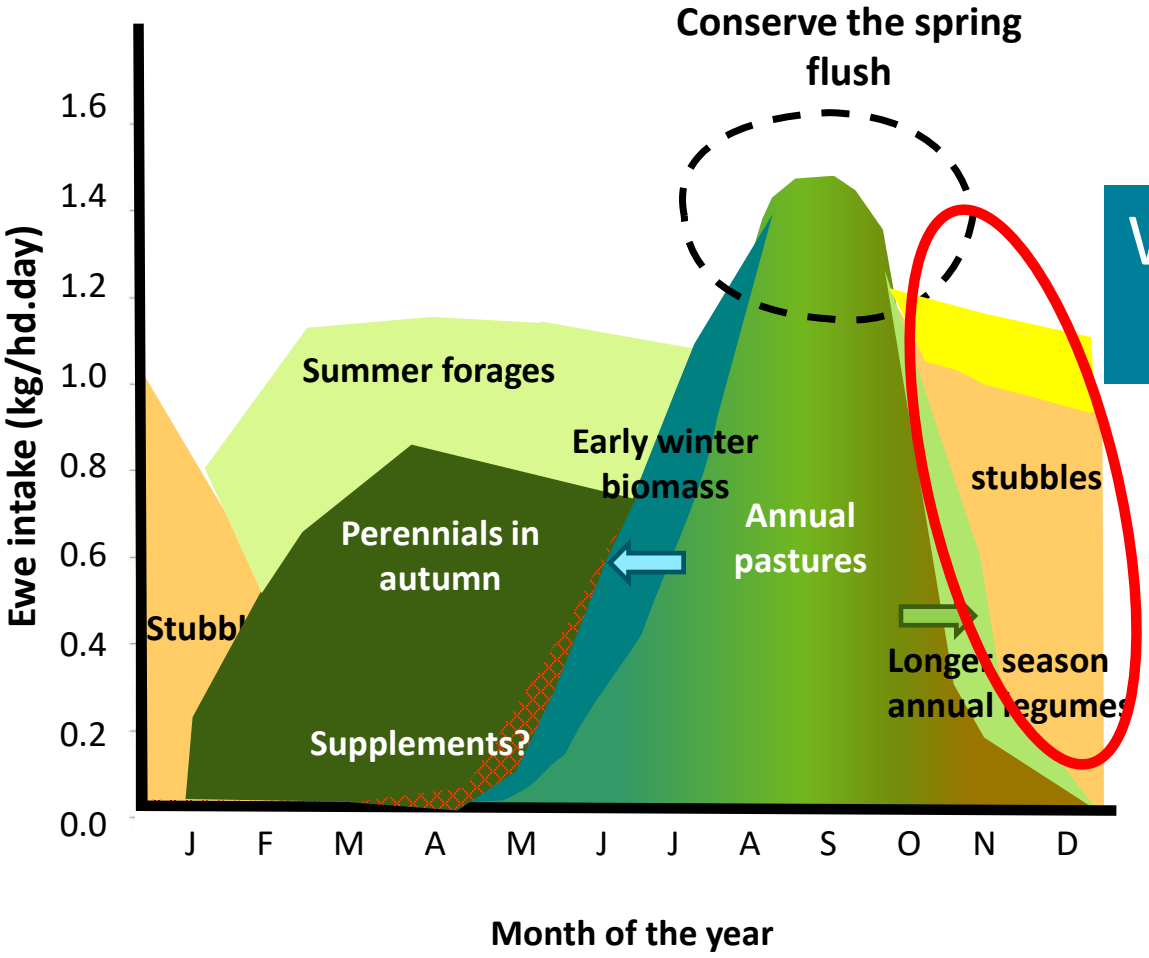
Better stubbles/standing crops

6. Better crop stubbles or grazing standing crops



- Standing crops - low lignin oats, lupins?
- More legume stubbles
- Awnless wheats

6. Better crop stubbles or grazing standing crops



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Why don't crop breeders quantify feeding value of stubbles?

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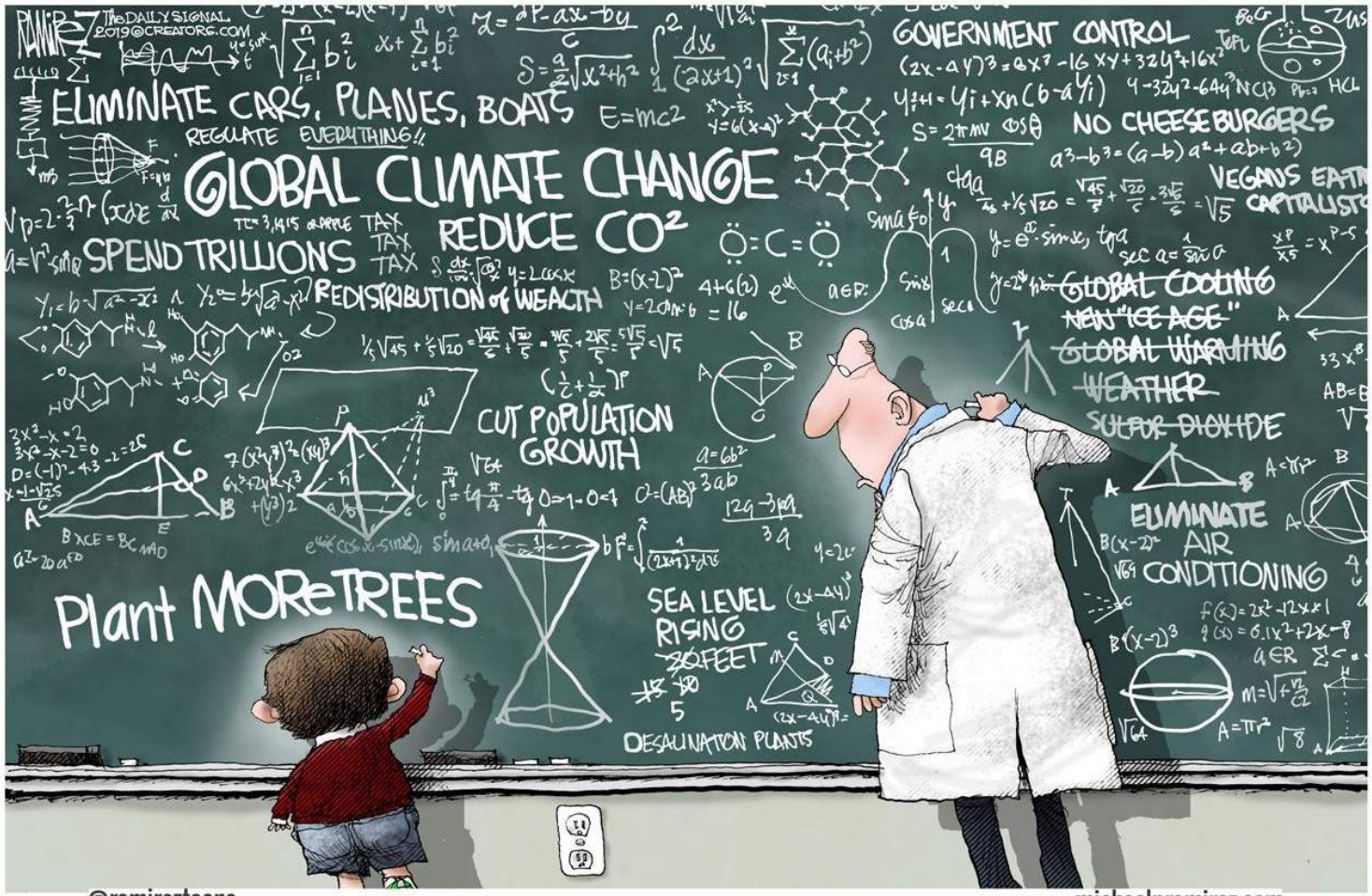
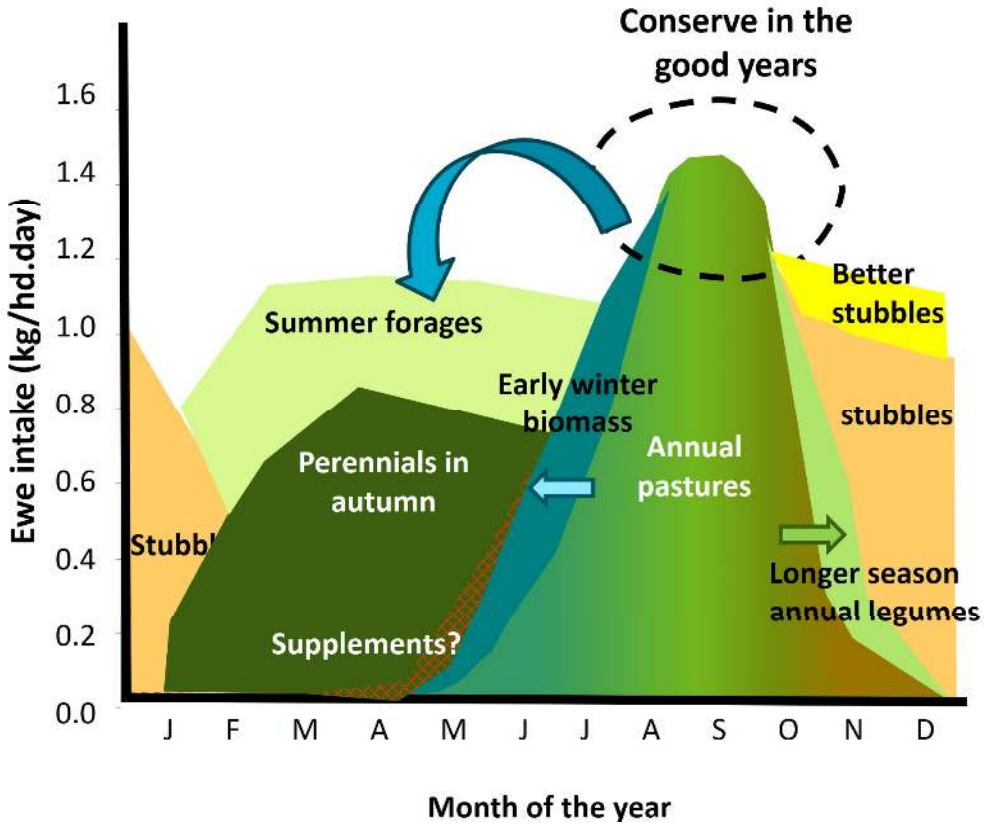


Six key opportunities to improve the feedbase in mixed zones

1. Better legumes
2. Crop Grazing
3. More forage conservation
4. Perennials on marginal soils
5. Summer forages (if summer rainfall)
6. Better crop stubbles/standing crops



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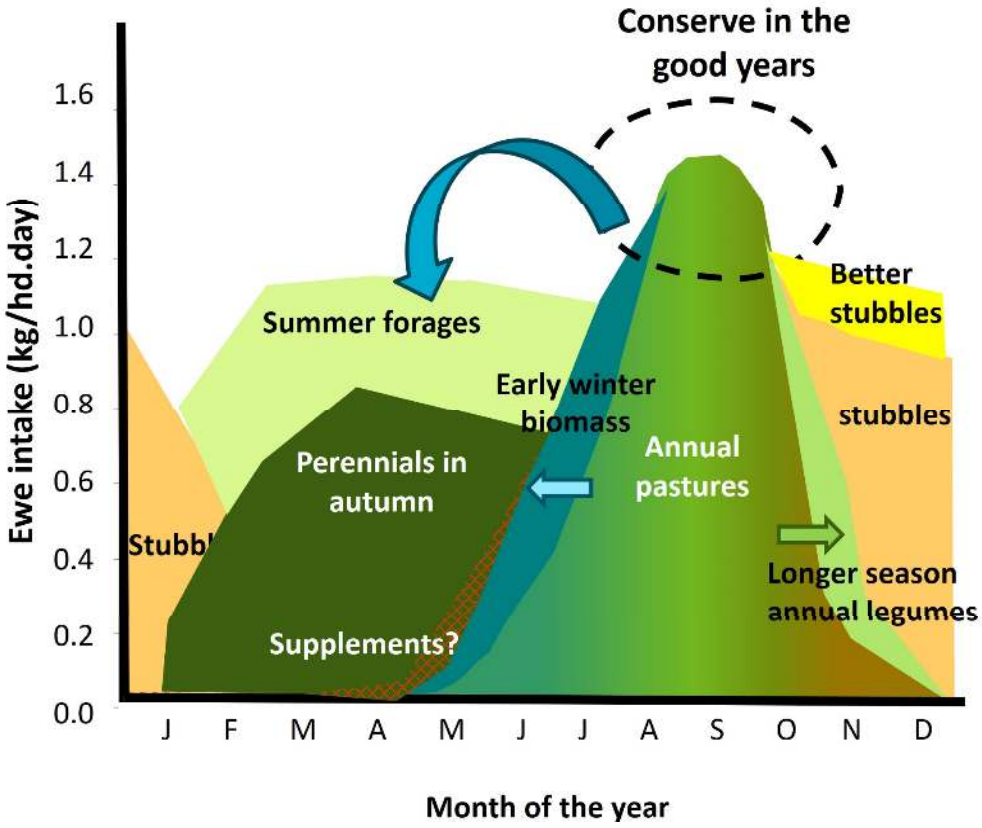
…and must be practical, easy to manage and complement cropping systems



Additional gamechangers

VF for management of spatial variation at sub-paddock scale

Multifunctional feedbase systems

Shade during heatwaves

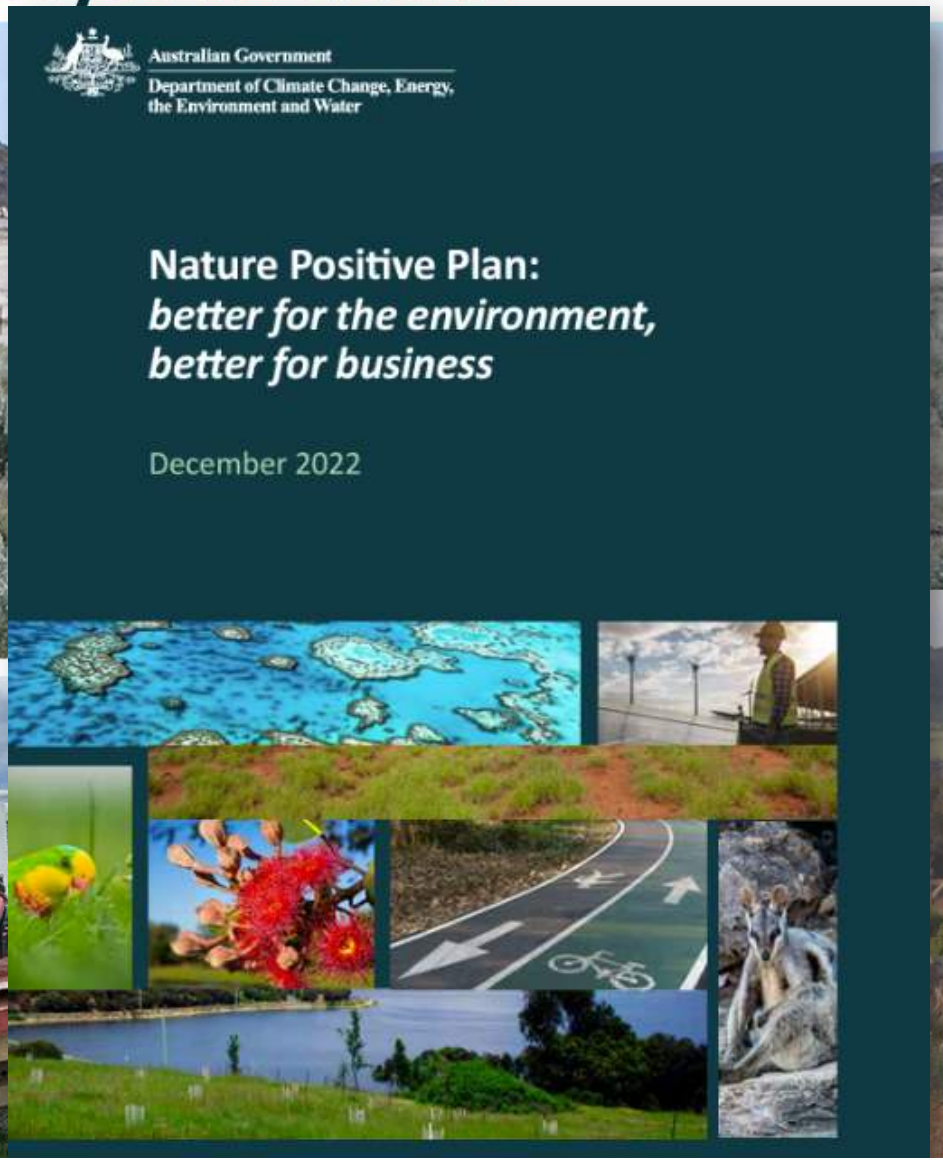
Reduced lamb deaths

Healthier animals & better meat

Less methane?

Livestock production driving ecosystem health

Livestock production driving ecosystem health



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- Move beyond seeking incremental gains and look to future needs
- Consider future market expectations and nature positive opportunities
- Multidisciplinary research to optimise synergies between enterprises and capture more benefits
- Break down the research funding silos and seek to optimise whole of system benefits, not just a component
- **…and please measure plant quality!!!**

Hayley Norman, Belinda Hackney, Chao Chen, Jessica Rigg, Tom Edwards, Andrew Fletcher, Matt Wilmot, Ron Yates, Rob Harrison, Tyson Wicks and John Howieson

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CSIRO

Murdoch University

SelectCarbon

Department of Primary Industries and Regional Development