Regenerating land with grazing livestock

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Grasses and grazing management

1. How grasses grow and respond to defoliation – enhancing plant condition to contribute to soil health and pasture production - multi species

2. Grazing management to encourage pasture growth and soil health

3. Monitoring techniques to inform feed budgeting and grazing plans

All with a view to increasing productivity

Grass Growth

Herbage Mass Low

Quality High

Herbage Mass Good to High

Quality High

Herbage Mass High

Quality declining

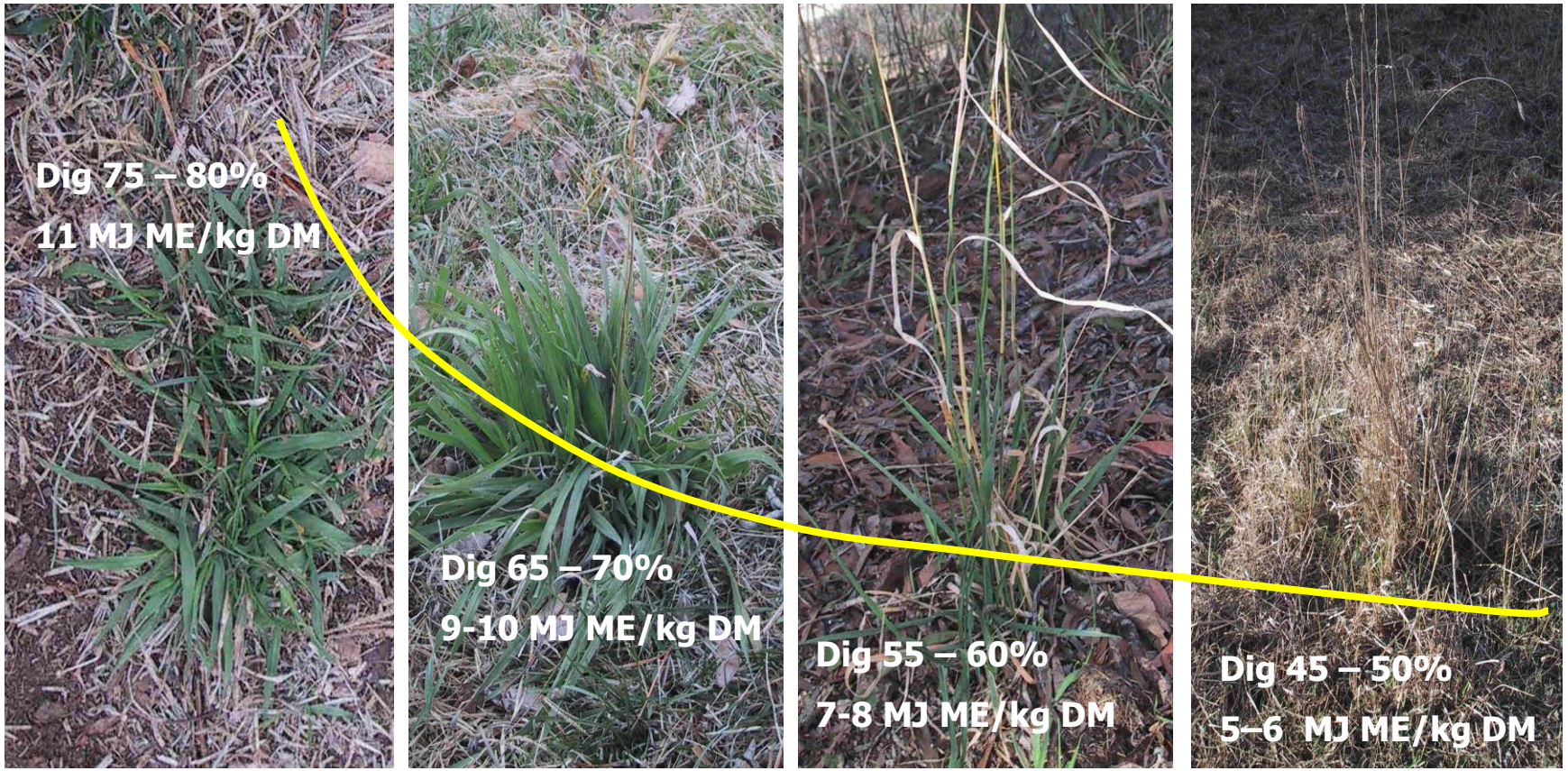
Herbage Mass High

Quality Low

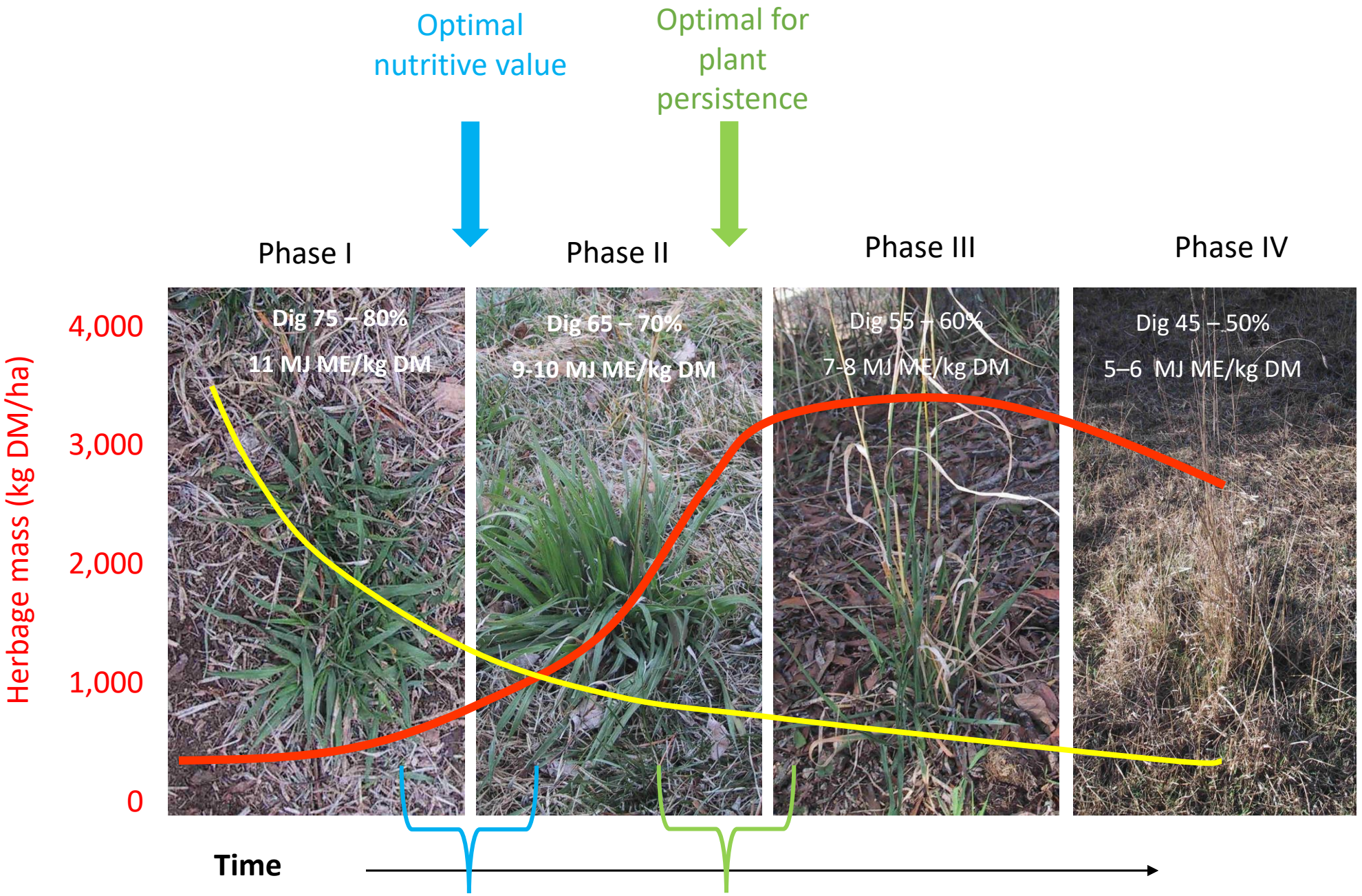
Time

Grass Growth

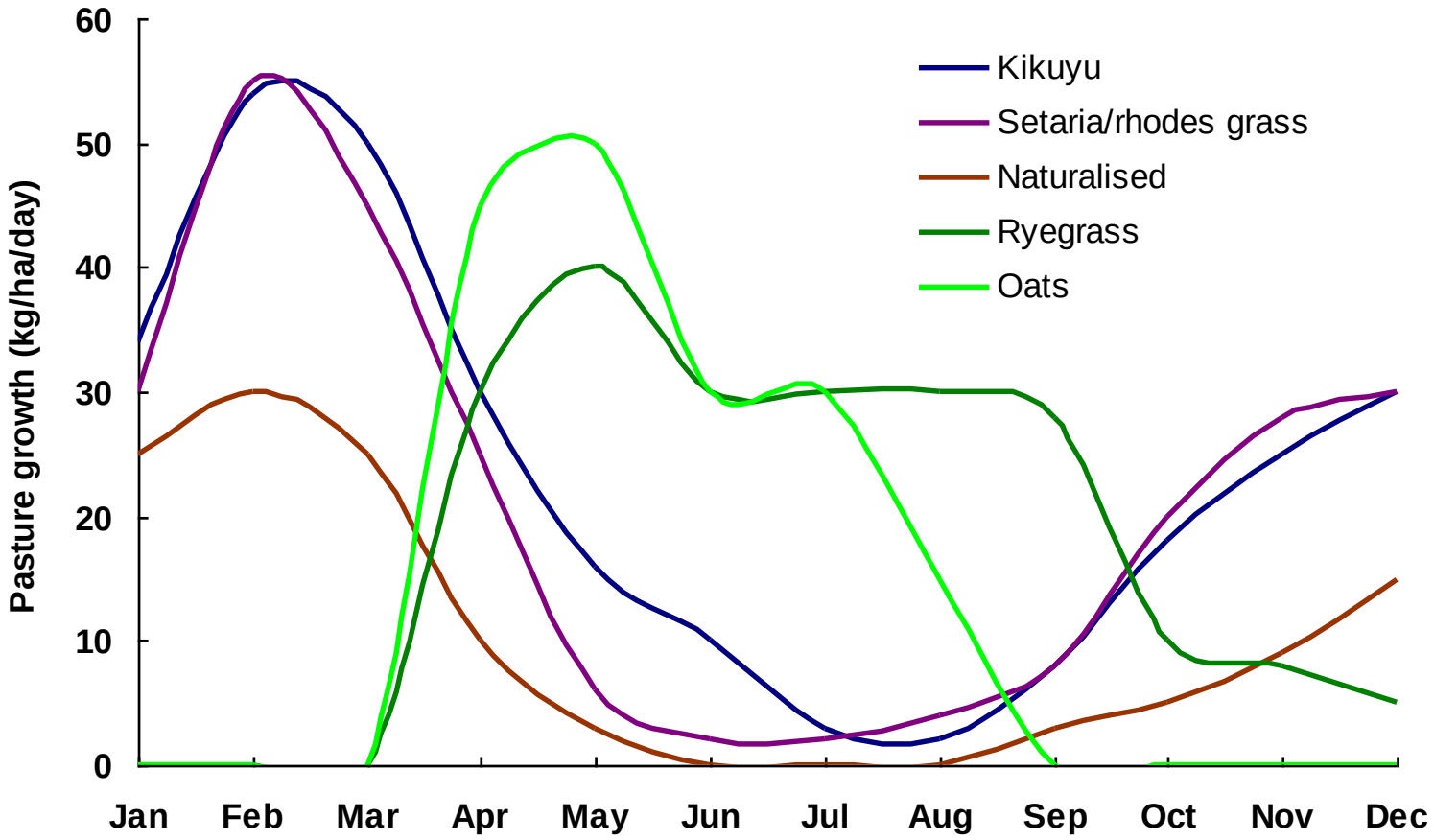
Quality changes as plants grow



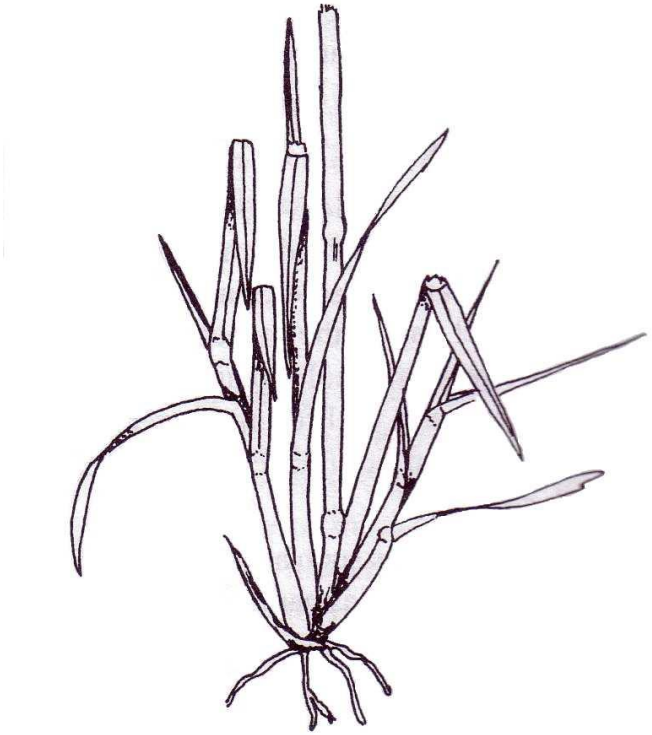
Time →


Optimal nutritive value
Optimal for plant persistence
Phase I
Phase II
Phase III
Phase IV
Herbage mass (kg DM/ha)
4,000
3,000
2,000
1,000
0
Dig 75 – 80%
11 MJ ME/kg DM
Dig 65 – 70%
9-10 MJ ME/kg DM
Dig 55 – 60%
7-8 MJ ME/kg DM
Dig 45 – 50%
5–6 MJ ME/kg DM
Time

Growth cycles



Tussock grasses



Tussock grasses are made up of a number of independent but connected units or tillers.

Growth points

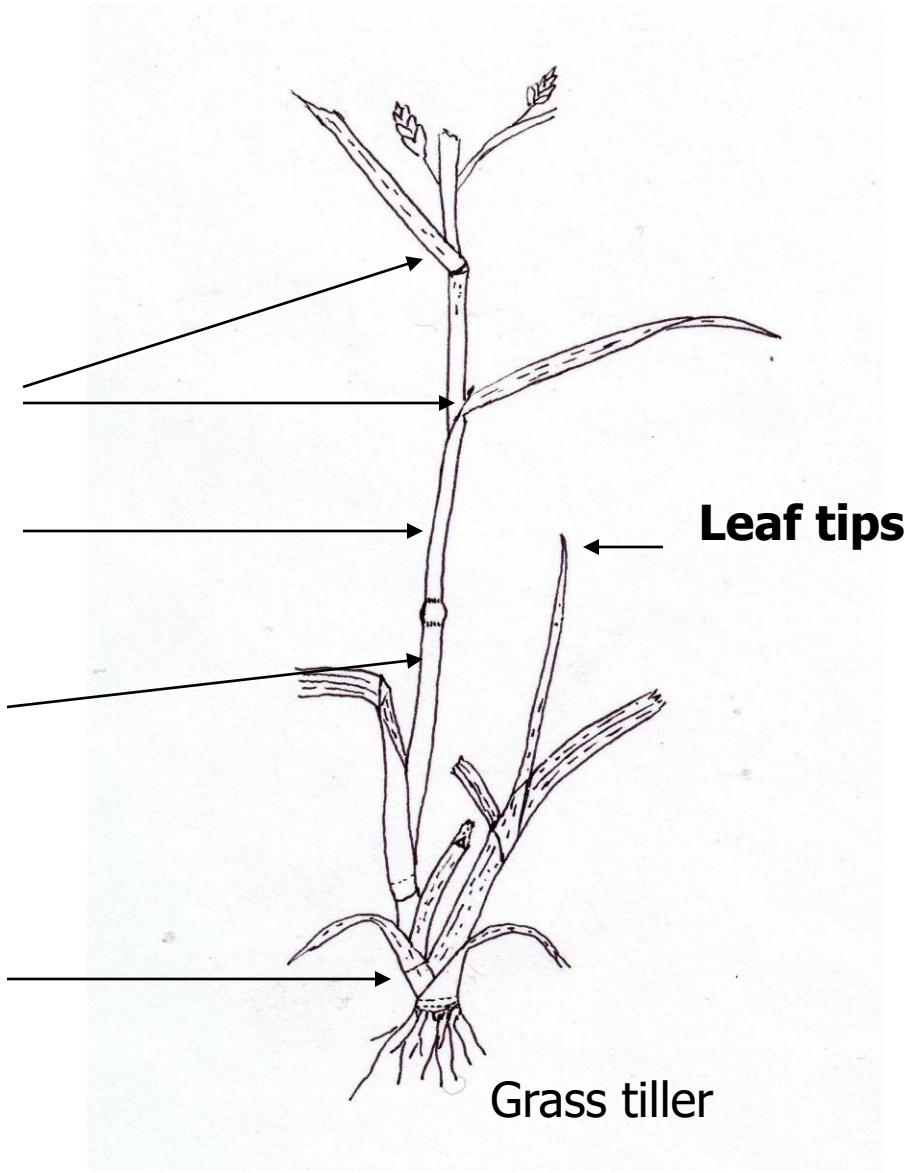
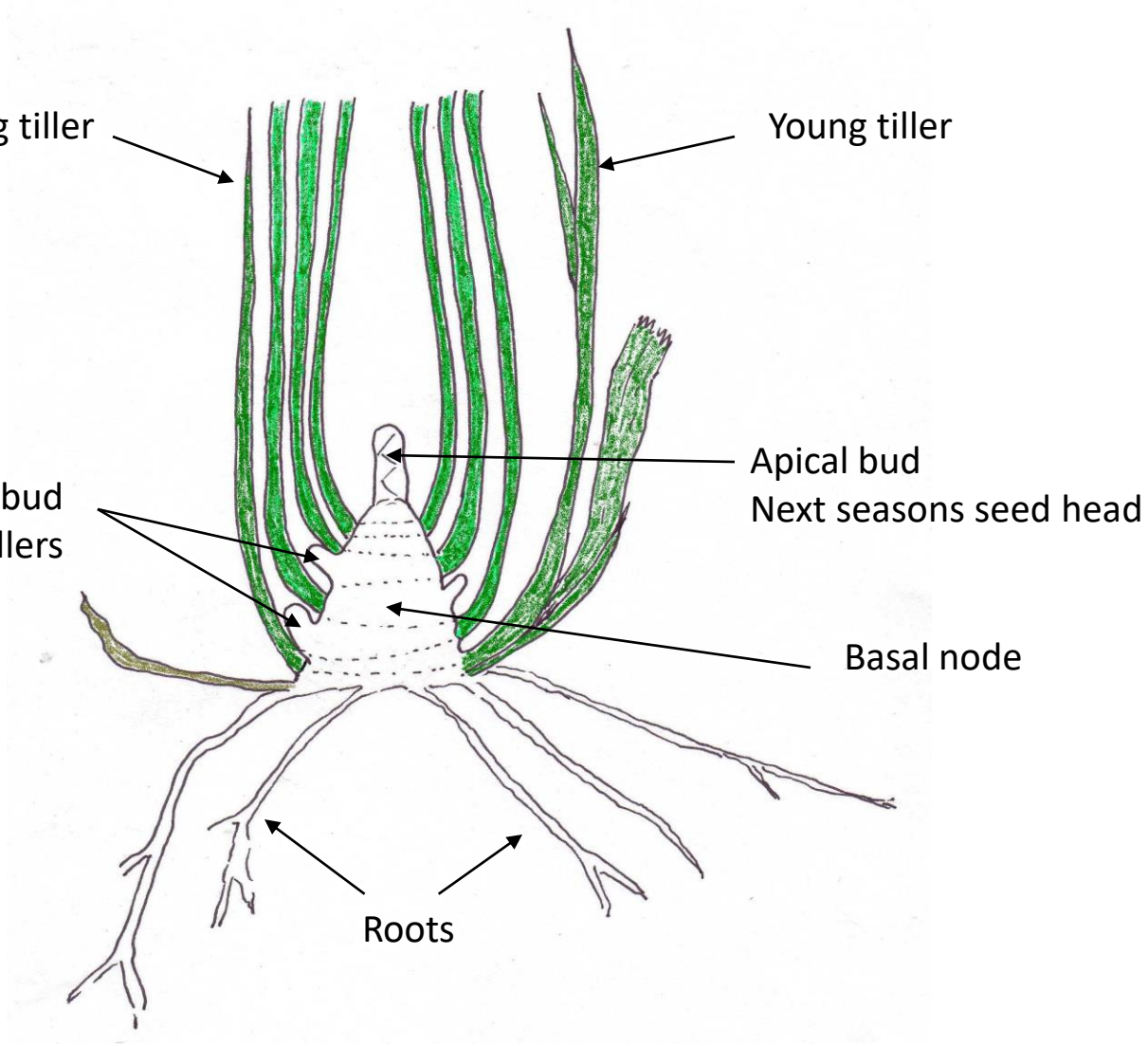
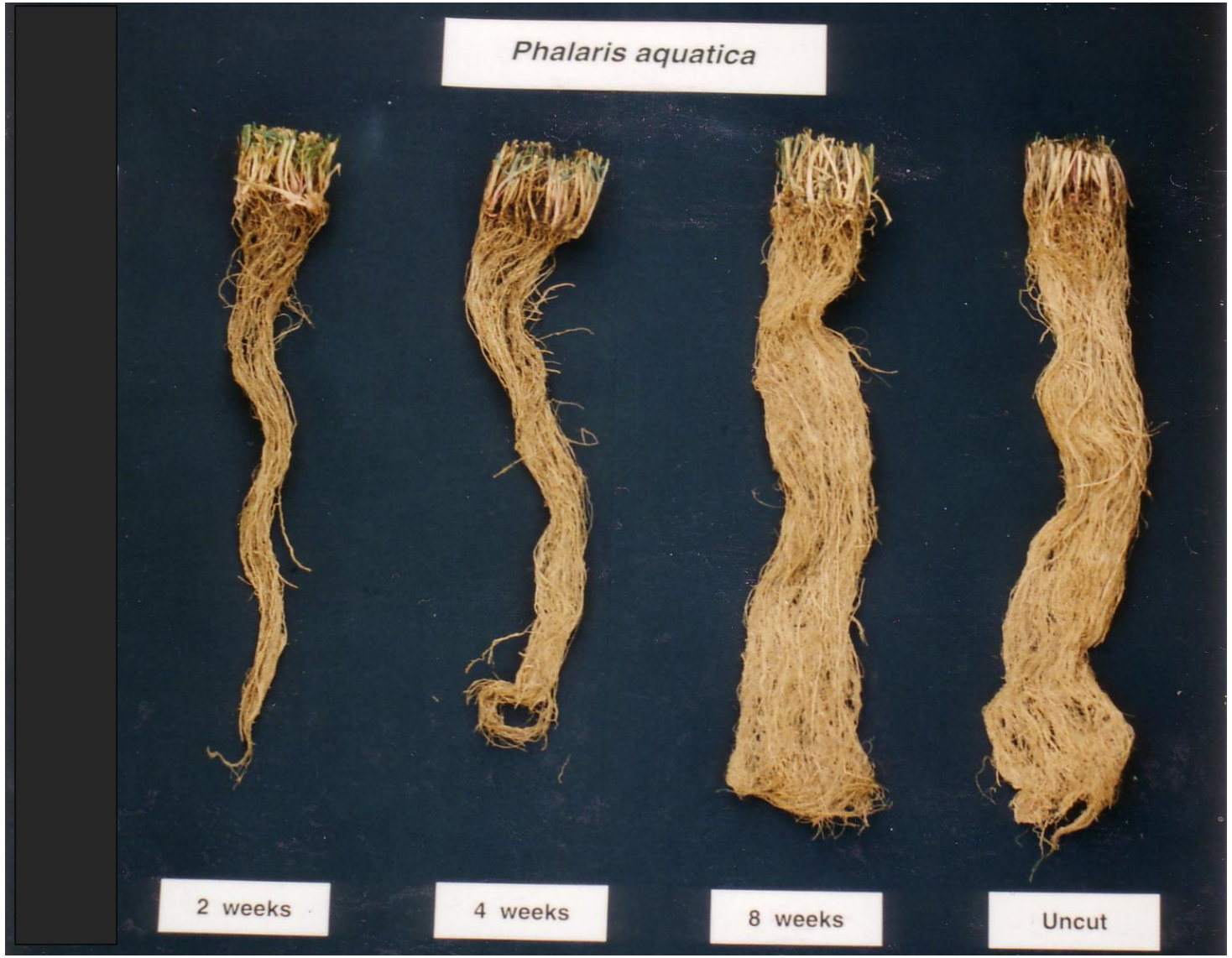


Diagram of the basal growth point of Phalaris



Adapted from Wheeler *et al* 2002


Senesced leaf
Axillary Bud
New tillers
New roots

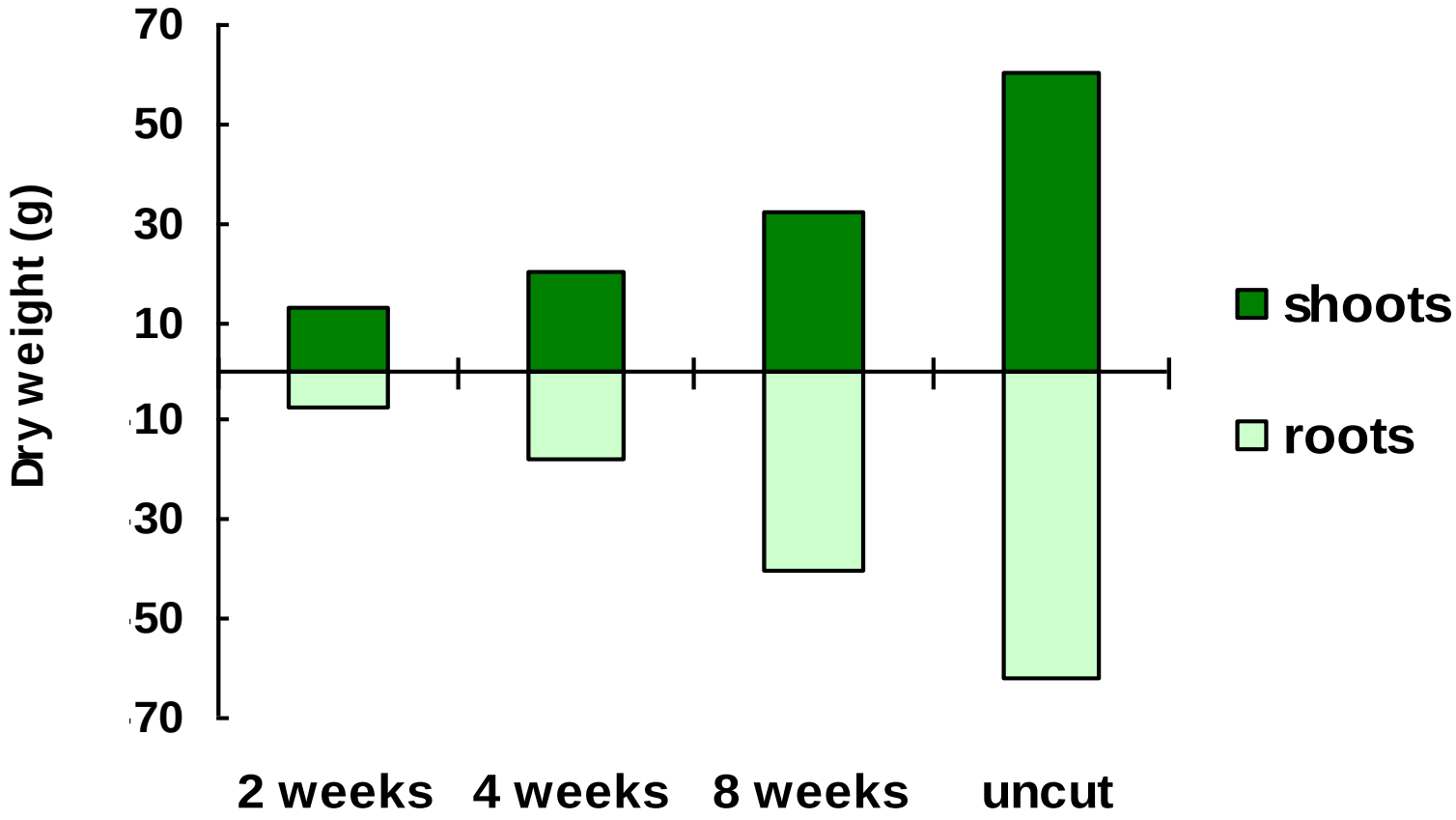


50cm

Effect of frequency of cutting on roots over 1 year

Shoot to root ratios

Controlled pot experiment where plants were cut to 3cm at 2, 4 or 8 week intervals or uncut over 12 months



Leaf removal and growth rates

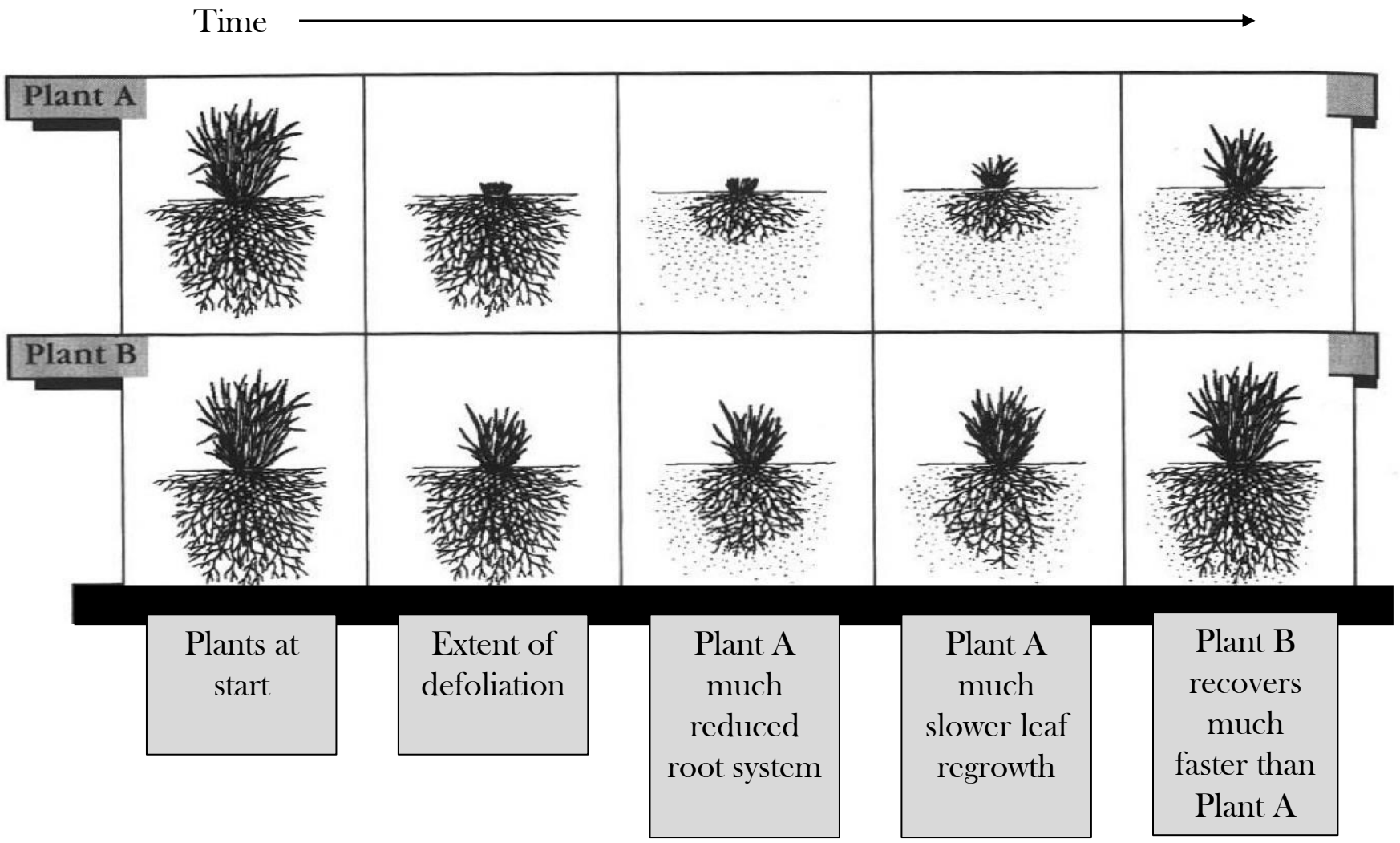
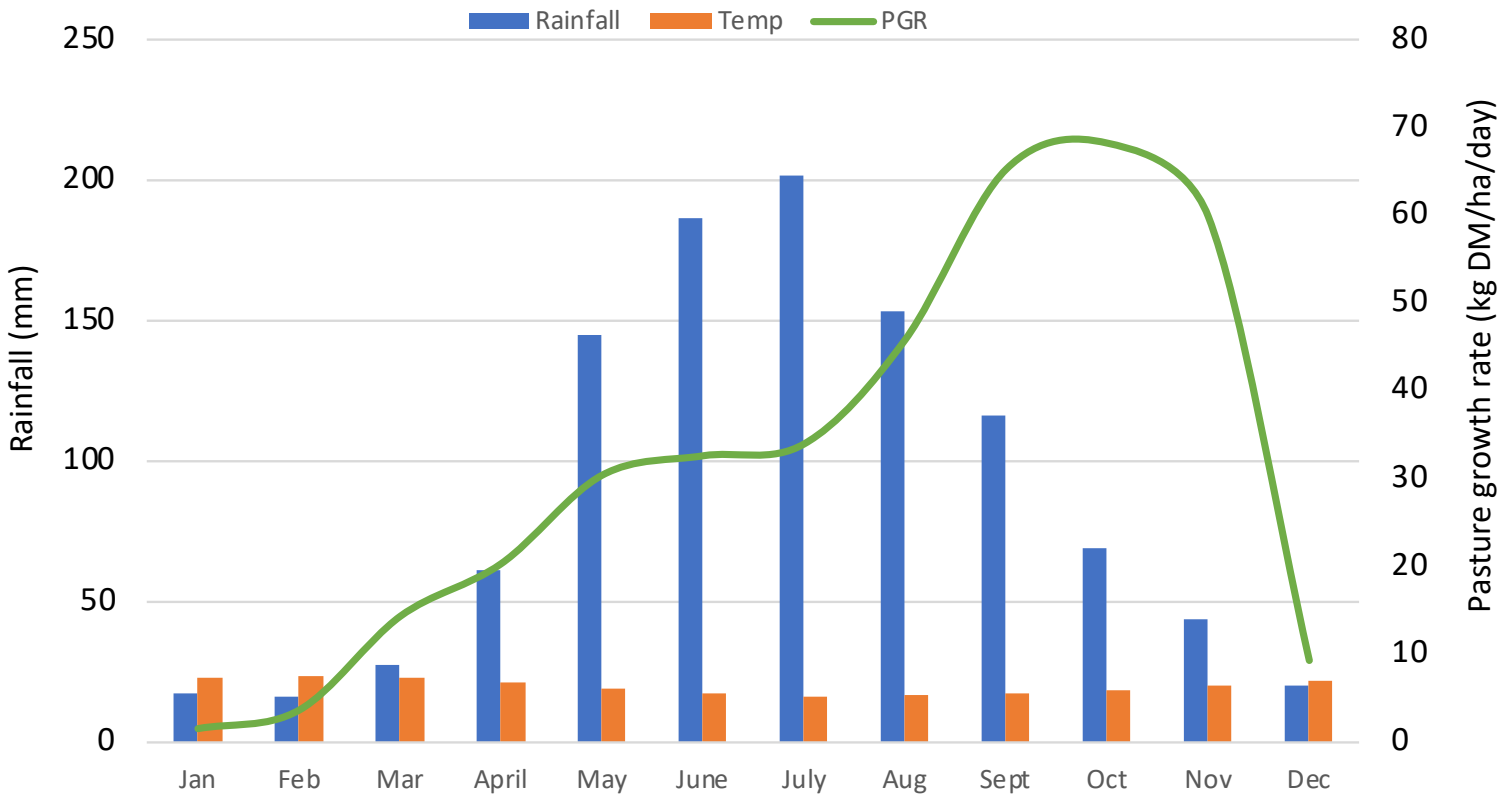


Photo: Christine Jones

Plant material above the ground is a reflection of root material present below the ground

Environmental influences on plant growth



Factors that influence plant growth

Environmental factors	Plant factors	Soil factors
Rainfall: amount & distribution	Species	Cation exchange capacity
Temperature	Stage of growth	Fertility and pH
Sunlight: duration & intensity	Height or leaf area	Water holding capacity
Season	Time since grazed	Water infiltration rate
Soil type	Residual herbage mass	Compaction
Slope	Groundcover	Organic matter and soil C
Aspect	Presence of weeds	Biological activity
Proximity to water	Tree cover	Depth of topsoil

Local Issues

Mediterranean environment – short defined growth period
Soil fertility
Low populations of perennial grasses
Low pasture species diversity
Absence of seed bank species diversity
High populations of undesirable species
Slow early season pasture growth rate
Lower than optimal pasture growth rate
Lower than optimal stocking rates
Need to feed hay or silage during summer
Low levels of residual herbage mass
Excessive rates of utilisation
Highest livestock demand at the most critical time for new season growth

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Solutions

- Introduce species diversity – multi species planting
  - Perennial and annual
  - Different plant families
  - Different growth cycles
- Planned grazing management
  - Increase number of paddocks per mob
  - Use stock density
  - Plan recovery
  - Plan residual herbage mass
  - Control utilisation

Species selection

Your goals?

- Production stability
- Enhance ecosystem processes
- Improve production
- Increase soil carbon


Species selection
Perennial grass
Annual grass
Legume
Broadleaf

Establishment

Multi species
Advantages

Water cycle

- Diversity of root architecture
- Diversity of root depth
- Improved soil structure
- Improved water holding capacity

Mineral cycle

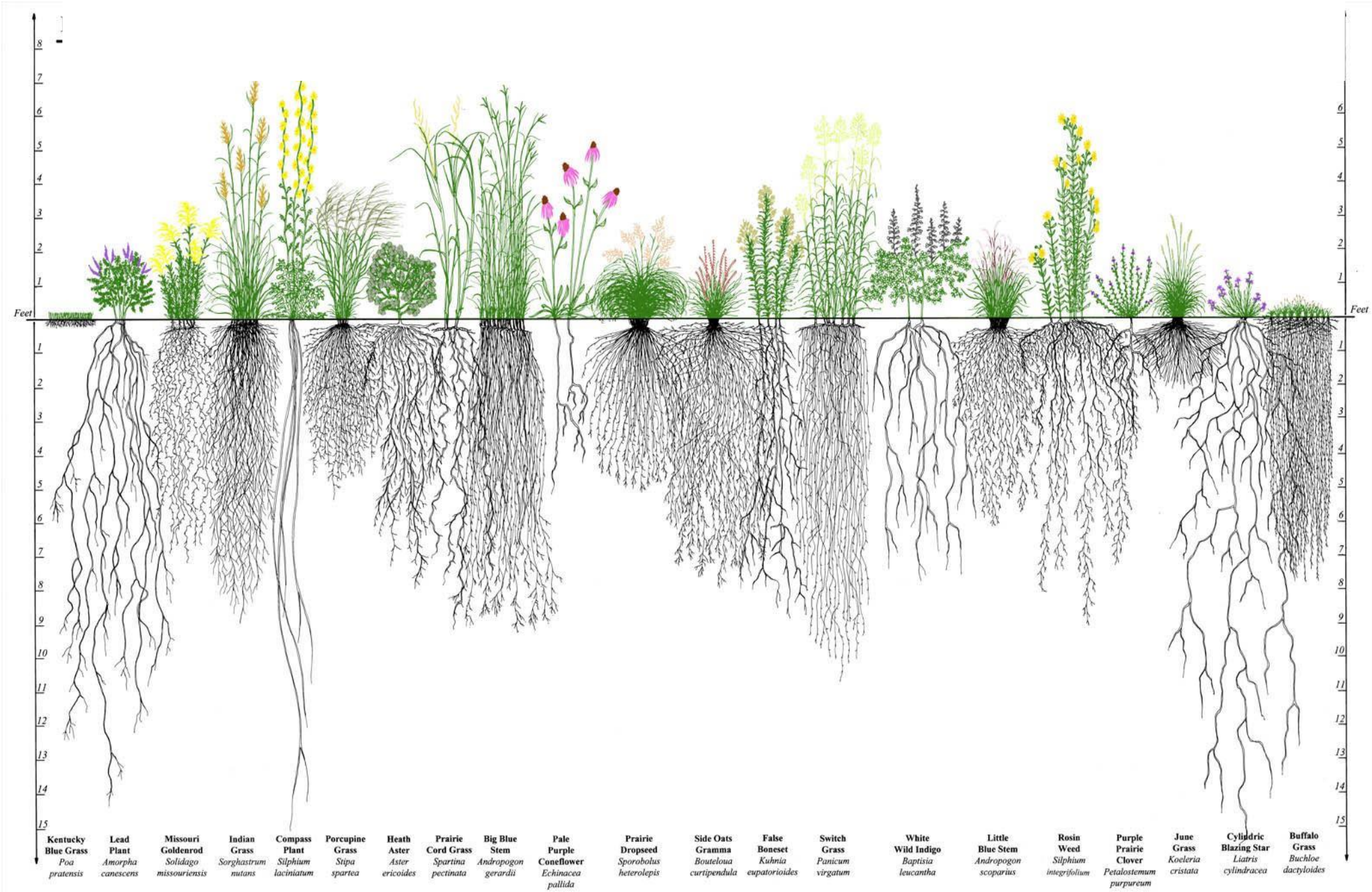
- Biological activity
- Different species host a range of different microorganisms
- Aggregate stability

Community dynamics

- More species, more resilience
- More even annual production
- Improved animal nutrition
- Plant species complementarity

Energy Flow

- Species differ in growth cycles
- Increased photosynthetic capacity
- Increased plant growth


Feet
Feet
8 7 6 5 4 3 2 1
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Kentucky Blue Grass Poa pratensis
Lead Plant Amorpha canescens
Missouri Goldenrod Solidago missouriensis
Indian Grass Sorghastrum nutans
Compass Plant Silphium laciniatum
Porcupine Grass Stipa spartea
Heath Aster Aster ericoides
Prairie Cord Grass Spartina pectinata
Big Blue Stem Andropogon gerardii
Pale Purple Coneflower Echinacea pallida
Prairie Dropseed Sporobolus heterolepis
Side Oats Gramma Bouteloua curtipendula
False Boneset Kuhnia eupatorioides
Switch Grass Panicum virgatum
White Wild Indigo Baptisia leucantha
Little Blue Stem Andropogon scoparius
Rosin Weed Silphium integrifolium
Purple Prairie Clover Petalostemum purpureum
June Grass Koeleria cristata
Cylindric Blazing Star Liatris cylindracea
Buffalo Grass Buchloe dactyloides

Diversity – Some examples

- Northern tablelands NSW :- 16 species / 0.25m^2 quadrat
- Inverell:- 23 - 64 species /5m^2 – total 135 species (43 grasses)
- Brewarrina:- 65 species (18 grasses)
- Cunnamulla:- 124 - 193 species recorded over 3-5 monitoring periods
- Coolatai:- Over 12 years, 295 plant species from 62 families including 84 grasses, 115 forbs and 25 legumes

Grazers

- Selective
- One plant at a time
- Physical impact
- Conversion of nutrients
- Conversion of carbon
- Need to be managed

Healthy perennial grass plants

Increased root biomass

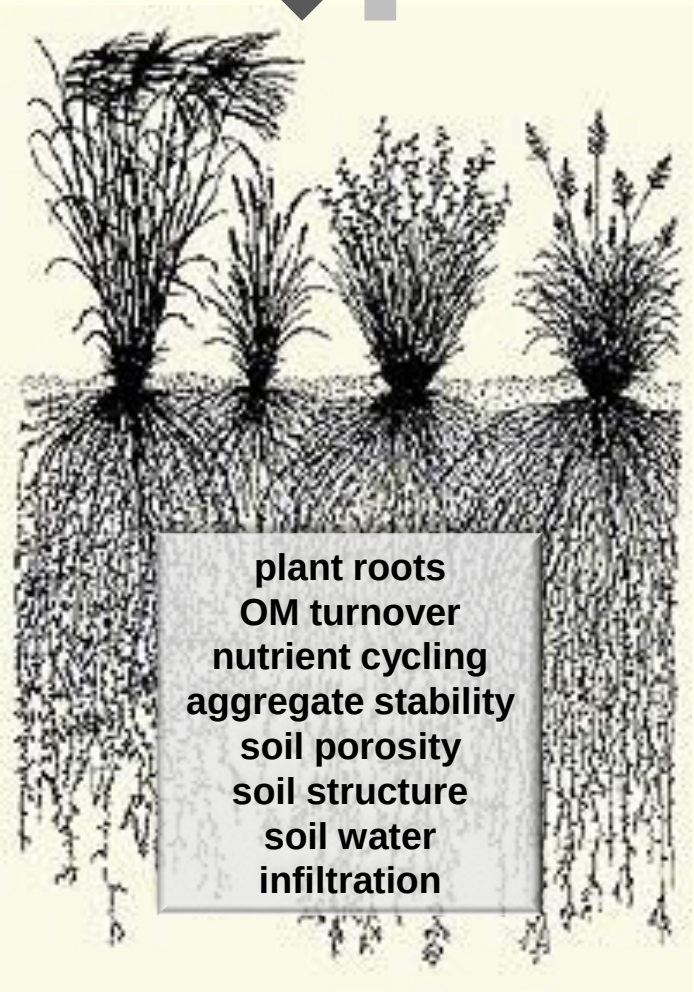
- Increase soil organic matter
- Increase biological activity
- Increase nutrient cycling
- Increase humus
- Increase plant growth rate
- Increase livestock carrying capacity

Sunlight, water & atmospheric C (primarily CO_2)

plant residues
nutrients from animals

micro & macro organisms

<u>decomposers</u>
dung beetles
earthworms
mites
springtails
nematodes
mycorrhiza
fungi
bacteria



plant growth
pasture production

<u>active soil carbon</u>
soil animals
micro-organisms
root exudates

<u>stable soil carbon</u>
humus - chemically protected C
physically protected C

Plant Competition

Pasture plants compete with each other for

- Moisture
- Nutrients
- Light
- Space

Within a single plant competition is for

- Nutrients
- Light
- Space

Features to remember

- With grasses, what you see above ground in terms of leaf biomass is reflected below in root biomass
- While the paddock is the management unit – change occurs one plant at a time
- Defoliation intensity and frequency can be compensatory

Plant and pasture growth

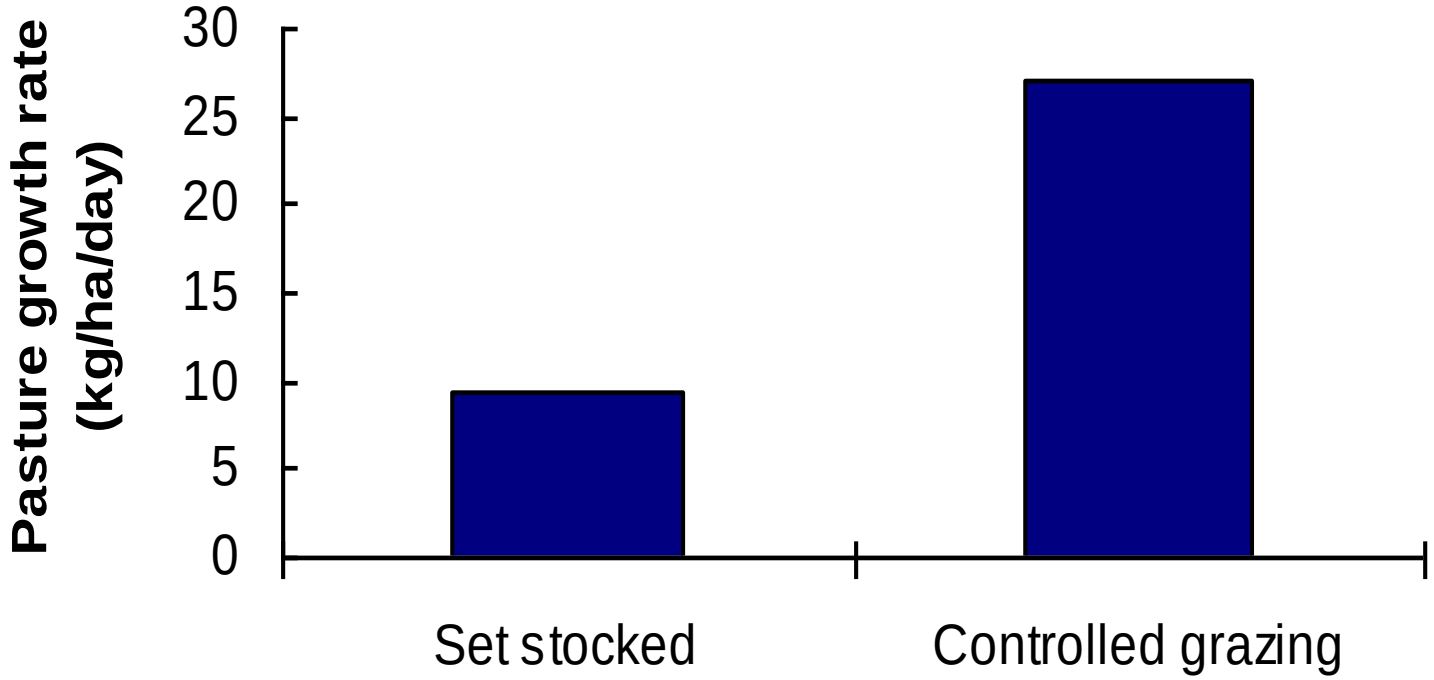
- There can be large differences in plant growth rate between paddocks with similar soil type and rainfall
- Grazing management (defoliation) is an important factor in controlling plant growth rate
- All grasses have the same basic sigmoidal growth pattern
- The growth rate and quality of pasture plants change through the seasons
- Different species have different growth cycles
- The capture of sunlight drives pasture growth

How can we use this knowledge of plant growth to optimise management of pastures and livestock?

The range of grazing strategies

- Continuous grazing
- Set stocking
- Rotational grazing ‘system’
- Strategic grazing
- Tactical grazing
- Techno grazing
- Cell grazing
- Planned holistic grazing
- Planned grazing

Spring growth rates of adjacent paddocks west of Guyra



South Australian trials 2001-2005

	Set Stocking	Planned grazing
Stocking rate (DSE/ha)	2.4	4.2
Groundcover %	60	90
Infiltration rate (mm/min)	4	18

Influencing plant growth with management

4 key factors that are within your control

- Recovery period → Growing season
  - → Non or slow growing season
- Graze period
- Residual herbage mass
- Stock numbers – stocking rate

Recovery period

- Critical considering the effect of defoliation on plants
- Will depend on pasture growth rate
- Distinction between rest and recovery
- Getting it ‘right’ is a challenge

Graze period

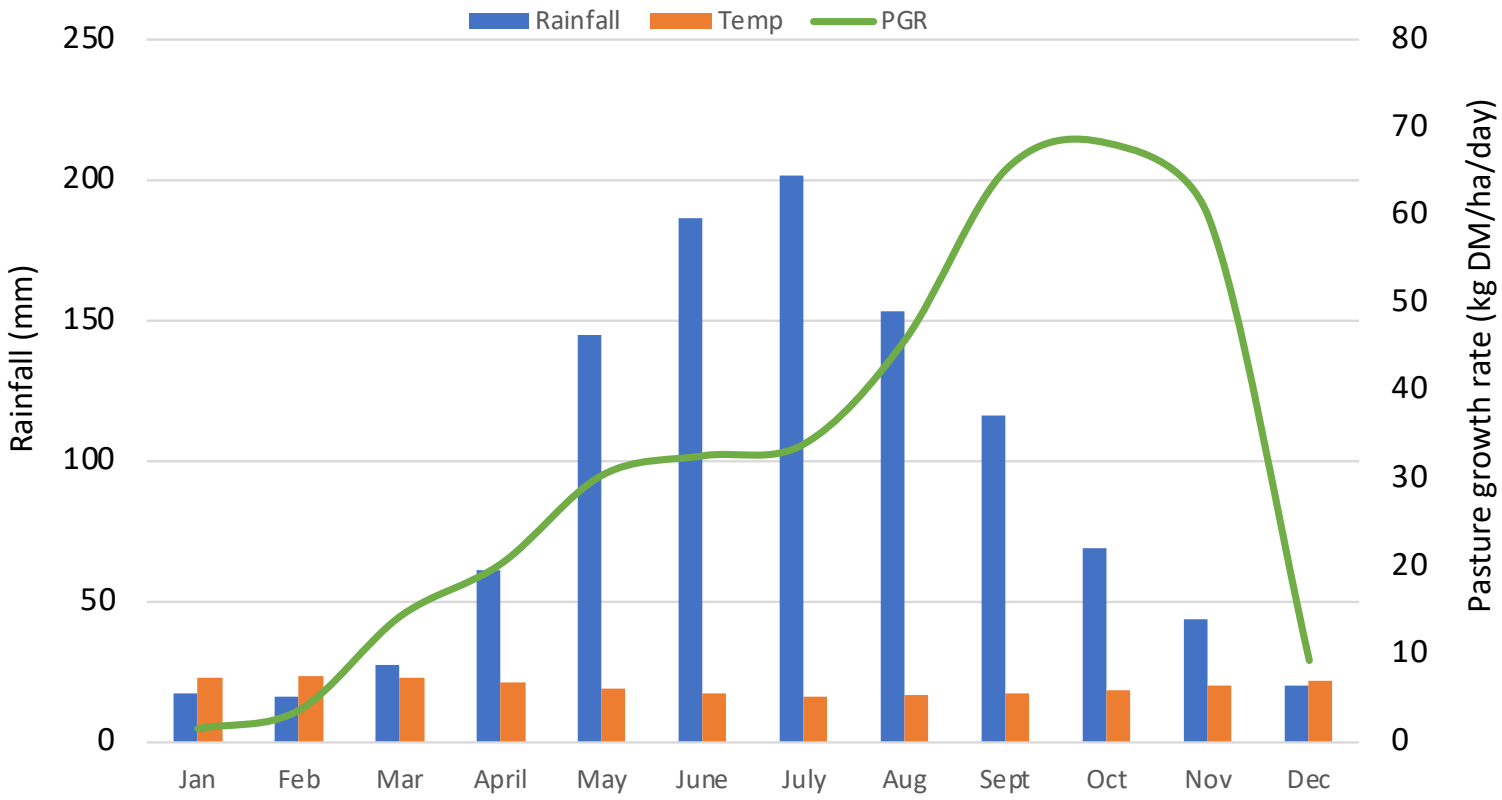
- Will be a function of the recovery period required
- Aim to avoid a second bite on growing plants
- When plants grow quickly graze period will be shorter and when growth is slow the graze period can be longer

Residual herbage mass

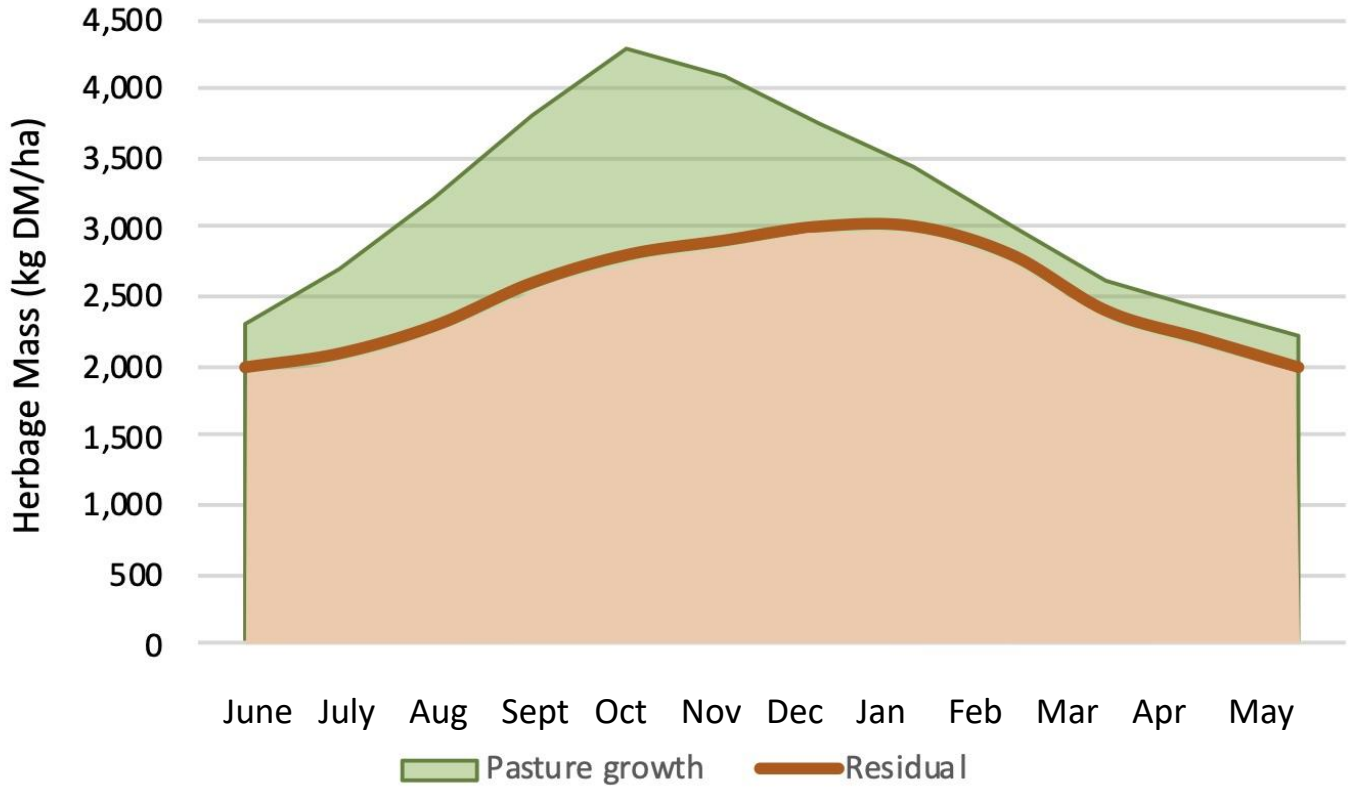
Grazing ….. occurs one plant at a time

Residual leaf 5cm height

Pasture growth



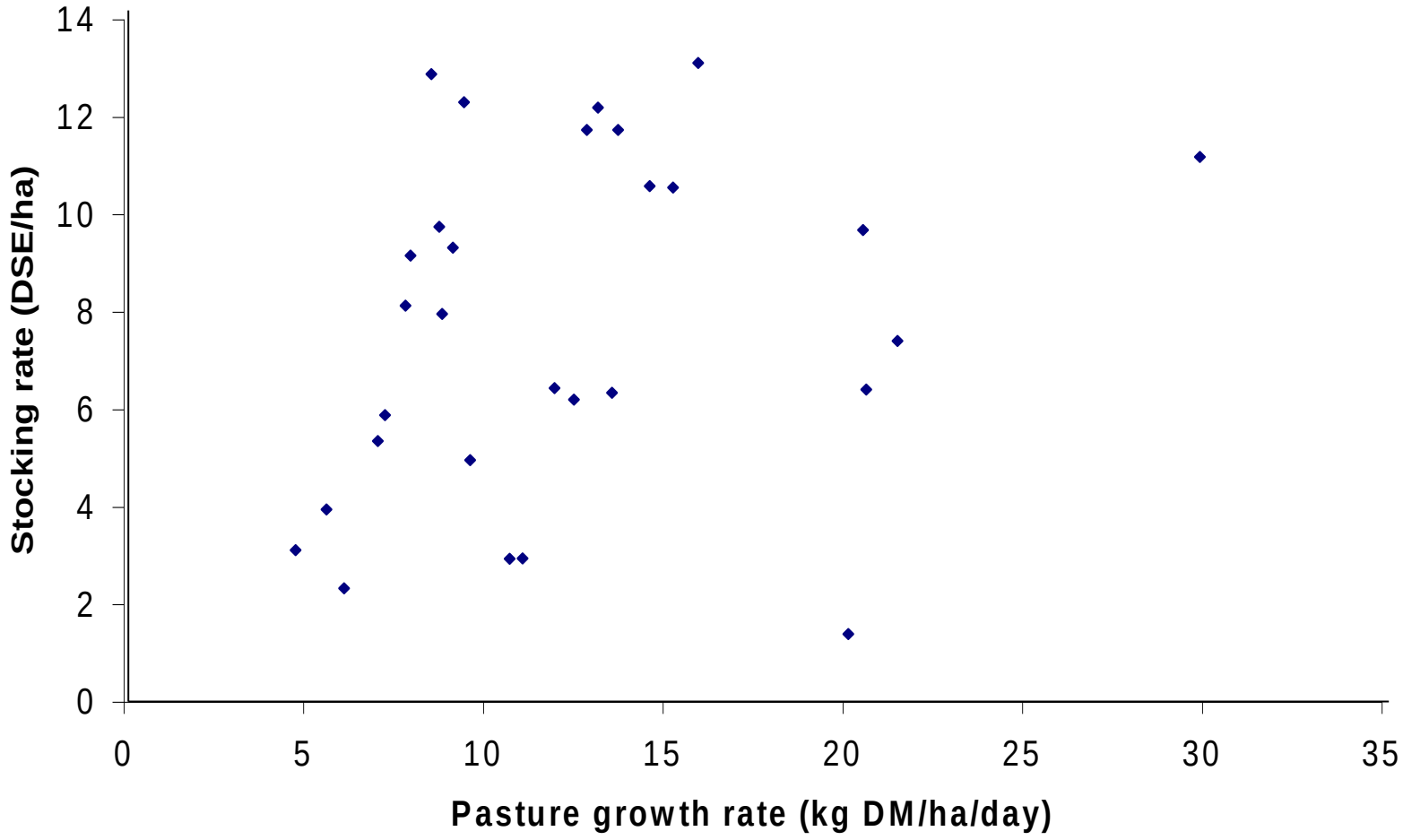
Residual herbage mass



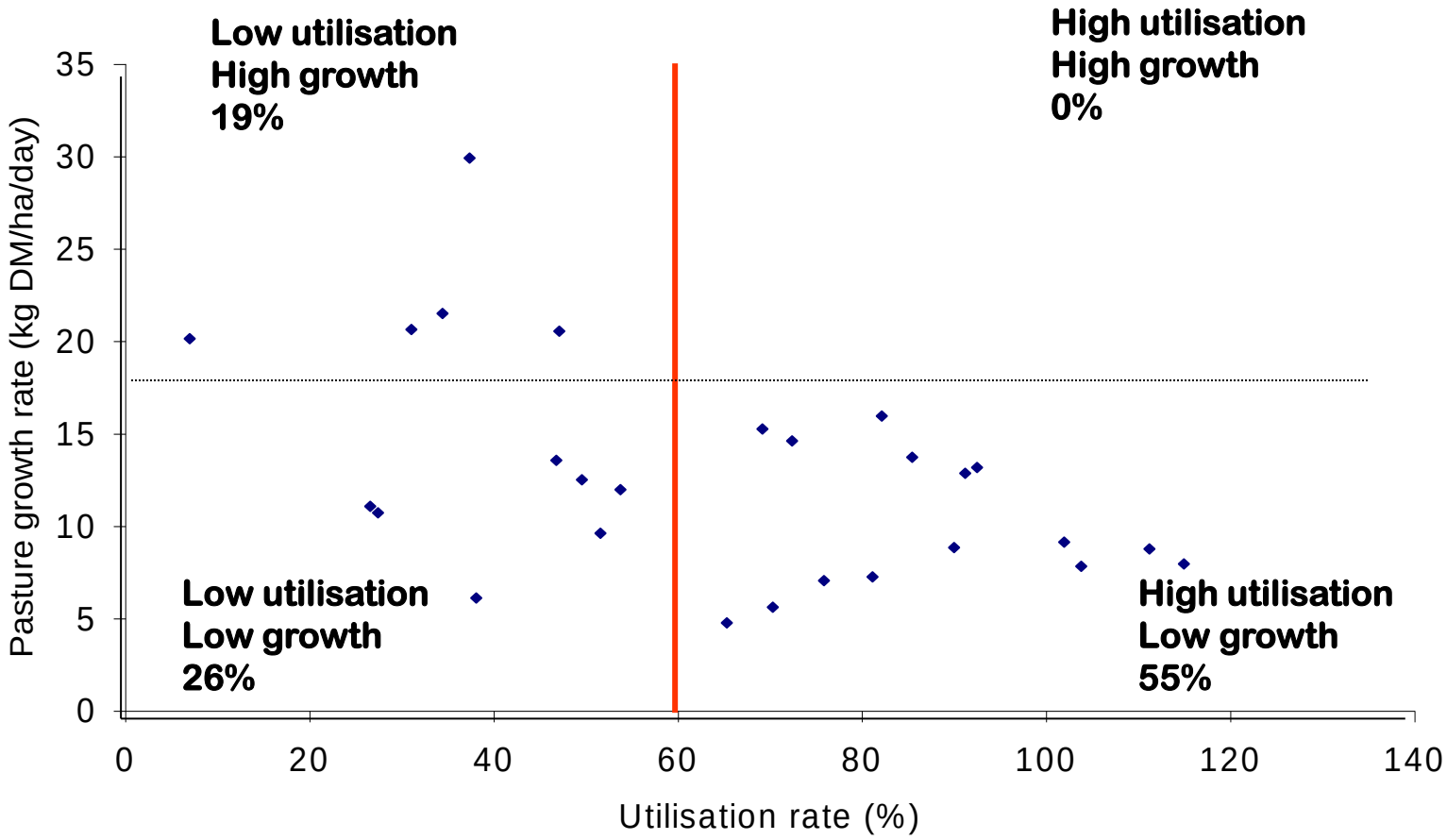
The number of animals – Stocking rate

- Is the number of animals carried (DSE/ha)
- Usually calculated over a 12 month period
- Should always be matched to carrying capacity
- A key driver of enterprise profitability ?

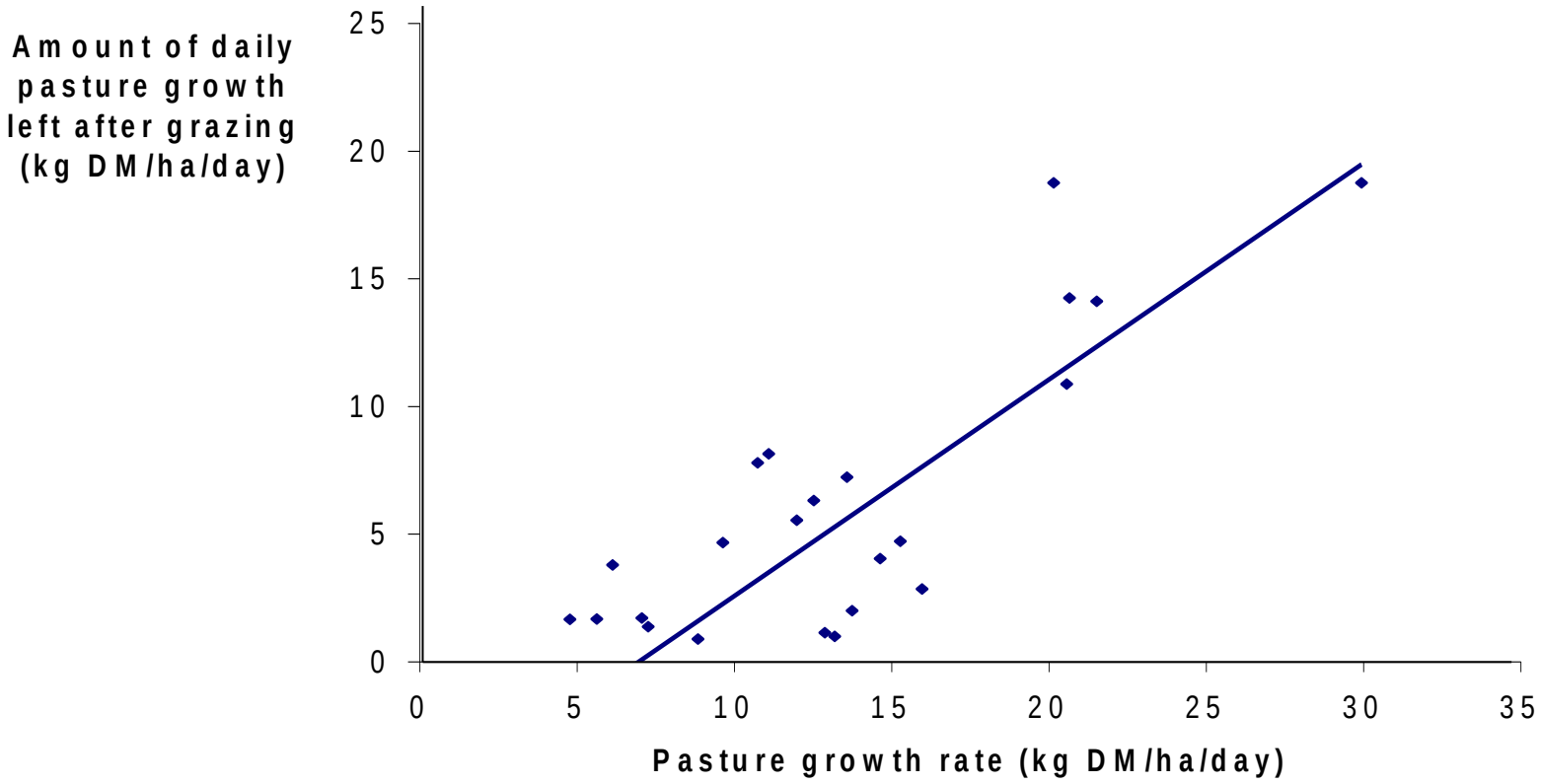
Stocking rate had no effect on pasture growth rate



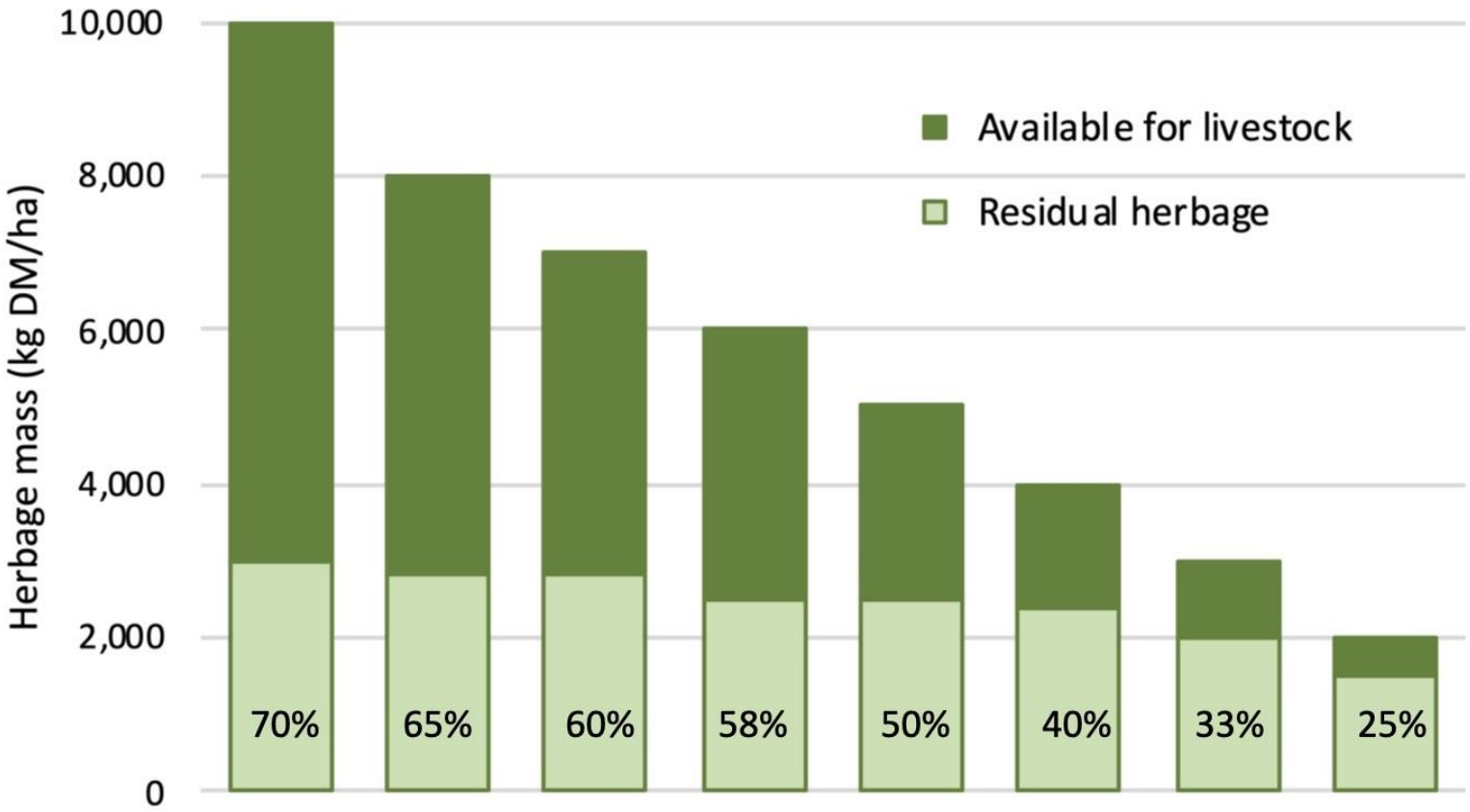
Pasture growth increases as utilisation rate declines



Grow more by leaving more



Grow more - use more - leave more



Selectivity
- animal designed pastures

- Animals are able to select from the pasture and graze ‘palatable’ plant parts and species.
- Selective grazing modifies competition between plants in favour of less palatable species.
- This allows unpalatable species to potentially better compete for water, nutrients and light.

Animal designed pastures

Animal grazing patterns

- Structure the vegetation and environment
- Change plant competitive interactions
- Influence mineral cycling
- Influence water use efficiency

CAN BE MANAGED

Photo: Christine Jones

Remember:

Plant material above the ground is a reflection of root material present below the soil surface

Control of the grazing process

Planning the grazing allows you to control

- plant competition
- plant and pasture growth rates
- pasture utilisation
- pasture composition – species diversity

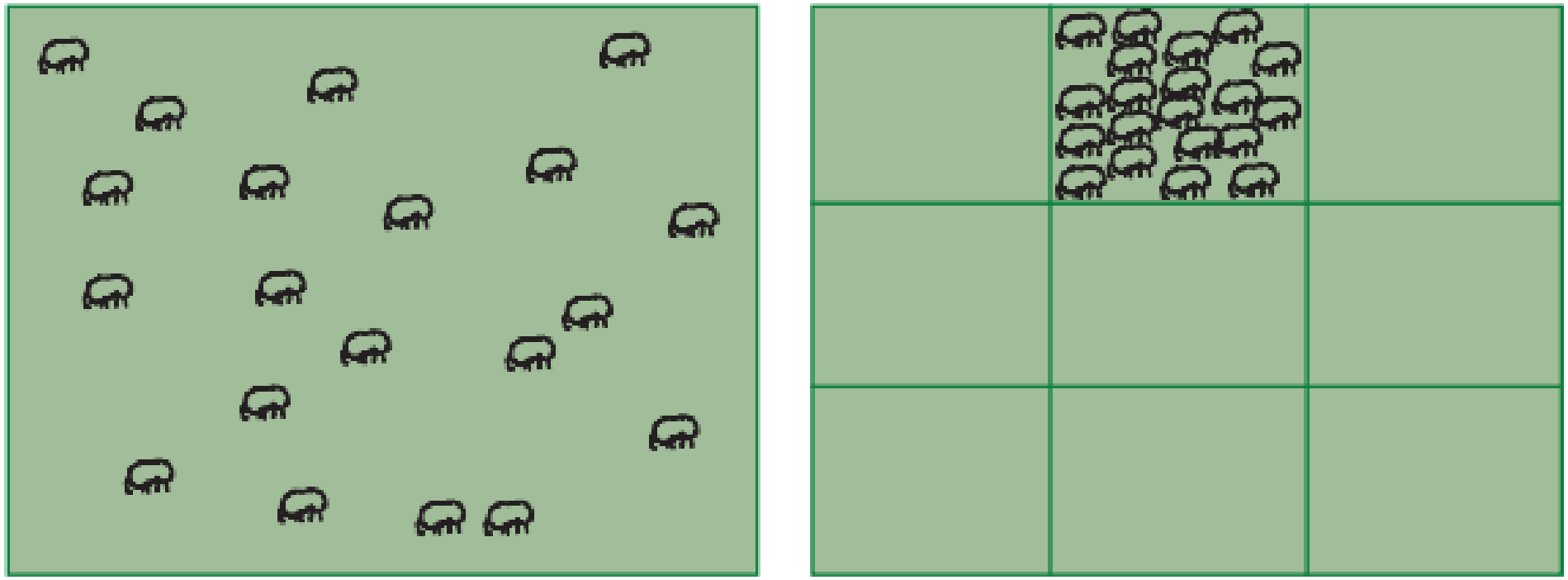
Control of the grazing process

Fewer & bigger mobs
→ more paddocks per mob

- Increases period between grazing events
- Provides relative advantage to selectively grazed species
- Provides potential to use stock density
- Provides potential to increase feed utilisation, stocking rate & pasture growth

Stocking rate & stock density

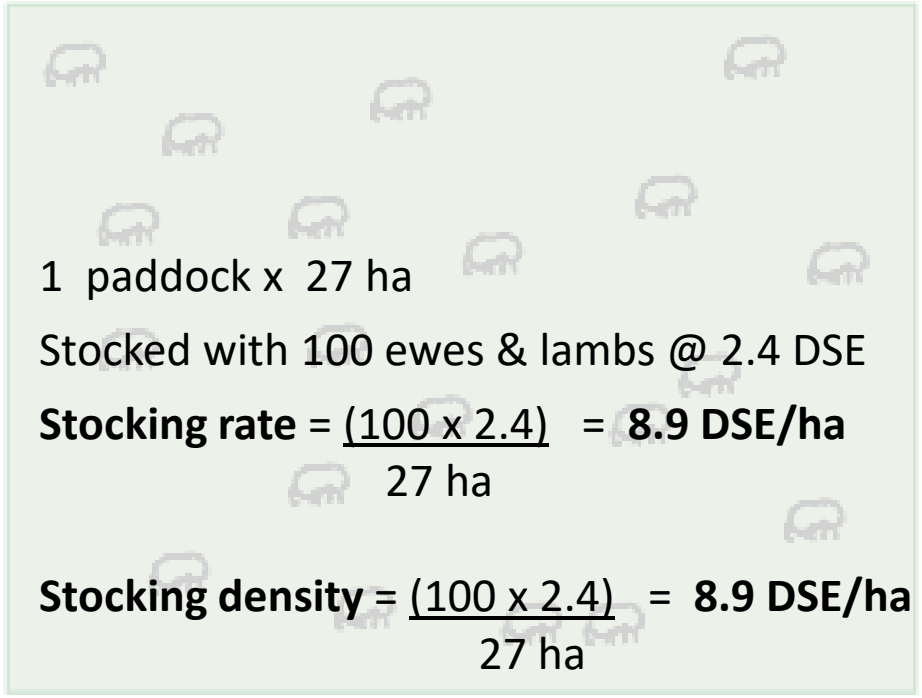
Uncontrolled grazing vs Controlled grazing



Same grazing area same number of stock

Stocking rate & stock density

Uncontrolled grazing vs Controlled grazing



1 paddock x 27 ha

Stocked with 100 ewes & lambs @ 2.4 DSE

Stocking rate = $\frac{(100 \times 2.4)}{27 \text{ ha}}$ = **8.9 DSE/ha**

Stocking density = $\frac{(100 \times 2.4)}{27 \text{ ha}}$ = **8.9 DSE/ha**

9 paddocks x 3 ha, total area = 27 ha

Stocked with 100 ewes & lambs @ 2.4 DSE

Stocking rate = $\frac{(100 \times 2.4)}{27 \text{ ha}}$ = **8.9 DSE/ha**

Stocking density = $\frac{(100 \times 2.4)}{3 \text{ ha}}$ = **80 DSE/ha**

Effect of number of paddocks

Area	200 ha
Stock	100 steers @ 10 DSE
Total mob size	1000 DSE

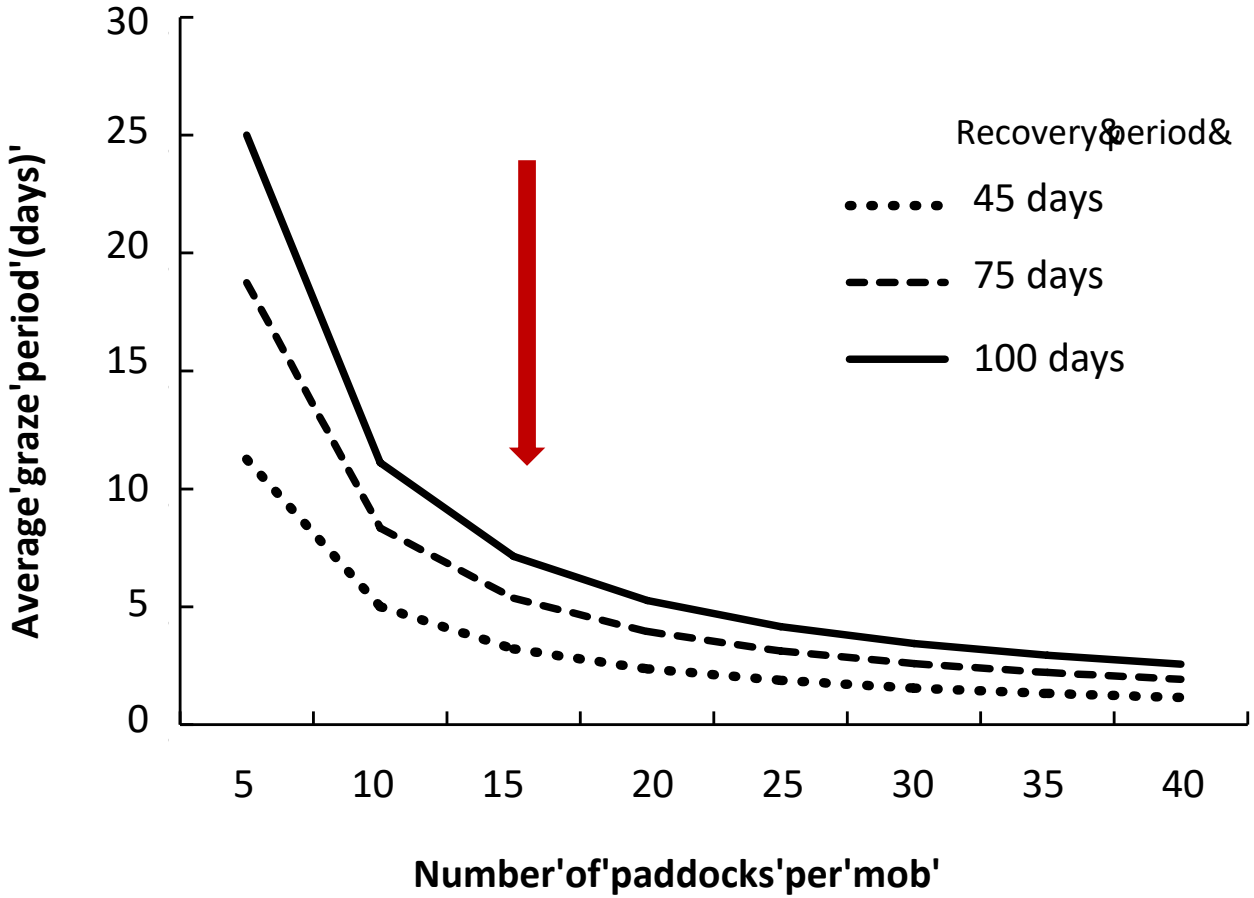
Number of paddocks	1	4
Average paddock size	200	50
Stocking rate (DSE/ha)	5	5
Stock density (DSE/ha)	5	20
Average days grazing per year	365	91
Average days rest per year	0	274
% of year resting	0	75

Effect of number of paddocks

Area	200 ha
Stock	100 steers @ 10 DSE
Total mob size	1000 DSE

Number of paddocks	1	4	10	20
Average paddock size	200	50	20	10
Stocking rate (DSE/ha)	5	5	5	5
Stock density (DSE/ha)	5	20	50	100
Average days grazing per year	365	91	36	18
Average days rest per year	0	274	329	347
% of year resting	0	75	90	95

Effect of number of paddocks per mob on the average graze period

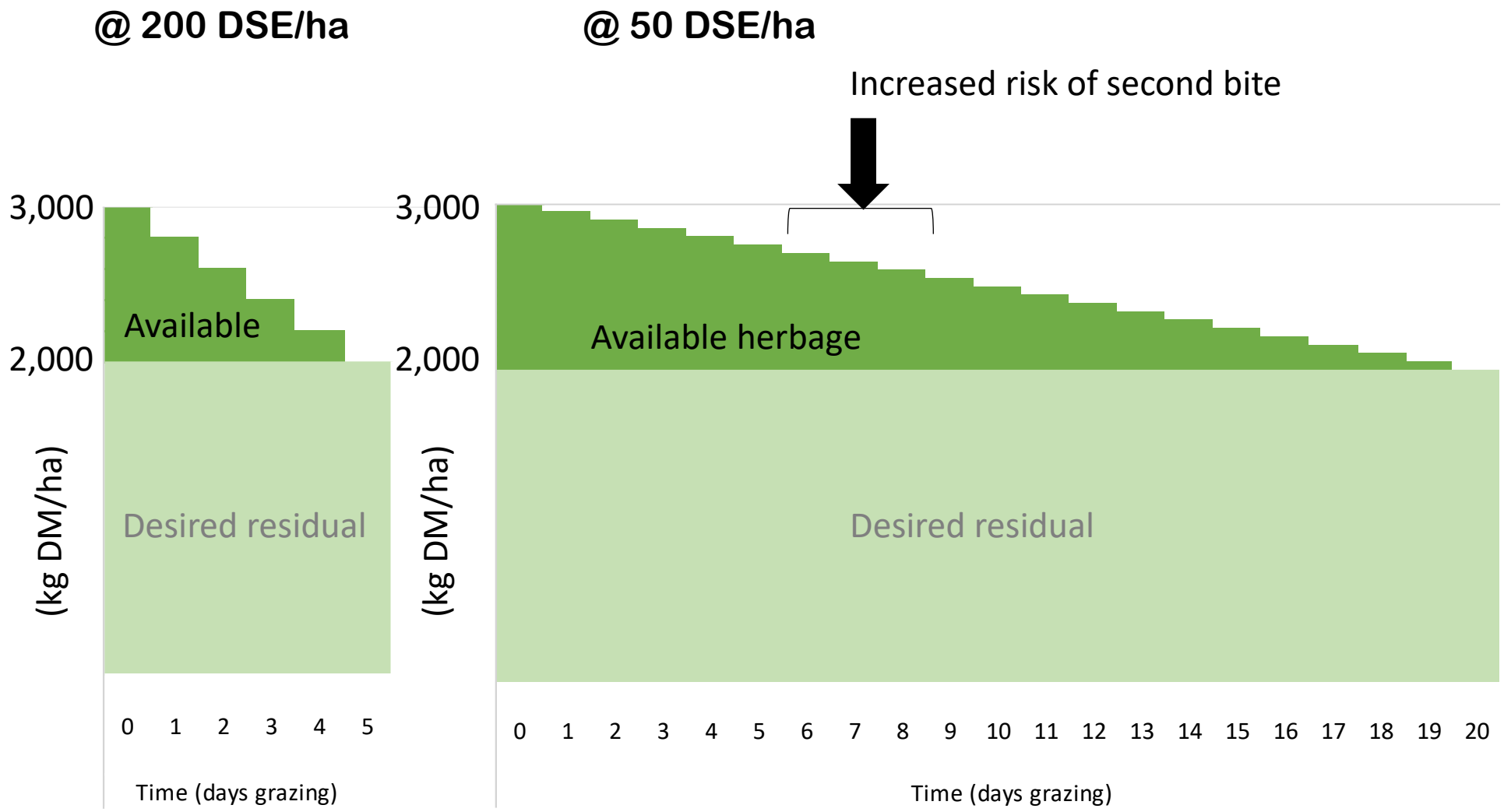


Adapted from Savory (1999)

Increasing paddocks per mob - advantages

- The capacity to use stock density to improve pastures and soil health
- More control over pasture utilisation
- More even pasture utilisation
- More plants impacted more evenly in any grazing event
- More even distribution of dung and nutrients
- More even plane of nutrition for grazing livestock
- Livestock move frequently onto fresh pasture
- Livestock become quiet to handle with frequent moves
- Regular inspection of stock to identify any health issues early

Stock density



Realistic stocking rates in the region

Annual Herbage Mass (kg DM/ha)	Daily herbage growth (kg DM/ha/day)	Stocking rate to Utilise 50% (DSE/ha)	Residual (kg DM/ha)
5,000	13.7	6.8	2,500
7,000	19.2	9.6	3,500
9,000	24.7	12.3	4,500
11,000	30.1	15.1	5,500

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5,000	13.7	6.8	2,500
6,000	16.4	8.2	3,000
9,000	24.7	12.3	4,500
11,000	30.1	15.1	5,500

	Utilisation %	Stocking rate	
9,000	66.6	16.4	3,000
11,000	72.0	20.5	3,000

Summary

- There are a limited number of factors that can be controlled by management
- Recovery period and rest period are not the same
- The graze period in any paddock will be a function of the required recovery period
- Utilisation has a significant impact on productive potential in short and long term
- Grow more – leave more – use more
- Stock density is an important tool to drive pasture change
- Today – reduce number of mobs ! Increase the number of paddocks per mob