

The beginning...



However, reality indicates...



Under grazing environment...

- We *only* have *partial* control over
 - Quantity
 - Quality
 - Timing
- There are interactions between the plant, the rumen and the animal
- Animal expresses its innate **behavioural patterns**



Diurnal grazing pattern its understanding and strategic management

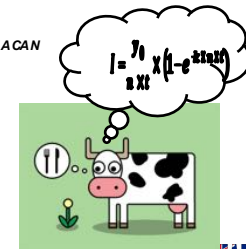
Dr. Pablo Gregorini

BAGSc (AgEng), MSc, PhD, SAR, PAS, CFP, Dipl. ACAA, Dipl. ACAN

Senior Scientist
Feed & Farm Systems Group

DairyNZ

NZARN Farmers Conference,
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Contents

- Grazing pattern
- Fluctuation of herbage feeding value
- Interactions between ingestive and digestive behaviours
- Management
- Conclusions

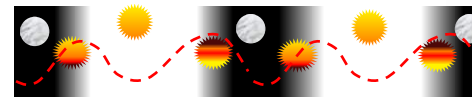
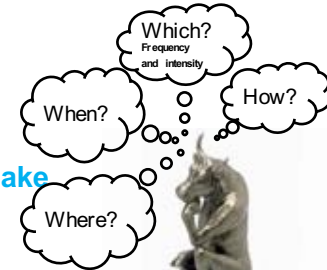


Introduction

• Grazing:

A *process* that involves

Decisions → actions = *intake*



Circadian Pattern

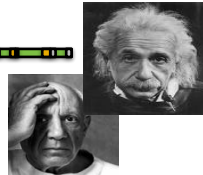


Objectives

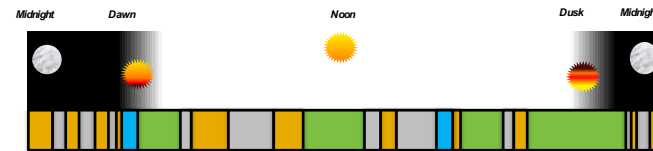
- Little information in the nutritional ecology of these foraging decisions → *diurnal grazing pattern*...

✓ Answer

- 'Why'?
- 'How' can...?



Diurnal grazing pattern



(Adapted from Gibb, 2006)



Hudson et al. (1986) Phillips (1993) Gibb et al. (1998) Pins (1996) Orr et al. (1991) Orr et al. (1997) (Adapted from Gregorini et al. 2013) Gregorini et al. (2007) Taweel et al. (2005)

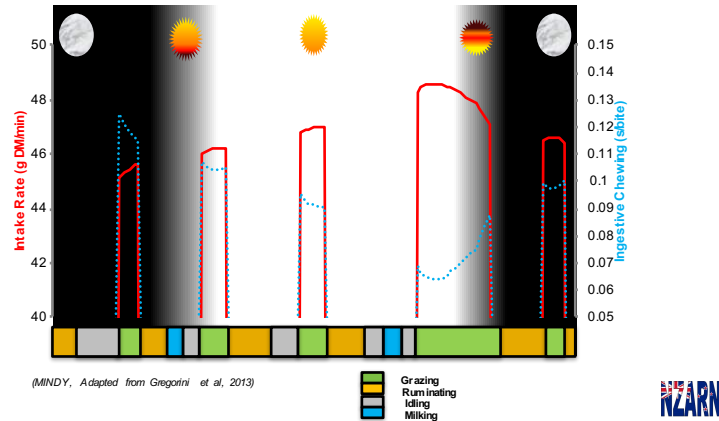
MINDY (virtual grazing dairy cow)

Grazing
Ruminating
Idling
Milking

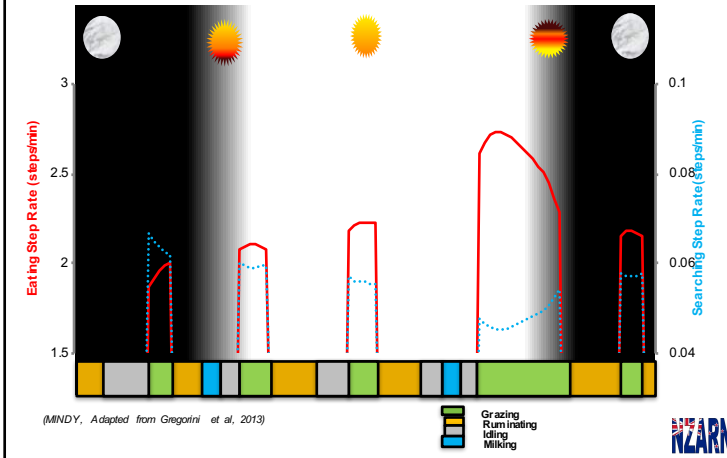


Diurnal grazing pattern

- Particular differences between grazing meals



Diurnal grazing pattern



Take home message



Ruminants show behavioural actions and patterns indicating that they prefer to graze late in the day



Diurnal grazing pattern

✓ ... reasons why?



- Herbage chemical composition
- Photoperiod
- Rumen fill and function
- Anti-predator strategy

'... have not been determined'



(Cosgrove and Edwards, 2007)

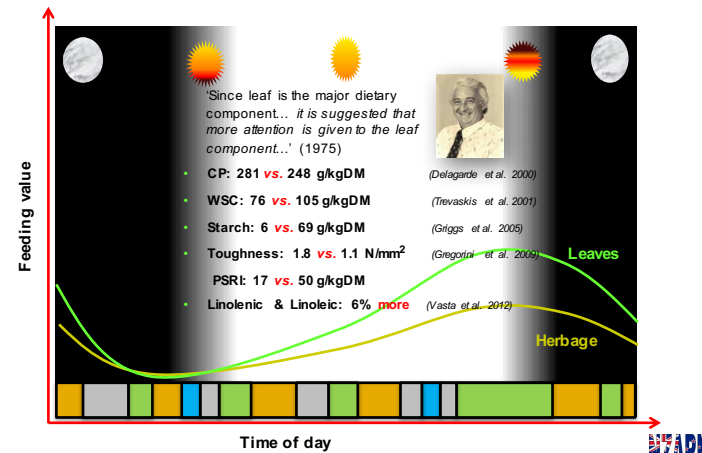


Herbage feeding value



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Herbage feeding value



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Herbage feeding value increase during the day, being the highest late in the afternoon

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Preference

Fisher et al. 1999; 2002; Bunitt et al. 2005



- IF capable of >90% of DMI in 4 hrs.
Why graze in the morning?
- Dusk grazing events last the same...
What stimuli determine such a pattern?

(Gregorini 2011; Rutter et al. 2002)



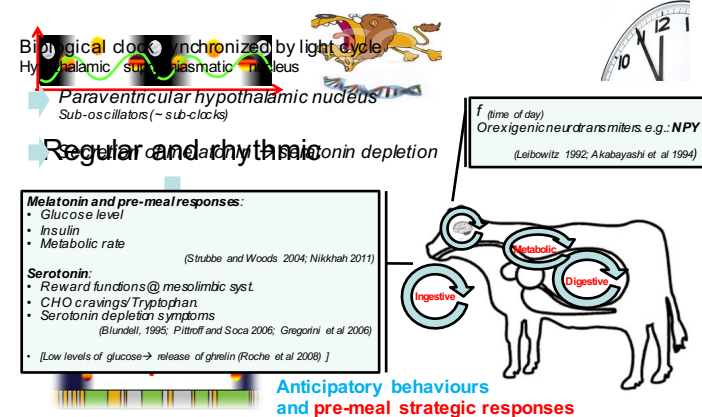
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Photoperiod



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Photoperiod, the cue to start...



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Ruminants seems to be synchronized - grazing pattern - with photoperiod ... to use the feeding environment better

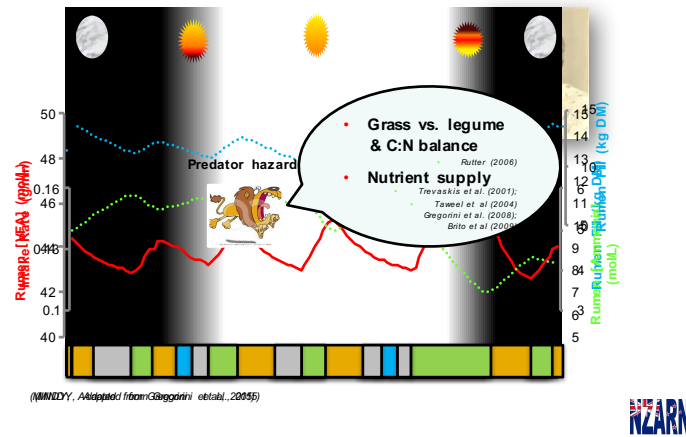
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Ingestive-digestive interactions

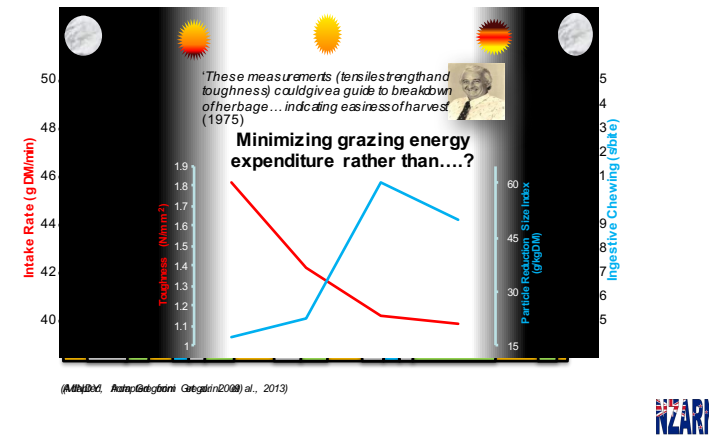


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- During the 'dusk' grazing event

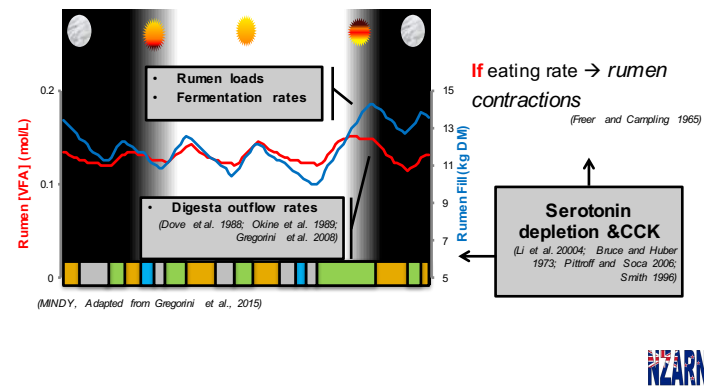


- During the 'dusk' grazing event

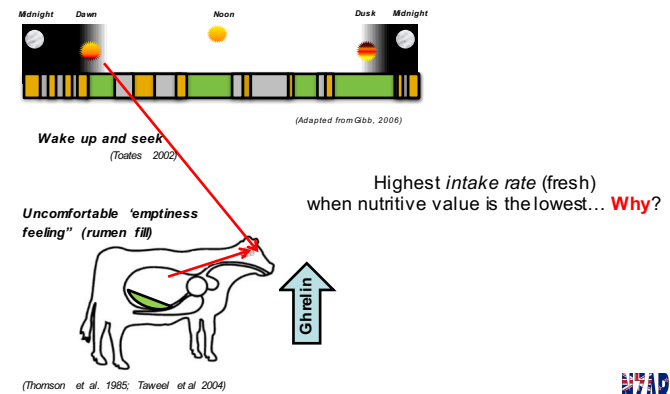


- During the 'dusk' grazing event

If ingestive *chewing* is more efficient,

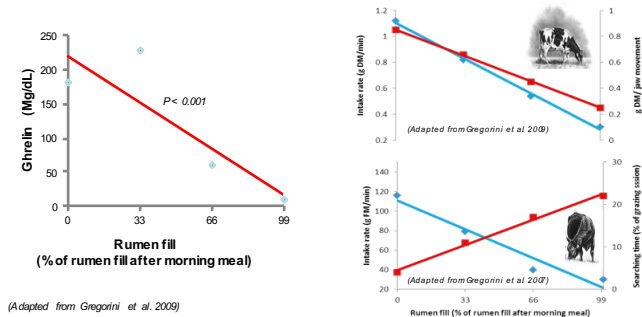


- During the 'dawn' grazing event



- During the 'dawn' grazing event

Hunger deceives them!



- During the 'dawn' grazing event

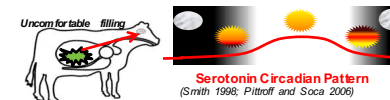
But grazing bouts are the *shortest*... *why*?



- High herbage intake rate (FM)
- Low chewing efficiency
- Greater herbage toughness



- Large particle size
- Greater water content



- Delay rumination and grazing bouts
- Prolonged retention time
- Acetogenic fermentation



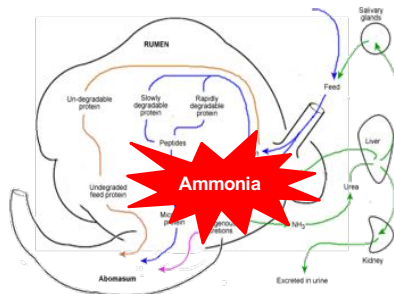
- Regurgitation failures
- Limit packing capacity
- Pseudo-rumination

(Schellin et al. 1999; Whelan et al. 2004; Tahir et al. 2009; Gogorini et al. 2008)



- During the 'dawn' grazing event

But grazing bouts are the *shortest*... *why*?



Rapid increases & short-term excesses

(Chilbrast et al. 2000; Cosgrove et al. 1999; Chapman et al. 2007)

Reduction [L-glutamate, L-Aspartate] → less NPY

(Miner 1992)



Take home message



It is easier and worthier for ruminants to graze late in the day... and...

The rumen or herbage alone do not tell the whole story



Strategic management



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- Altering frequency, intensity and temporal distribution of meals

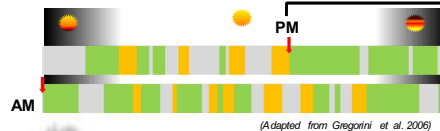
'...it is possible that some improvement in production could be obtained by allocating new pastures each evening so that the less attractive pasture would be available during daylight hours' (1977)



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- Through: Timing of herbage allocation

Since the work of Mayland et al. (1998)



(Adapted from Gregorini et al. 2006)

More and healthier animal products (functional foods)



2-10% milk/d

Oleic acid: 20% more
Rumenic acid: 13% more
(Looor et al 2003 & ~Avondo et al 2008 [goats])



150-310 g ADG

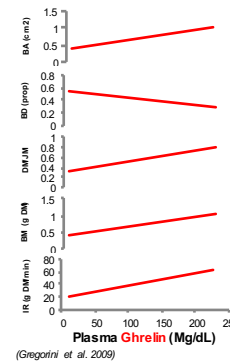
MUFA: 3.5% more
PUFA: 11% more
n6/n3 ratio: 7% less



Vibart et al. (2011)
Andueza et al. (2011)
Vasta et al. (2012)

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- Through: Hunger and pasture management for short and intensive grazing events



Increase:

Meal duration
Eating time
Intake rate
Bite mass
Bite area
Bite rate

Decrease:

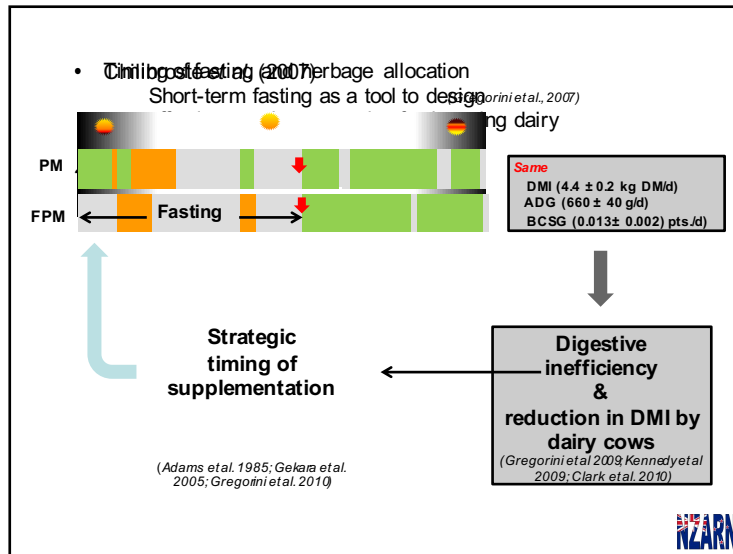
Searching time
Chewing efficiency
Bite depth

Uncomfortable state that motivates feeding and strategic ingestive behaviour to overcome the discomfort.



(Gregorini 2011)

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Timing of supplementation

Adams (1985) (2005) *Anim. Sci.*

- **Treatments:** Early vs late morning maize grain supplementation
- **Animals:** Beef cows
- **Pasture:** Russian ryegrass
- ✓ **Greater ADG for late morning supplementation**
- ✓ **Greater DMI, grazing time and pasture utilization for morning**



Timing of supplementation

Blessdale (2002) *J. Dairy Sci.*

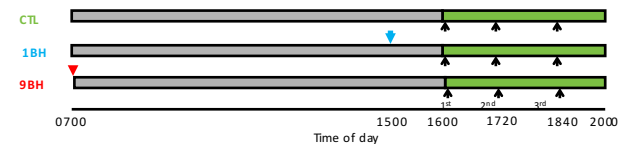
- **Treatments:** AM vs. PM maize concentrate supplementation
- **Animals:** Dairy cows
- **Pasture:** Ryegrass
- ✓ **Greater forage OMI, total OMI rumen NDF**
- ✓ **Digestibility and response to supplements for AM supplementation**



Timing of supplementation

Gregorini et al (2010) *J. Dairy Sci.*

- **Treatments:** 9BH vs. 1BH maize silage
- **Animals:** Continuous culture fermenters
- **Pasture:** Orchardgrass
- ✓ **Greater (13%) glucogenic nutrient supply, and 30 % less rumen ammonia for 9BH supplementation**



- Timing of supplementation

Al-marashdeh et al (2015) –in doors-
Same as Gregorini et al (2010) **BUT** real cows

- Treatments: 9BH vs. 1BH maize silage
- Pasture: ryegrass

Measurement	1 BH	9BH
Herbage DMI	10.4	11.2
Milk Yield	15.4	18.8
Milk Solids (Fat +Prot)	1.5	1.6
Rumen-NH3 (mmol/l)	6.4	5.84
Total VFA (mmol/l)	186.5	193.7
Propionate (mmol/l)	19.7	23.4
Acetate (mmol/l)	155.7	159.5



- Timing of supplementation

Al-marashdeh et al (2015) – **Grazing**-
Same as Gregorini et al (2010) **BUT** real cows

- Treatments: 9BH vs. 2BH maize silage
- Pasture: ryegrass

Measurement	2 BH	9BH
Herbage DMI	10	11
Substitution rate	0.5	0.2
Milk Solids (Fat +Prot)	1.2	1.3



- Is timing the only strategy to alter grazing patterns?!



- Diurnal pattern of selectivity



Dry and lactating ewes
(Parsons et al., 1994)



Lactating cow
(Rutter et al., 2004)



Heifers
(Rutter et al., 2004)

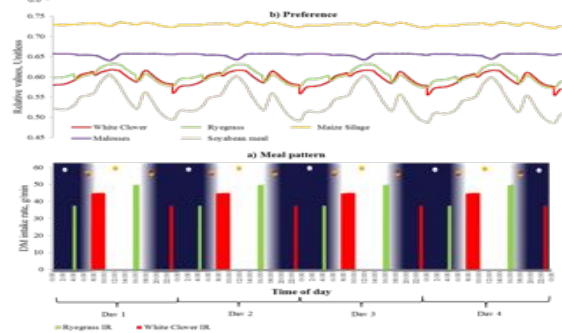


Sarda ewes
(Rutter et al., 2005)

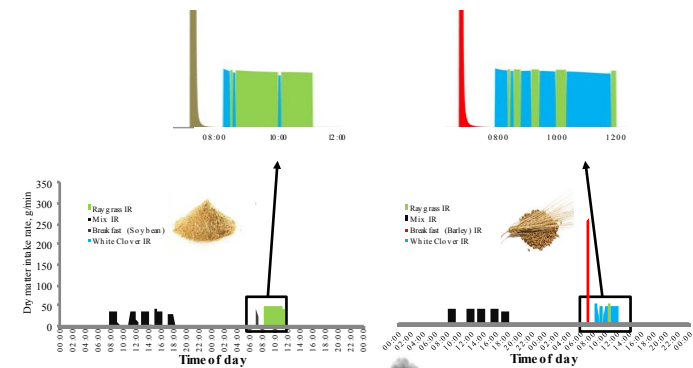
Would MINDY show deferential pattern of diurnal selectivity for grass and clover?



- Simulation examples: **RG** vs. **WC** patterns of preference and selective behaviour.

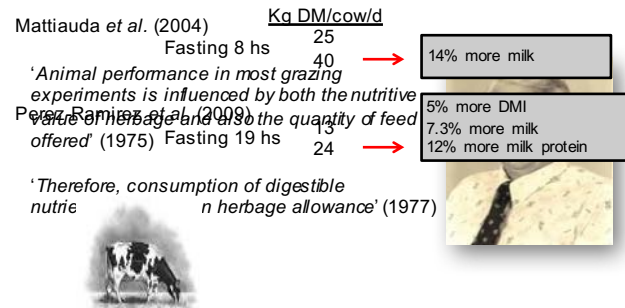


- Simulation: Mixed sward, overnight fasting, a breakfast of either soybean or barley before RG and WC.



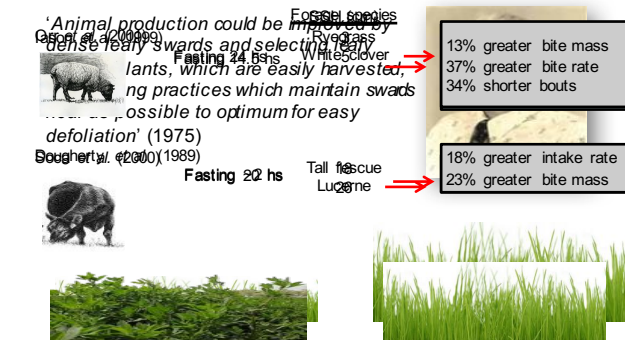
(Gregorini et al., 2014 – Martin et al. 2014 – Emmick 2007)

- An alternative/complement to supplements... and hunger! **Herbage allowance**

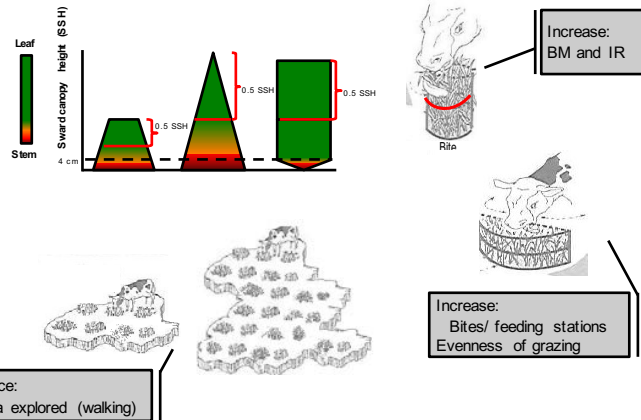


- Similar milk production and DMI to non-fasted cows at the same herbage allowance

- BUT!** Thinking about a **simple amount of herbage** appears to be **incomplete...**



• Last but not least: Leaves' accessibility...

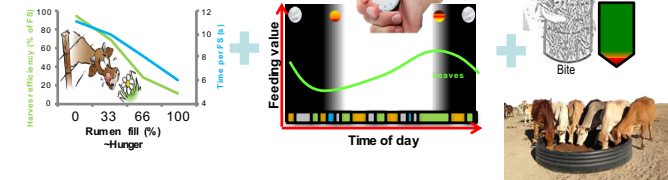


(Gregorini et al. 2007, 2009, 2011)



Take home message

Therefore...



We could:

- Increase efficiency of and manage harvesting nutrients from pastures
- Reduce regrowth heterogeneity and ingestive constraints
- Reduce environmental impact (e.g. capture UN, reduce pasture damage)

...and then

- ✓ Think of short, intensive and more efficient grazing events



Conclusions

'A three-dimensional sampling of pasture is necessary to understand the feeding behaviour of grazing animals' (1975)



- ✓ A better understanding of the diurnal grazing pattern enables us to:
 - Match plant-rumen and animal processes, and alter the connections among meals into a temporal (the 4th dimension) arrangement that increases and or differentiates nutrient supply to grazing ruminants.



DairyNZ
Profitability Sustainability Competitiveness

Support and time are really appreciated!



Thank you very much!

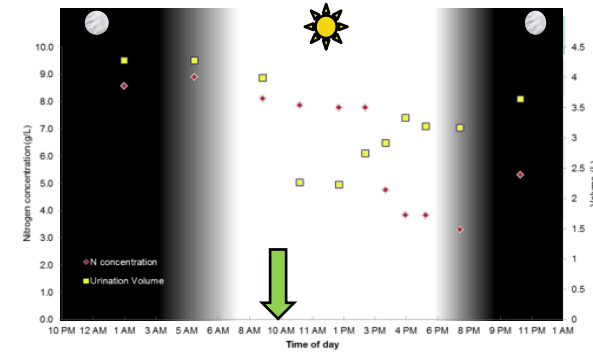


To all of whose hearts beat faster
when watching them graze



Betteridge *et al.* (*Proc. NZ Grassland Assoc.*, 2013)

→ Urination behaviour and N excretion of non-lactating dairy cow strip grazing a ryegrass dominated sward.



Clark *et al.* (*J. Dairy Sci.*, 2010)

→ Water consumption, Urination frequency and N excretion of lactating dairy cow strip grazing a ryegrass dominated sward with or without restriction of time at pasture.

