

# Where Does the Time Go ... Current Research on Time Budget Behaviors and Cow Comfort

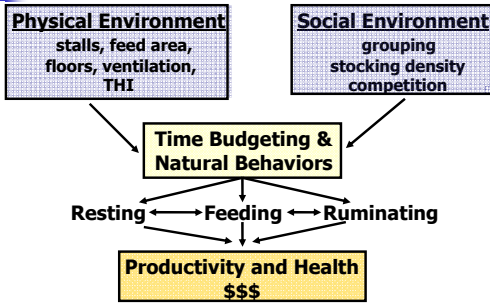
Rick Grant  
W. H. Miner Agricultural Research Institute  
Chazy, NY



## Foundational research in management and cow behavior by Dr. Carl Polan

- Social Rank, Feeding Behavior, and Free Stall Utilization by Dairy Cattle
- Free Stall and Feed Bunk Requirements Relative to Behavior, Production and Individual Feed Intake in Dairy Cows
- Milk Production Response to Shifting Cows Between Intra-herd Groups
- Change in Adrenal Response from Free Stall Competition

## Environment, Time Budget Behaviors, and Cow Performance

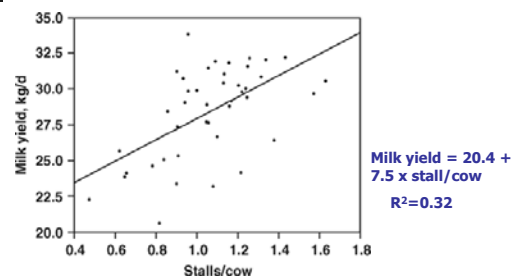


Will this management environment affect response to diet?

## Non-dietary factors and herd performance (Bach et al., 2008)

- 47 herds with similar genetics were fed same TMR
- Milk yield varied by  $\pm 29$  lb/d
  - Mean milk yield = 65 lb/d
- Non-dietary factors accounted for **56%** of variation in milk yield
  - Age at first calving
  - Feeding for refusals (64.1 vs 60.6 lb/d)
  - Feed push-ups (63.7 vs 55 lb/d)
  - Stalls per cow

## Stalls per cow and milk production in 47 herds fed same TMR (Bach et al., 2008)



## Typical time budget of dairy cow (free-stall environment)

- 5.0 h/d eating
- 12-14 h/d lying (resting)
- 2.0-3.0 h/d standing, walking, grooming, agonistic, idling
- 0.5 h/d drinking
- 20.5 to 21.5 h/d total needed
- 2.5 to 3.5 h "milking" = 24 h/d

Mattress /  
Lame cows

Sand stalls  
Healthy cows

## Common ways to disturb time budget on-farm ...

- Excessive time outside pen
- Mixing of primi- and multiparous cows
- >1 h/d in headlocks, esp. fresh cows
- Short pen stays during transition; regrouping – social turmoil
- Lack of exercise
- Uncomfortable stalls – tie or free stalls
- Inadequate feed availability
- Overcrowding, excessive competition
- Inadequate heat stress abatement

## Time away from pen and cow response: Do time budgets matter?

- **3 h/d versus 6 h/d outside pen**
  - Adjusted pen size versus parlor capacity
  - Mixed primi- and multiparous cows
  - 100% stocking density
  - **Comparing 3 versus 6 h/d:**
    - Cows gained 2.6 h/d rest, 5.0 lb/d milk
    - First-calf heifers gained 4.1 h/d rest, 7.9 lb/d milk

(Matzke, 2003)

## Time Budget Behaviors: Primi- versus Multiparous Cows

- **Numerous natural behavioral differences**
- Heifers take smaller bites, eat more slowly, spend more time feeding
- Heifers typically less dominant, more easily displaced from manger, stalls, and water
- Heifers avoid stalls previously occupied by dominant cows and ruminate less
- **Neophobia** – fear of new environment
  - Lasts ~10-14 days

## Effect of competition with older cows on first-calf heifers . . .

- **Environments similar to ~100% stocking density:**
  - DMI reduced by 10%
  - Resting reduced by 20%
  - Milk reduced by 9% (Kongaard and Krohn, 1980)
  - Greater loss of BW by 30 DIM
  - Reduced FCM/DMI by 30 DIM (Bach et al., 2006)
  - Less drinking, rumination, and milk fat % (Bach et al., 2007)

## Question: Which is more important - eating or resting?



## Cows have strong behavioral need to rest ...

- Cows sacrifice feeding to make up lost resting

- Cows sacrifice 1 minute of eating for every 3.5 minutes of lost rest

- Cows spend more time waiting in alleys to lie down than eating when overstocked

- Negative effects of short periods of deprivation are **cumulative**

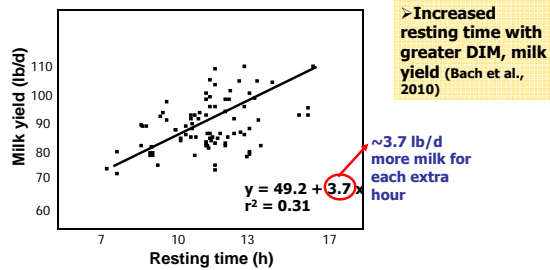


Resting: ~12 h/d  
"Vitamin R"

## Lying deprivation and cow welfare, stress level

- Increased cortisol response
- Reduced Growth Hormone, reduced milk yield (Munksgaard and Simonsen, 1996)
- Less blood flow to mammary gland and gravid uterine horn
- Reduced feeding time, reduced rumination, increased standing
- Predisposes cows to sole hemorrhages, lameness

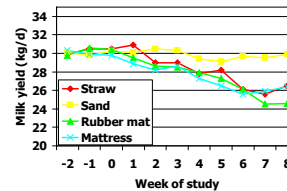
## Relationship between resting and milk yield (Miner Institute data base)



(Grant, 2005)

> Increased resting time with greater DIM, milk yield (Bach et al., 2010)

## Stall surface, resting, and milk yield (Calamari et al., 2009)



> Reduction in milk during last 3 wk

- > 11.6 lb/d actual
- > 3.2 h/d less resting time predicts ~11.8 lb/d less milk (3.2 h/d x 3.7 lb)

## Make smart bedding decisions (Tucker et al., 2009)

- **+3 min/d lying time** for each additional 2 lb sawdust shavings
- **+12 min/d lying time** for each additional 2 lb straw
- **+12 min/d lying time** for each additional 1/2 inch of sand

## What stimulates feeding behavior?

- Feed accessibility & periods of empty bunks
- Feed push-up
  - More important during the day rather than at night (DeVries et al., 2005)
- Feeding frequency, delivery of fresh feed
- **Biggest driver of feeding behavior is delivery of fresh feed** (DeVries et al., 2003; 2005)

## Cows naturally have aggressive feeding drive ...

- Cows willingly exert **>500-lb pressure** against feed barrier while eating
  - **225 lb** causes tissue damage
- Defines "aggressive feeding drive"
- Tie and free stalls



(Hansen and Pallesen, 1999)

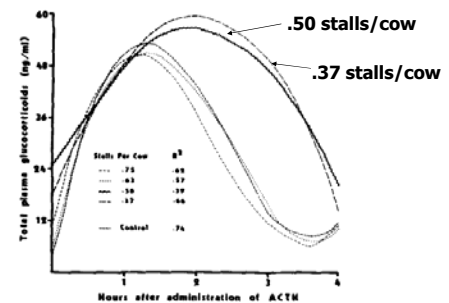
## Ruminating Behavior and Management Environment

- Mixed parity groups reduce rumination by ~16%
- Overcrowding reduces rumination by 10-20%
- Excessive head-lock time reduces rumination by ~14%
- Uncomfortable resting surfaces reduce rumination by up to 15%
- Heat stress reduces rumination up to 22%

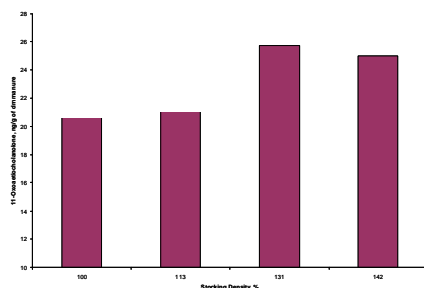


## Stocking Density and Behavioral Responses

## Plasma glucocorticoid response to ACTH increases with stall overstocking (Friend et al., 1979)



## Fecal cortisol metabolites and stocking density (Krawczel et al., 2010)



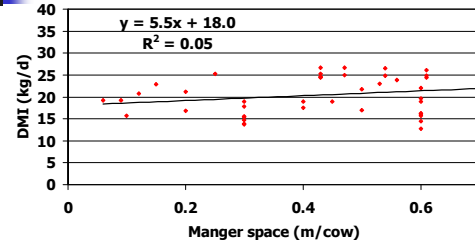
## Stocking Density and Feeding Behavior

- **As stocking density increases:**
  - Greater aggression and displacements
  - Time of eating shifted (Huzzey et al., 2006)
  - Fewer meals
  - Eating rate increased
  - Greater potential for sorting
  - Largest effect on subordinate cows
- **Within limits, cows can adjust feeding behavior in response to variable SR**

## Bunk Space and DMI (Friend et al., 1977)

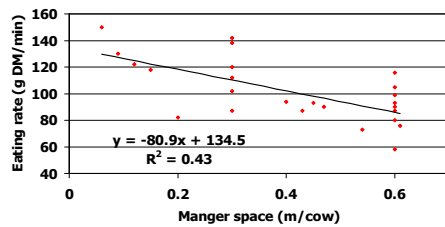
	Bunk length (in/cow)				
	20	16	12	8	4
Time at bunk, h	3.82	3.73	3.73	3.76	2.57*
Correlation of time with social dominance	0.46	0.32	0.30	0.67*	0.71*
% of time at bunk	21.5	26.9	34.6	51.9	70.6
DMI, lb/d	35.9	38.8	39.2	37.3	34.6

## Stocking density and DMI



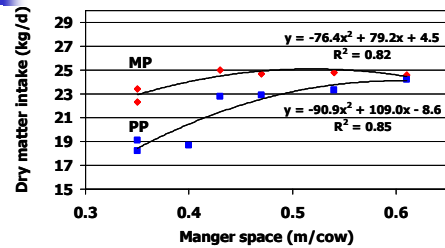
➤ Weak short-term relationship between stocking density or manger space and DMI

## Stocking density and eating rate



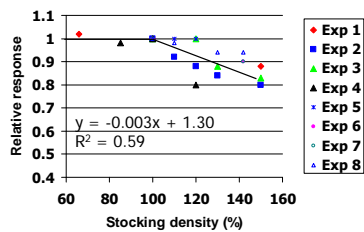
➤ Eating rate increases with increased stocking density, reduced feeding space

## Stocking density and DMI by parity in mixed groups



➤ Interaction between parity and stocking density  
➤ Component of future models

## Stocking density and relative resting response



(Winkler et al., 2003; Fregonesi et al., 2007; Wierenga and Hopster, 1990; Matzke and Grant, 2002; Hill et al., 2009; Krawczel, 2008; 2009; 2010)

## Overstocking and Lying Time (Fregonesi et al., 2007)

- Free-stall stocking rates:
  - 100, 109, 120, 133, or 150%

Variable	100%	109%	120%	133%	150%
Lying, h	12.9	12.1	12.0	11.5	11.2
Displacements, n/5 h	0.7	0.9	1.6	2.1	1.9
Latency to lie, min	39	34	38	28	26

➤ Overstocking creates more uniform use of stalls at expense of reduced lying for individual cows

### Activity from midnight to 4:00 am (Hill et al., 2009)

% of cows:	100%	113%	131%	142%
Resting	71.1	70.0	63.7	58.7
Feeding	11.8	12.6	14.6	15.4
Standing in alley	3.9	5.4	8.7	12.6



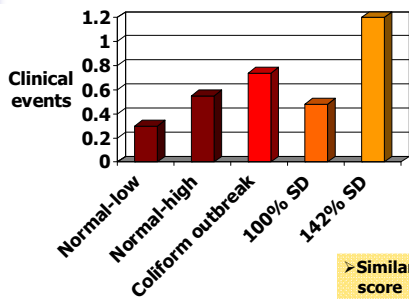
Cows wasting time at 142% SD; 1:00 am

### Milk quality and stocking density (Hill et al., 2006)

	100%	113%	131%	142%
Milk fat, %	3.84	3.77	3.77	3.67
SCC, x 1000/ml	135	114	169	236

- Overstocked cows eat faster (25% increase), ruminate less (1 h/d less)
- Overstocked cows experience greater pathogen load in the environment; greater teat end exposure; experience immune suppression?

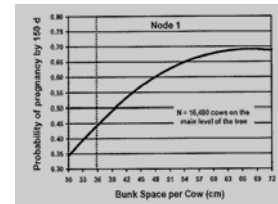
### Clinical mastitis events per 305-day lactation (Krawczel, 2008)



➤ Similar hygiene score

### Stocking and Reproduction

- Data from 153 farms used to identify factors affecting reproduction
- As bunk space in breeding pen decreased from 24 to 12 in
  - % of cows pregnant by 150 DIM decreased from 70 to 35%



(Caraviello et al., 2006)

### Stocking and Reproduction

- Overstocking of stalls in breeding pen associated with reduced conception rate
  - Greater aggression at feeding – reduced access to feed and compromised metabolic status
  - Reduced lying time
  - Less available lock-ups per cow and negative effect on compliance with estrus synchronization programs

(Scheffers et al., 2010)

### Primi- vs multiparous and lame vs sound cows (Hill et al., 2006)

	100%	113%	131%	142%
Multi - primi				
Milk, lb/d	+5.9	+13.8	+21.1	+14.9
Sound - lame				
Milk, lb/d	-9.4	+1.9	+16.7	+13.9

- Milk losses reflect reductions in resting and rumination activity.

## Cost of overcrowding: summary of cow responses

- Changes in these behaviors:**
  - Greater aggression & displacements at feed bunk
  - Greater feeding rate
  - Reduced resting time
  - Increased idle standing in alleys
  - Decreased rumination
  - Subordinate (i.e. primiparous and lame cows) most affected
- May result in these economic losses:**
  - Less milk yield
  - Lower milk fat
  - Greater SCC
  - More health disorders
  - Increased lameness
  - Fewer cows pregnant

**Effect on Cost of Production?**

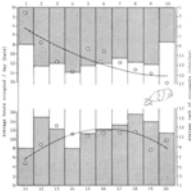
## What is optimal stocking density?

- Close-up and fresh: ≤80% of bunk space (30 in/cow)**
  - May be a function of stall availability
- Lactating cows**
  - 4-row barn: don't exceed 115-120% of stalls
    - Mixed heifer & older cows: 100%
  - 6-row barn: 100% of stalls?
- Ensure access to feed, water, stalls**

## Territoriality in Free Stalls: SR from Heifer's Perspective

(Friend and Polan, 1974)

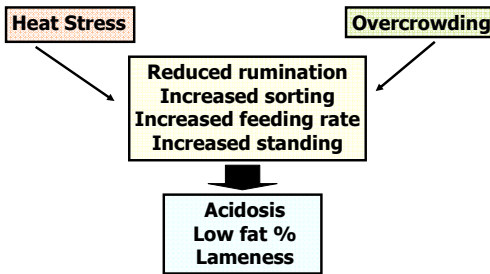
- Cows display **territoriality** in use of free stalls
  - Social rank determines priority
  - Stalls nearest the feed alley preferred (Gaworski et al., 2003)
- Subordinate cows avoid free stalls previously occupied by dominant cows
- Overcrowded conditions (from subordinate perspective) may exist even at lower stocking densities



## Rumination by primiparous cows in preferred/less preferred stalls (Krawczel, 2007)

	Preferred	Less preferred	P value
Rumination time, min/d	81.4	147.8	0.09
% resting time spent ruminating	35.2	58.4	0.05

## Physical and Social Environment Interact



TIME BUDGET EVALUATOR			
Date:	3/1/2014	3/1/2014	
Date:	25/Nov/10		
Group of cows:	30 cows		
1) Time Away From Feed	minutes	22	243.00%
2) Behaviors in the Pen			
3) Adjustment to Resting in the Pen			
4) Adjustment to Resting for Standing Time			
5) Resting in the Pen			
6) Resting in the Pen (Standing)			
7) Resting in the Pen (Lying)			
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## Bottom Line

- Herds with similar genetics fed the same diet differ in milk by  $\pm 29$  lb/day
- Improve cow environment and comfort to optimize time budget behaviors, health and performance



"I'm never contented anymore."  
Listen to your cows

## Thank You . . .

