

"The use of automated data collection, mining and analysis for future farm management"

G. Katz, A. Arazi

* S.A.E. Afimilk, Kibbutz Afikim, Israel



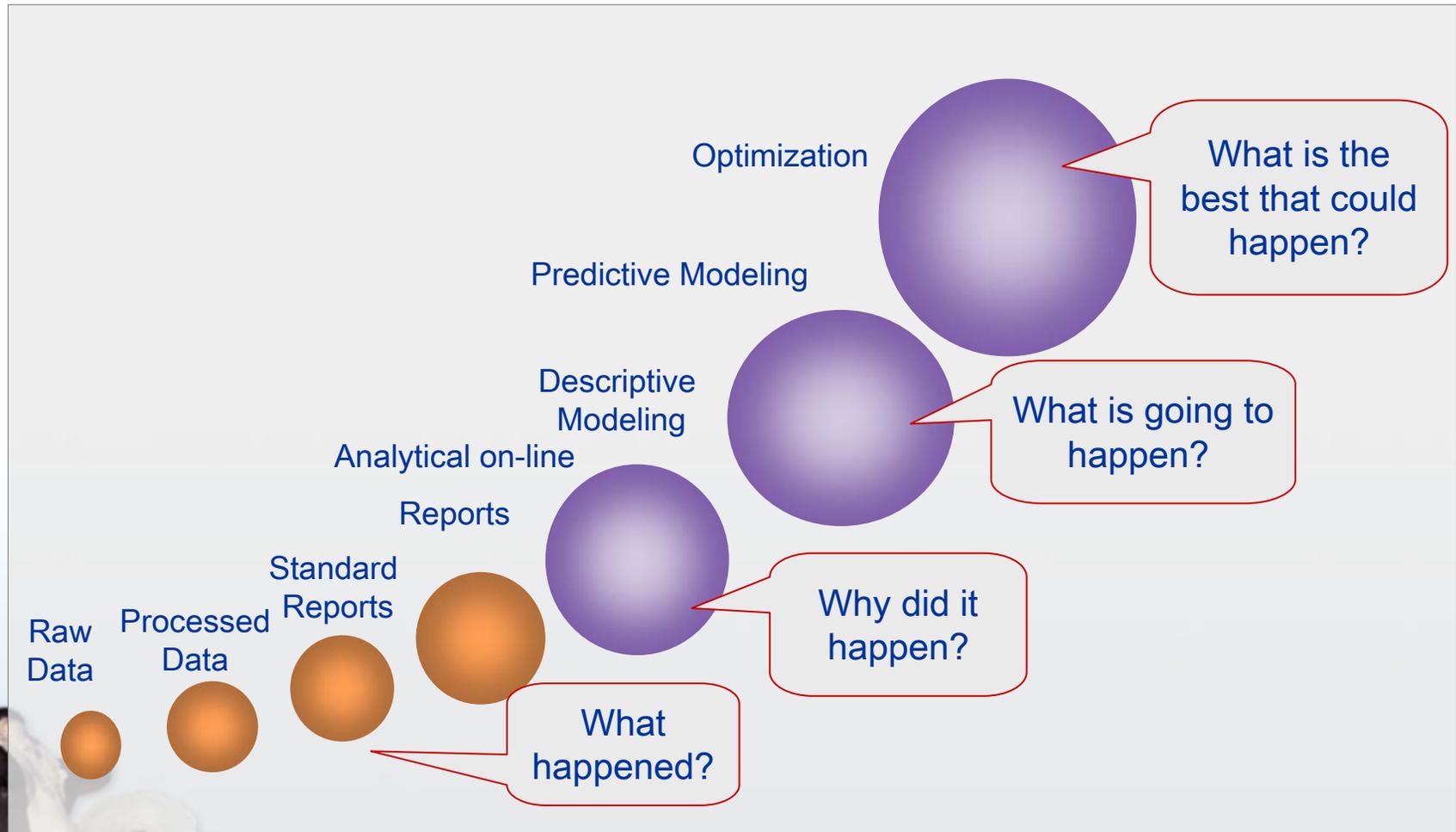
Outline

- **Introduction**
- **Automated Data collection**
- **Data mining and analysis**
- **Summary**

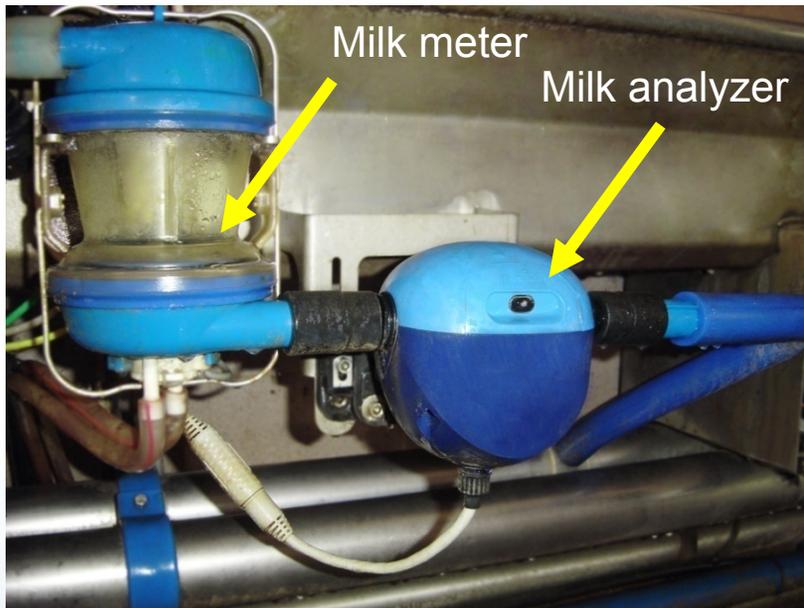


Data Collection, mining and analysis

Data → Information → Knowledge → Intelligence

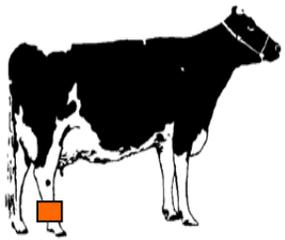


Real Time acquisition of milk components, yield and conductivity



- * Free flow
- * Non-interfering measurement
- * Continuous real time acquisition of milk components
- * Data is acquired automatically for the individual cow during its milking





Behavior Sensor (pedometer +)



How do we know how an animal feels?

Assuming an animal manifests its feeling by its behavior
there are numerous aspects of behavior

Activity

Moving – steps

Lying

Lying time

Lying bouts

Calmness

Restlessness

(option)



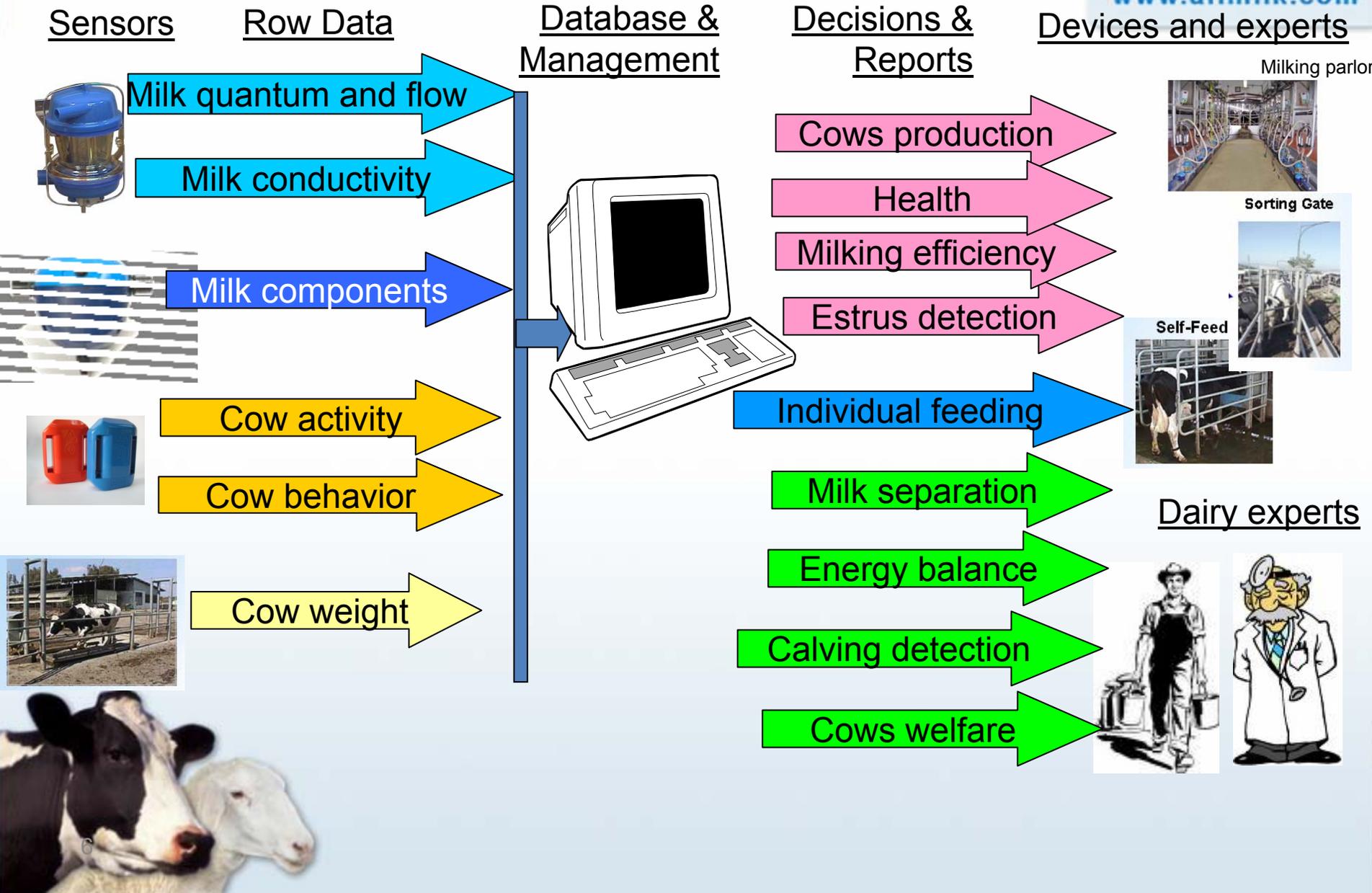
Pedometer Plus measures: •

Activity – Steps -

Rest time – Minutes Rest bout - # -

Antenna visits – # - Calmness/Restlessness

Scheme for a Data Recording and Management System



Data mining and analysis

Major Goal:

- Maximize Milk yield and Quality and minimize the Cost of production

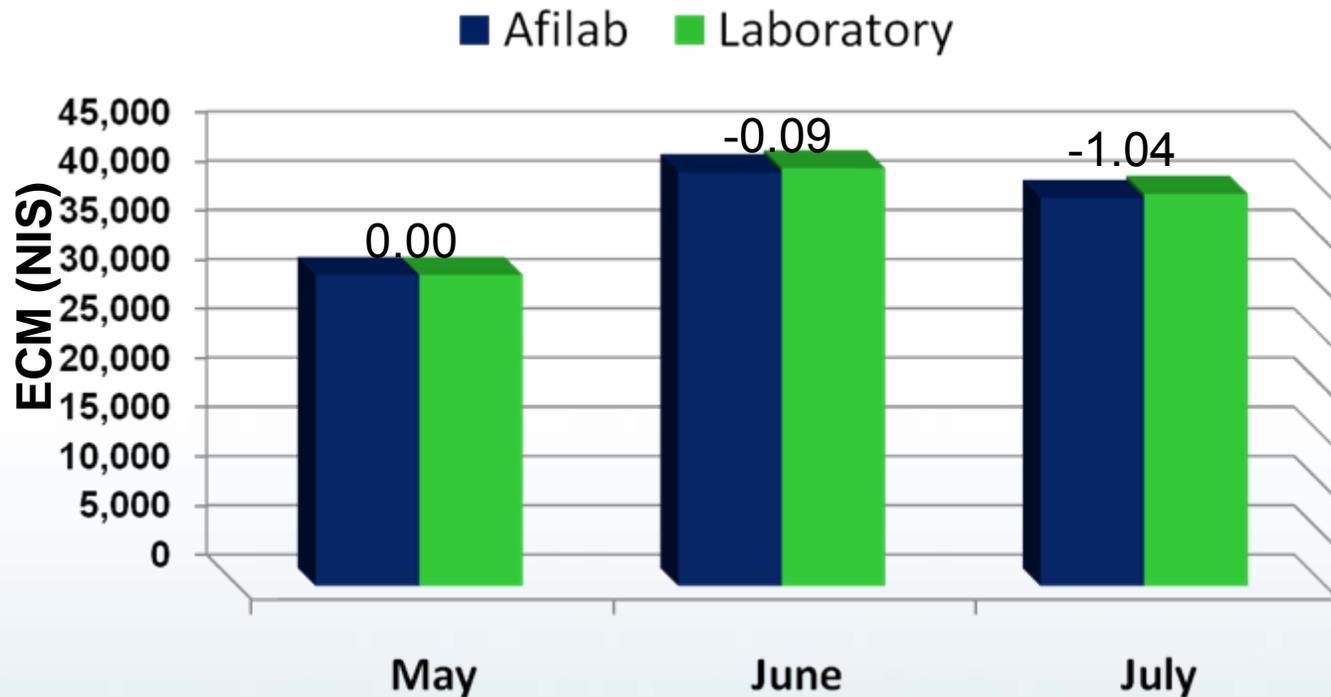
Primary Factors

- production
- Feed ration
- Health and welfare
- Reproduction



Milk Payment

ECM – Milk production, %Fat, %Protein, SCC •



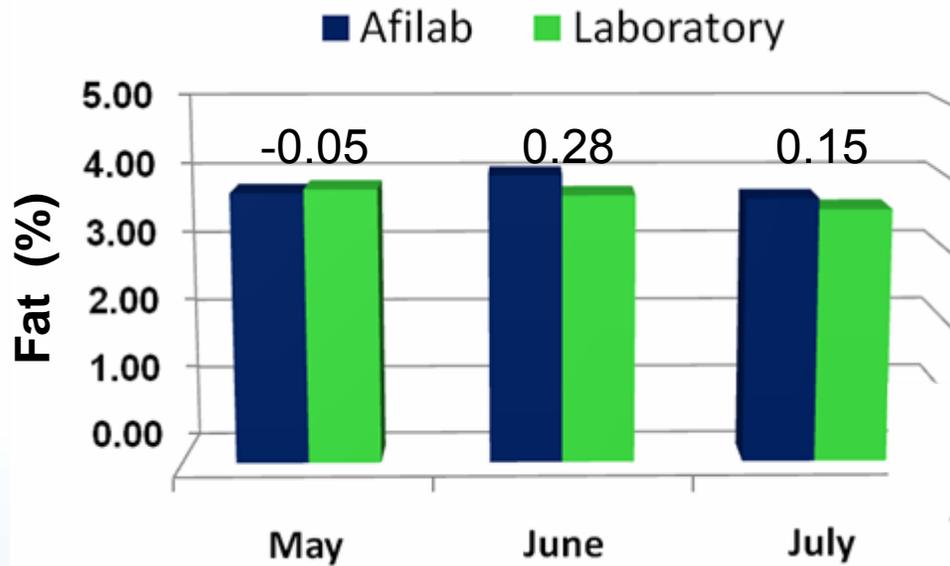
Scholnik et. al, 2007



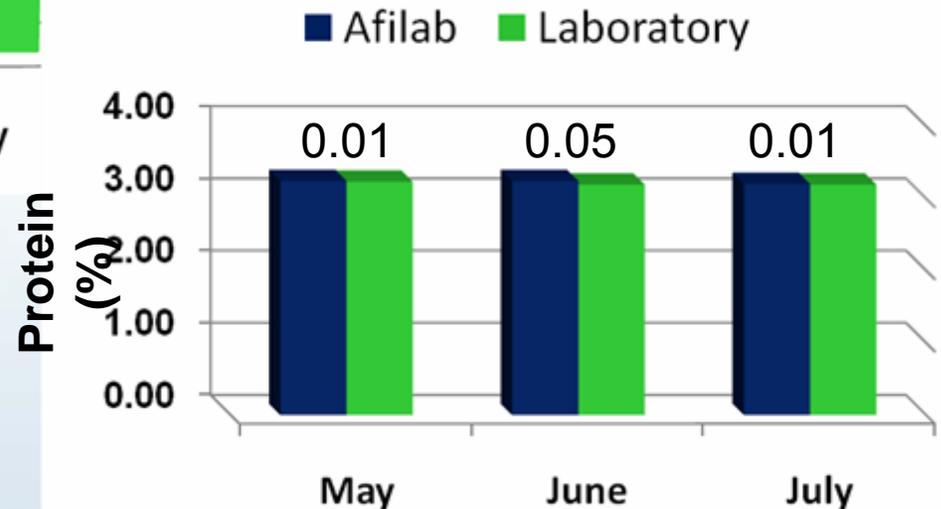
Nutritional Information - Control Nutritional Status

- Feed ration \neq Consumed ration

data \rightarrow rapid detection



Nutritional problems \rightarrow fat depression,
Fat/Protein fluctuations \rightarrow energy efficiency
Or moldy feed



Scholnik et. al, 2007



Nutritional Information - Individual Feeding

High importance – Management where supplement of additional concentrate feeding is needed (pasture, robotic milking, fresh cows)

RC 2001 formula:

Daily data required for calculation:

Fat

Protein

Milk yield

Body weight

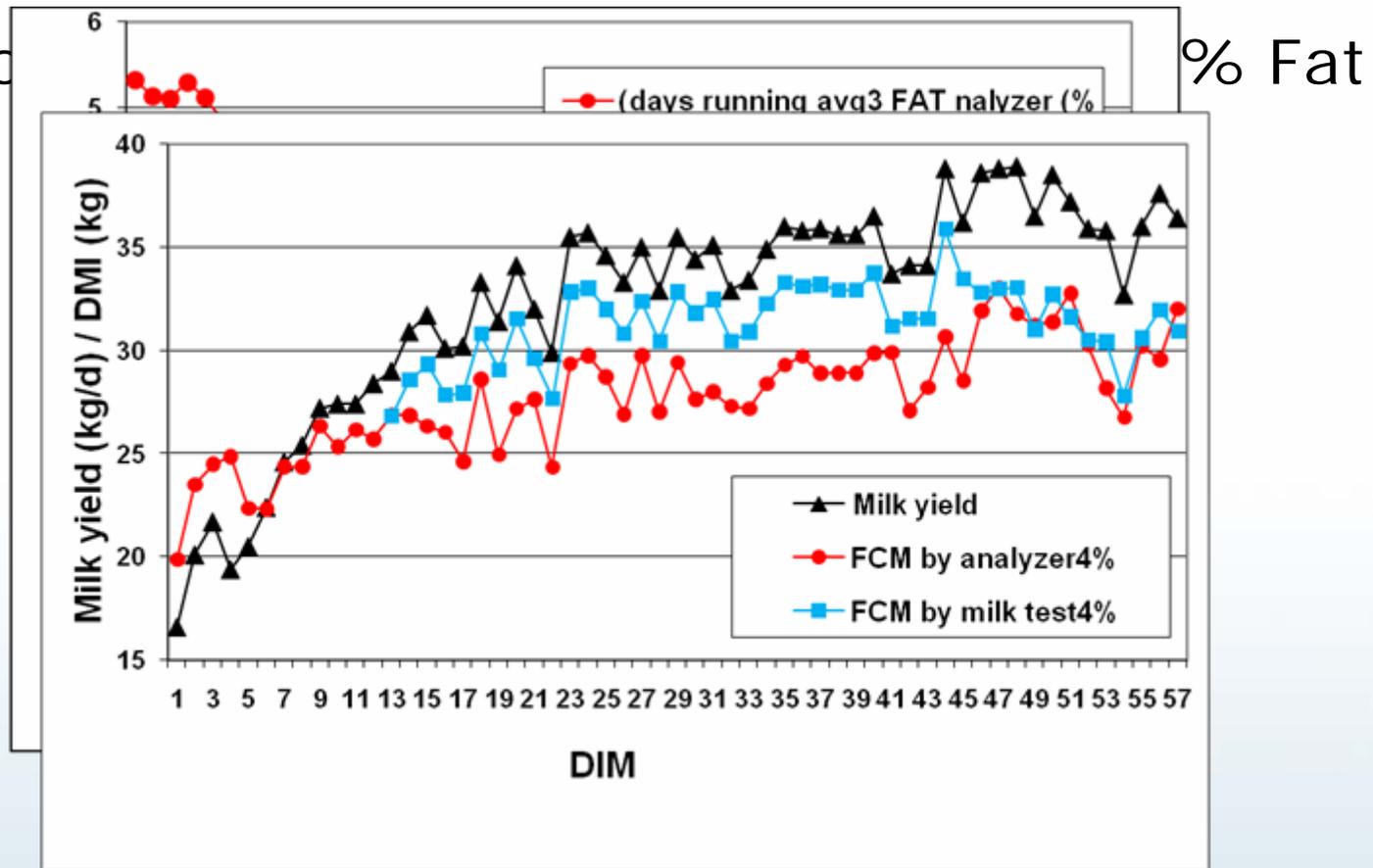
Week of lactation

$$MI_{(kg/day)} = (0.372 * FCM^{0.75} + 0.0968 * BW) * (1 - e^{-0.192 * (wol + 3.67)})$$



Individual Feeding - Example

- Cow 2823
- Allocation



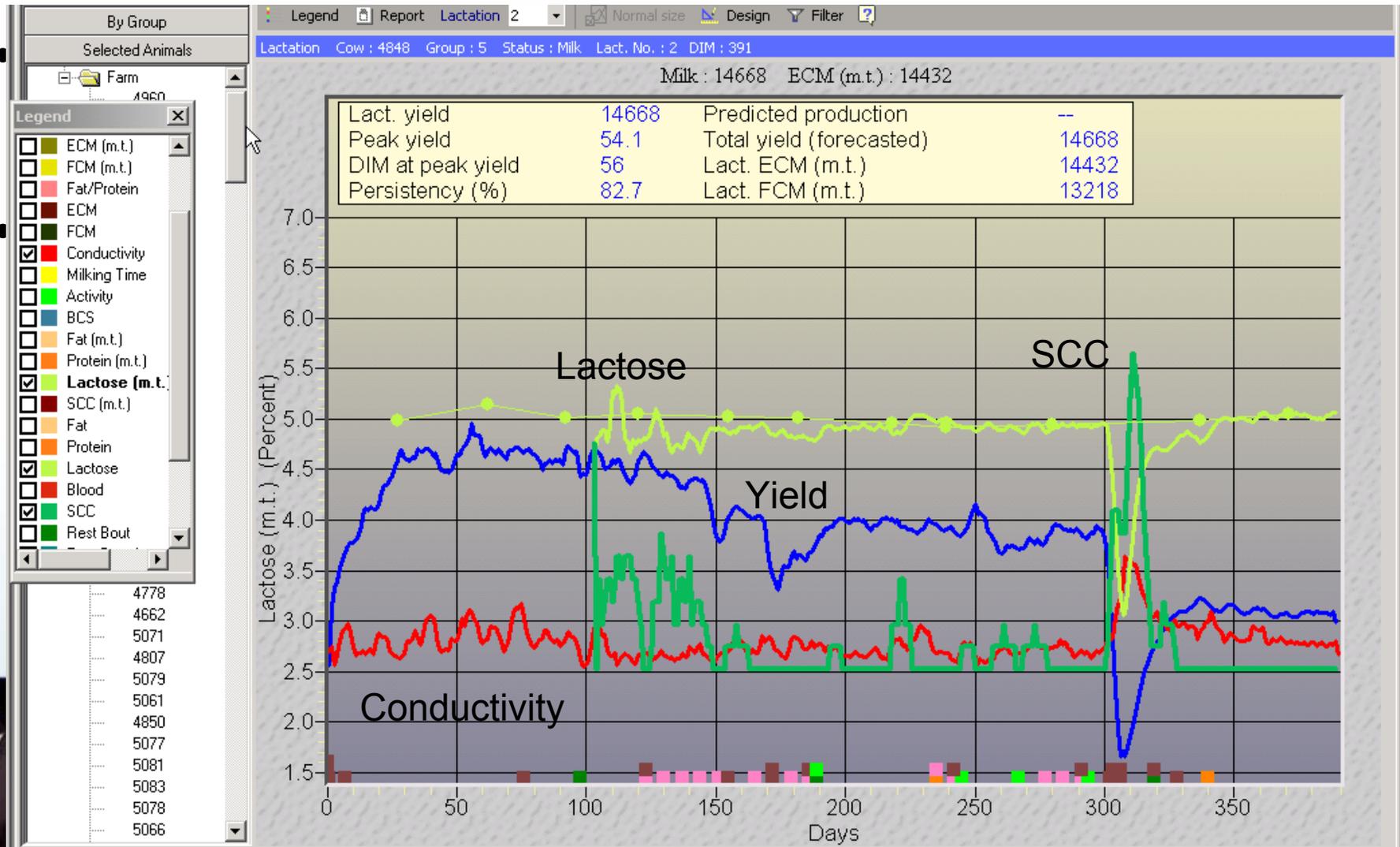
E. Maltz, personal communication

Over estimation of 60 kg concentrates by periodic test
– most likely leading to further decline in fat



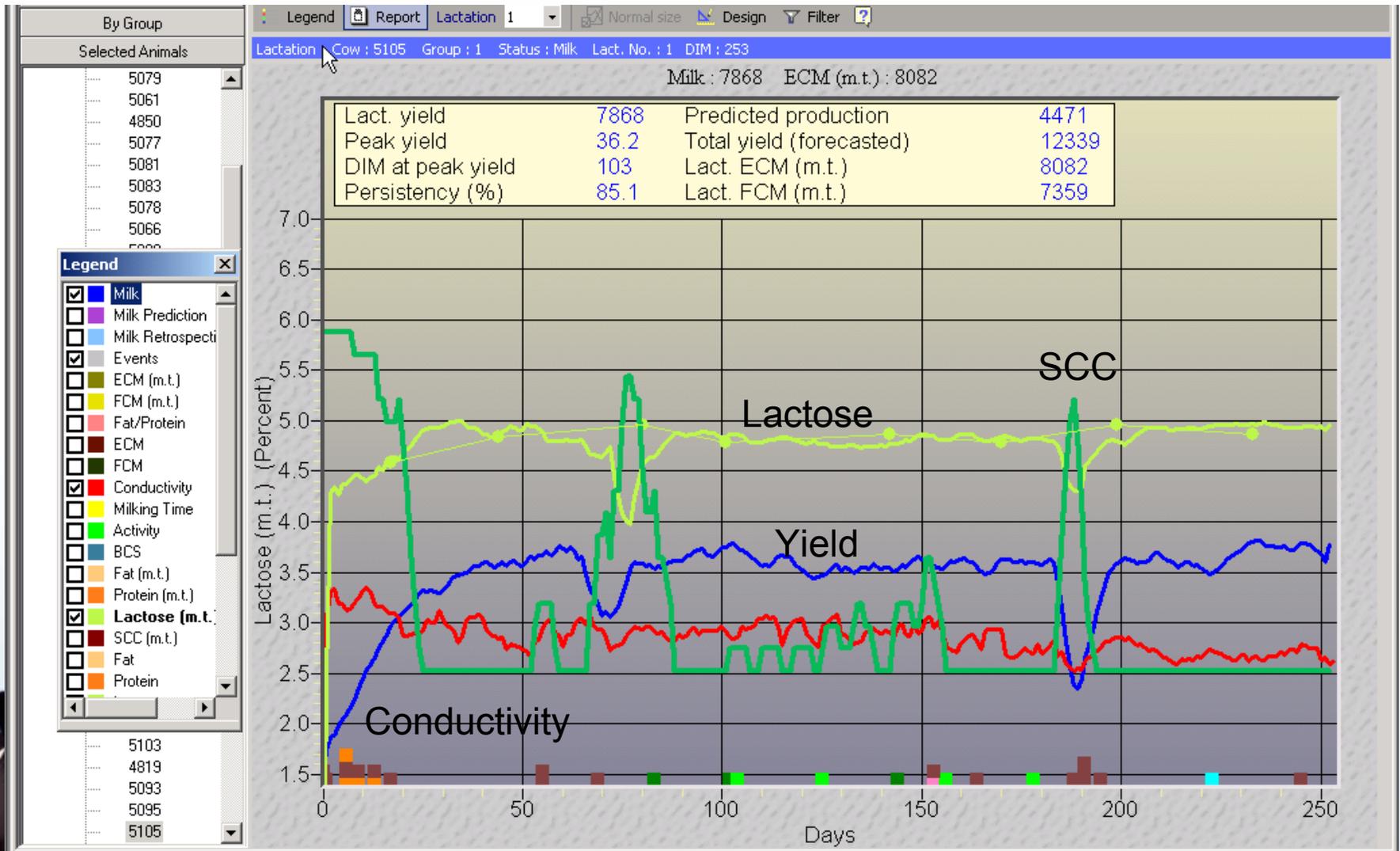
Mastitis Control

Mastitis – Case Report – Commercial Kibbutz Farm



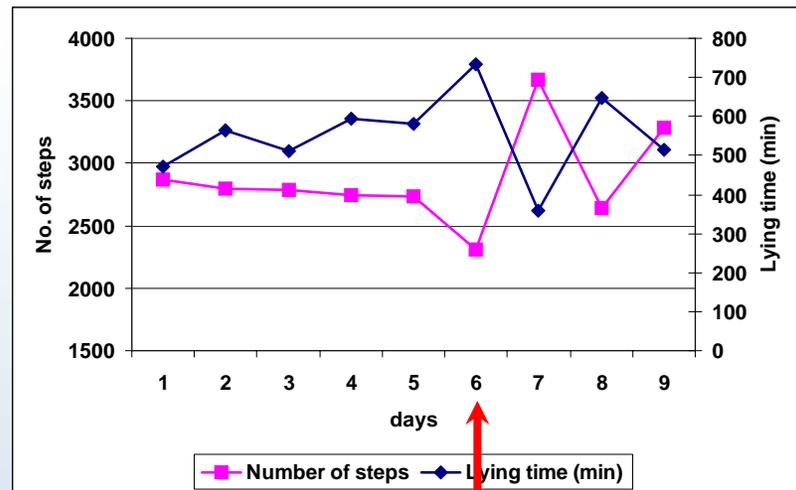
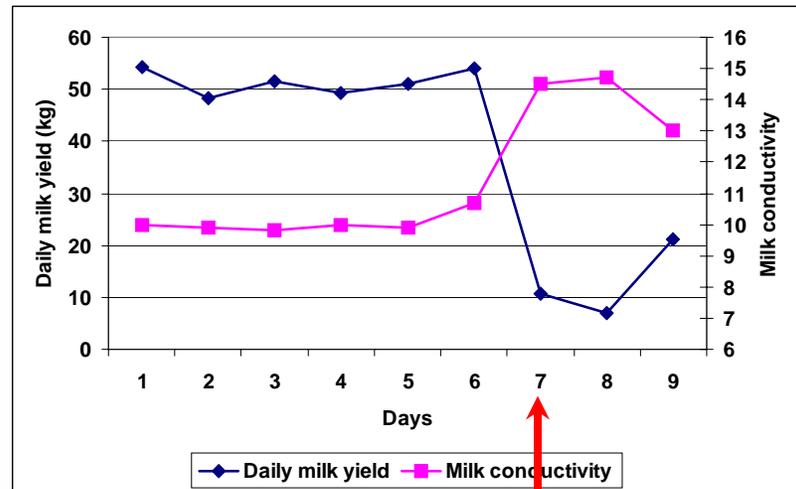
Mastitis Control

Mastitis – Case Report – Commercial Kibbutz Farm

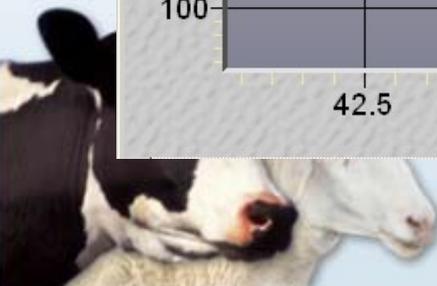
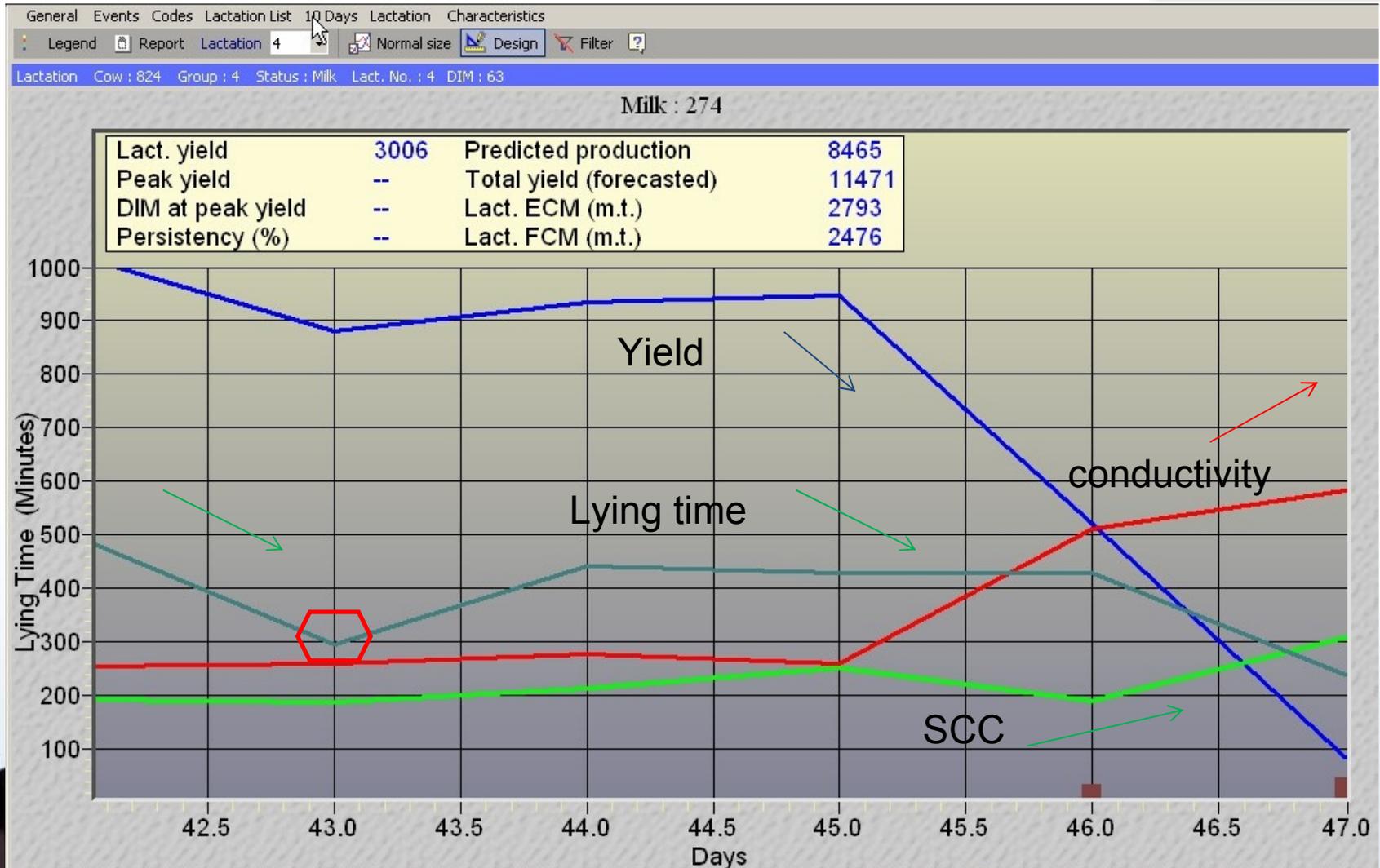


Cow Health Monitoring — Early Mastitis Detection

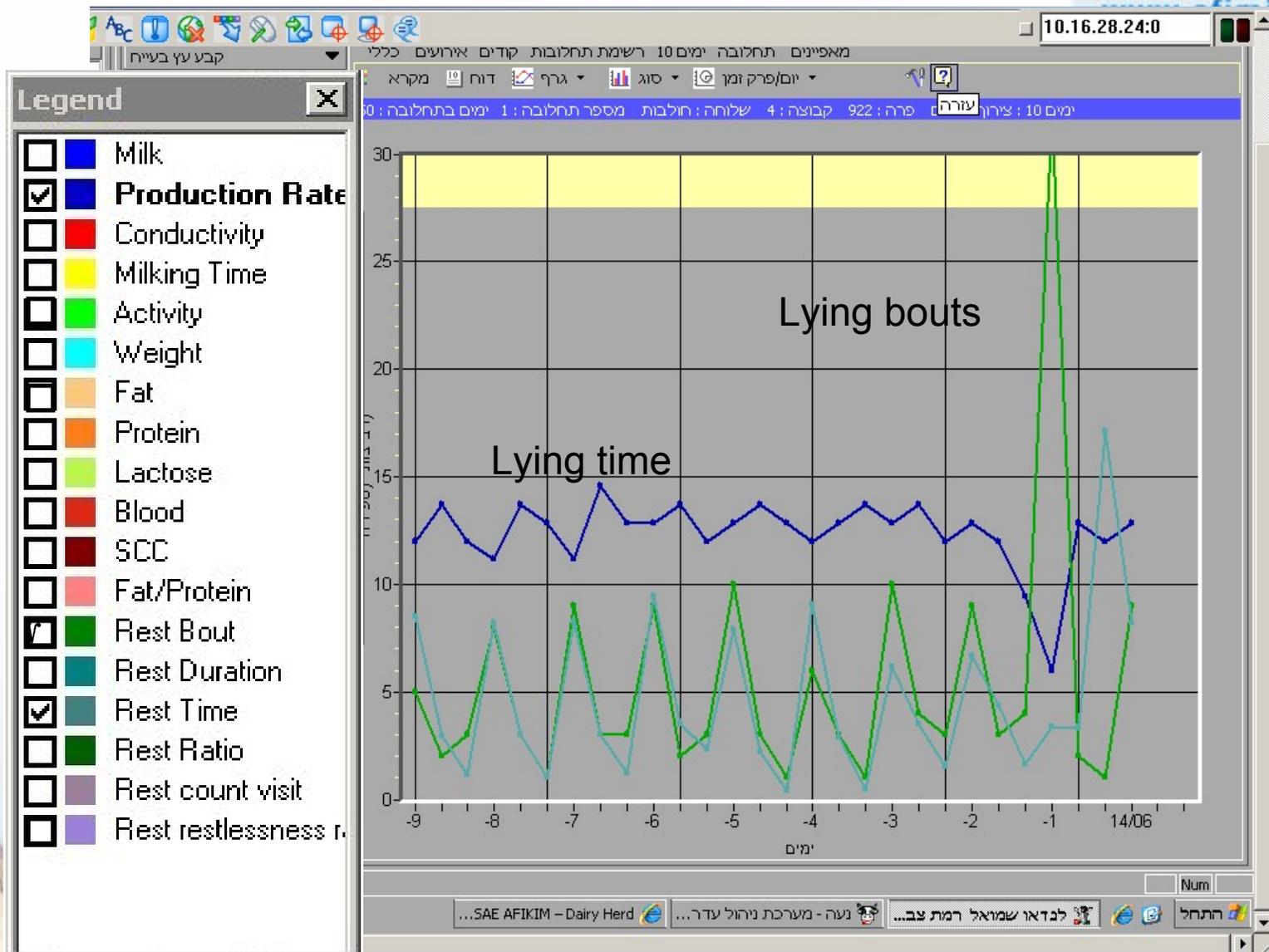
Behavior changes significantly during one day prior to milk drop and sharp increase in milk conductivity (mastitis diagnosed in day 7)



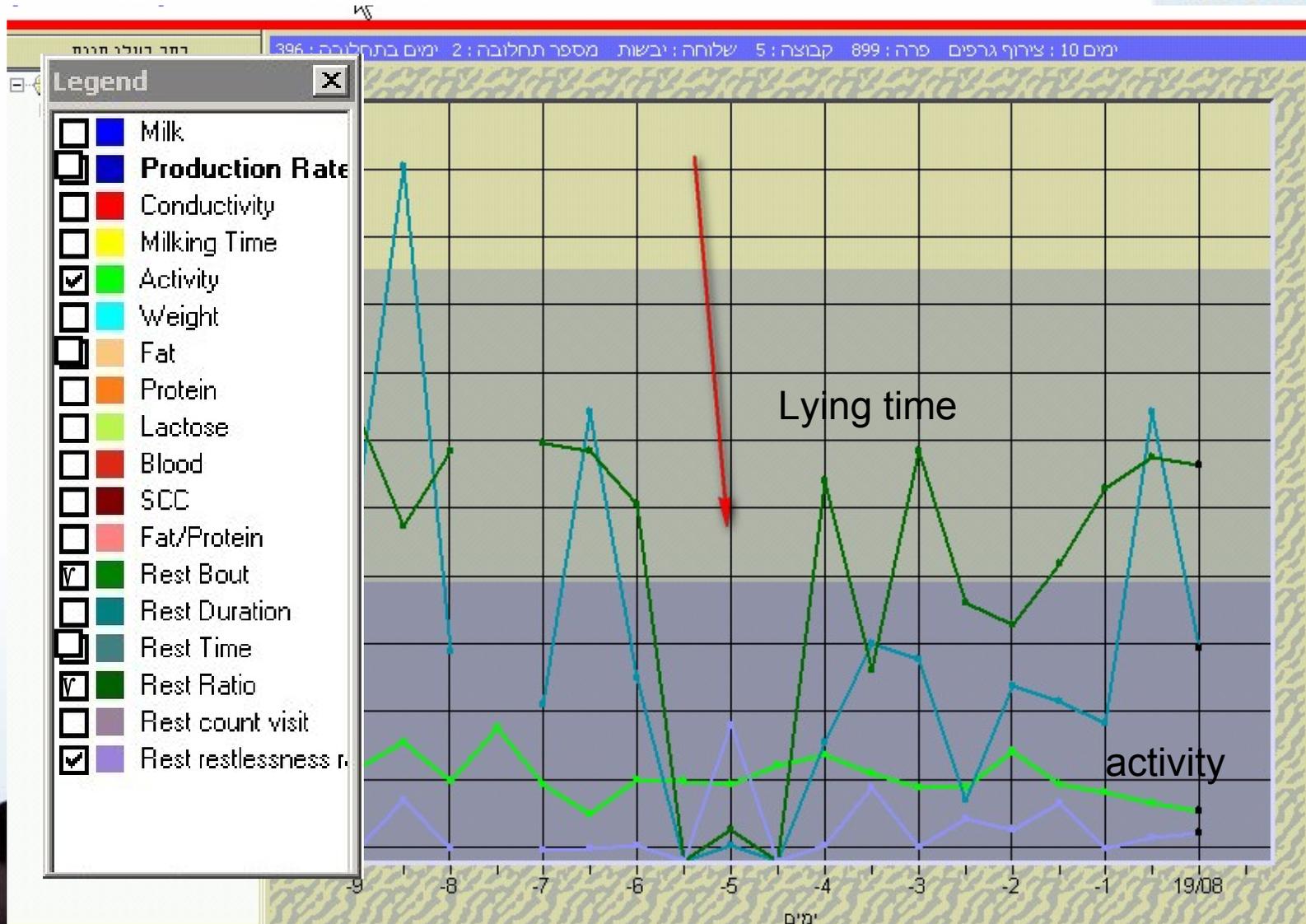
Clinical Mastitis Event



Abdominal Pain



Eye Scratching Injury



Cow Health Monitoring – Diagnosis of Metabolic Diseases

- Correlation between metabolic diseases and milk components
- Ketosis (NEB) – Fat/Protein Ratio (FPR) > 1.35-1.50 (Heuer et. al., 1999)
- SARA – FPR < 1.0 or more then 10% with fat < 2.5% (Tomaszewski and Cannon, 1993; Nordlund et. al., 2004)



Diagnosis of Ketosis – FPR

FPR	BHBA>1.4 (31.3%*)	
	Sensitivity (%) AfiLab (Laboratory)	Specificity (%) AfiLab (Laboratory)
>1.2	59.3 (90.3)	56.1 (37.4)
>1.4	33.3 (45.2)	82.7 (75.5)
>1.6	11.1 (25.8)	92.4 (92.8)
>1.8	2.8 (6.5)	98.3 (97.8)

* % of cases with BHBA above threshold

Scholnik et. al., 2007



Diagnosis of Ketosis – Multifactorial Approach

FPR cut off	FPR + SHI ¹ filters + BHI ² filters	
	Sensitivity (%)	Specificity (%)
1.25	82.6	73.4
1.30	83.5	73.7
1.35	85.2	74.4
1.40	77.4	76.1
1.45	74.8	75.0

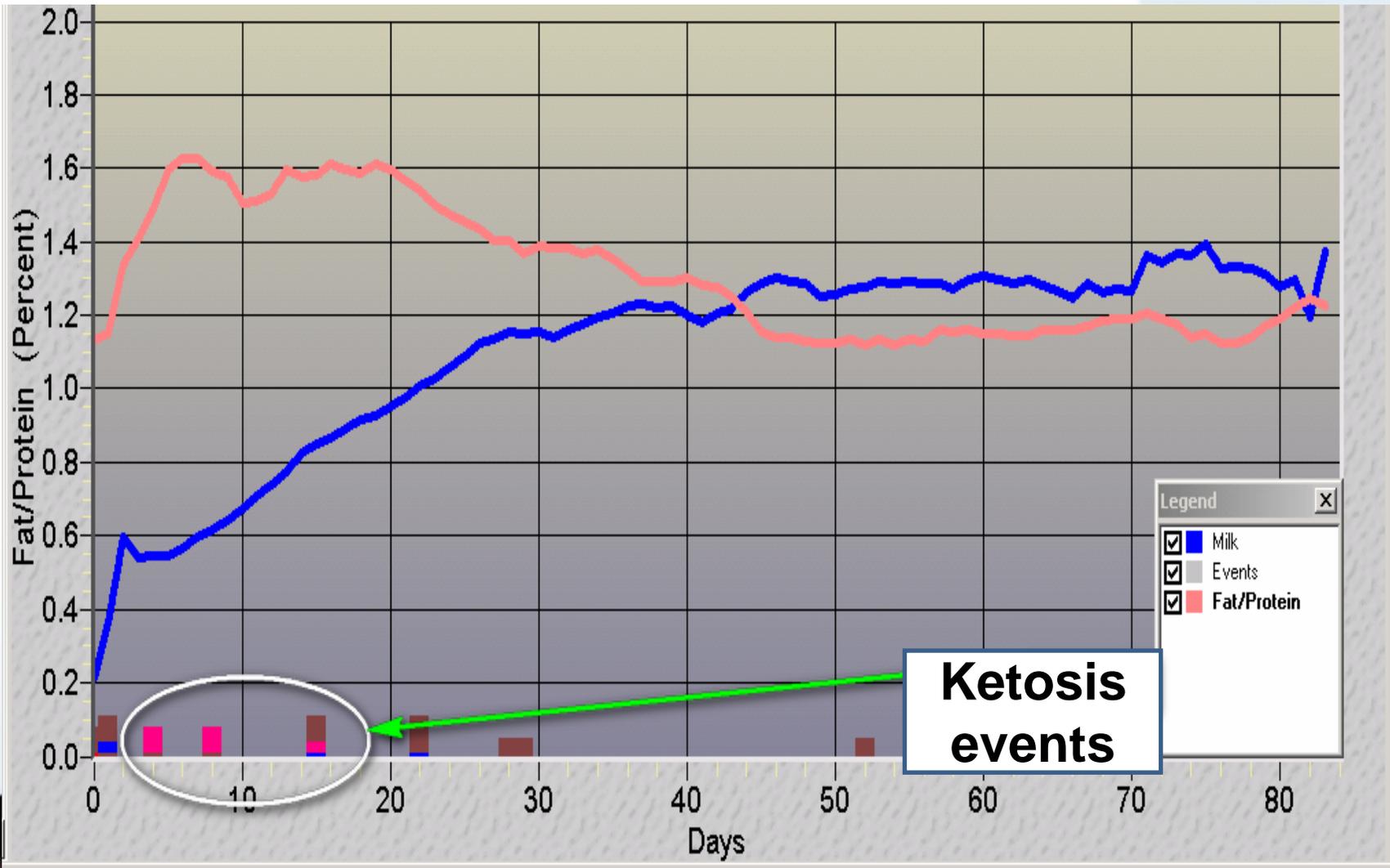
¹ SHI – Sound Health Indicators

² BHI – Bad Health Indicators

Livshin et. al., 2008



Ketosis – Case Report



Suspected SARA by Group

Suspected Subclinical Acidosis by Groups (01/01/2009 07:...

Save Save As... Design Refresh

Index	Status+ group	Total animals	Daily yield	Daily avg. yield	Daily yield <%>	Fat %	Avg. fat	% suspect. acidosis	Low fat cows
1	101	80	34.7	36.5	-5	3.27	3.21	10	8
2	102	75	26.2	28.7	-10	3.44	3.38	13	10
3	103	90	34.6	38.0	-9	3.31	3.20	4	4
4	104	80	36.4	39.8	-8	3.21	3.14	23	18
5	105	88	35.2	37.5	-5	3.21	3.19	22	19
6	106	90	39.2	41.0	-4	3.06	3.09	22	20
7	107	90	39.1	39.1	0	3.05	3.05	22	20
8	108	80	37.4	37.2	0	3.12	3.13	16	13
9	109	89	36.8	37.2	-2	3.29	3.26	9	8
10	110	89	34.8	35.8	-3	3.34	3.25	11	10
11	111	62	35.1	33.7	6	3.10	3.13	21	13
12	112	48	28.1	30.6	-8	3.51	3.40	2	1
Total	--	961	--	--	--	--	--	--	144
Avg.	--	--	35.2	36.7	-5	3.23	3.19	15	--

Index	Cow	Lact. no.	DIM	Gyn. status	Δ1 Fat %	Avg. fat	Daily yield	Daily avg. yield
1	4562	2	198	Insemination	1.90	2.44	27.4	35.7
2	1048	2	188	Insemination	2.04	3.18	44.7	47.6

Show details Show vertical

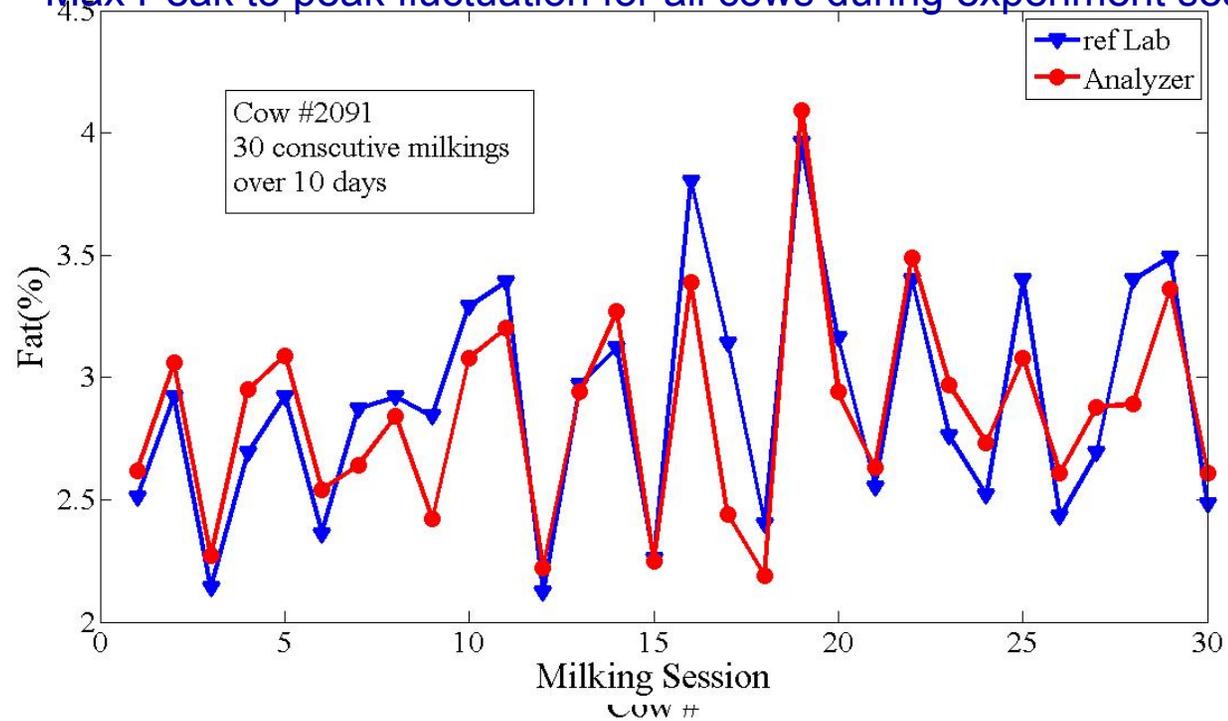


Fat concentration fluctuations between milking sessions

mean sd = 0.57 fat% , mean peak-to-peak = 2.16 fat %

Comparing lab results to on line Analyzer for a typical Holstein cow

Max Peak to peak fluctuation for all cows during experiment session



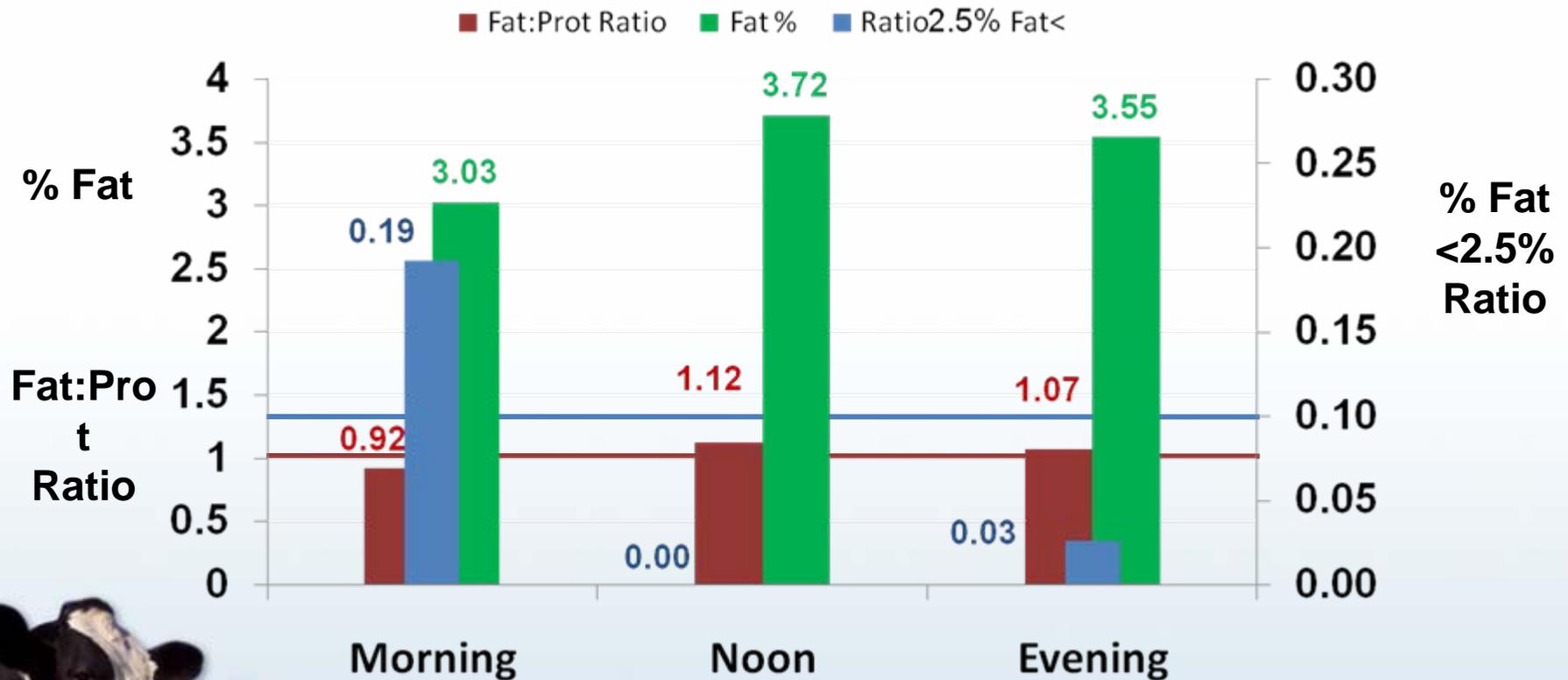
The range of our ensemble for a given 10 days period

30 consecutive milking sessions in 10 consecutive days was sampled in the lab and by the analyzer (A.R.O farm, n=88 Holstein cows).



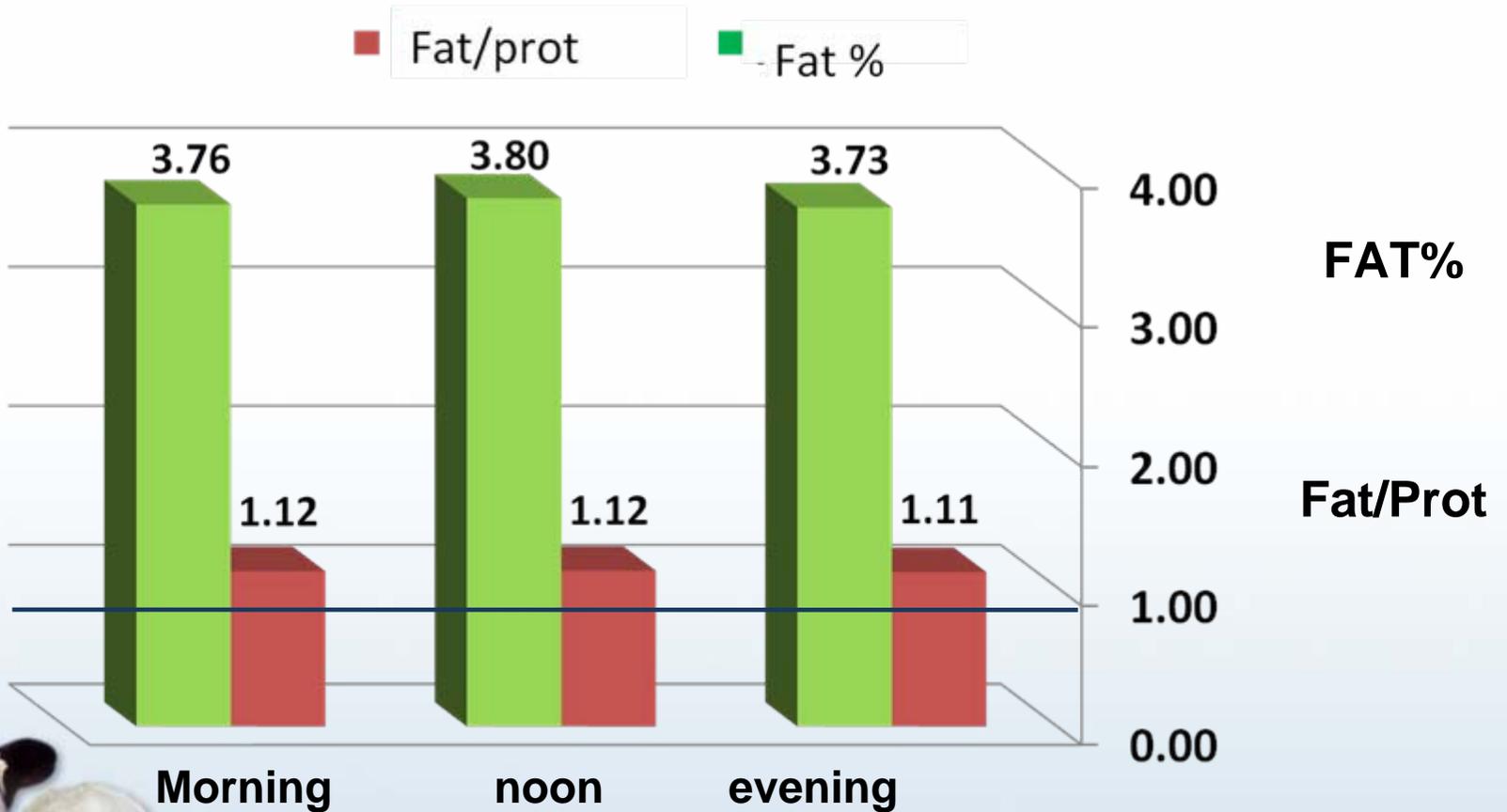
Feeding Management – %Fat by Milking

Difference of Fat between Milking (Group level)

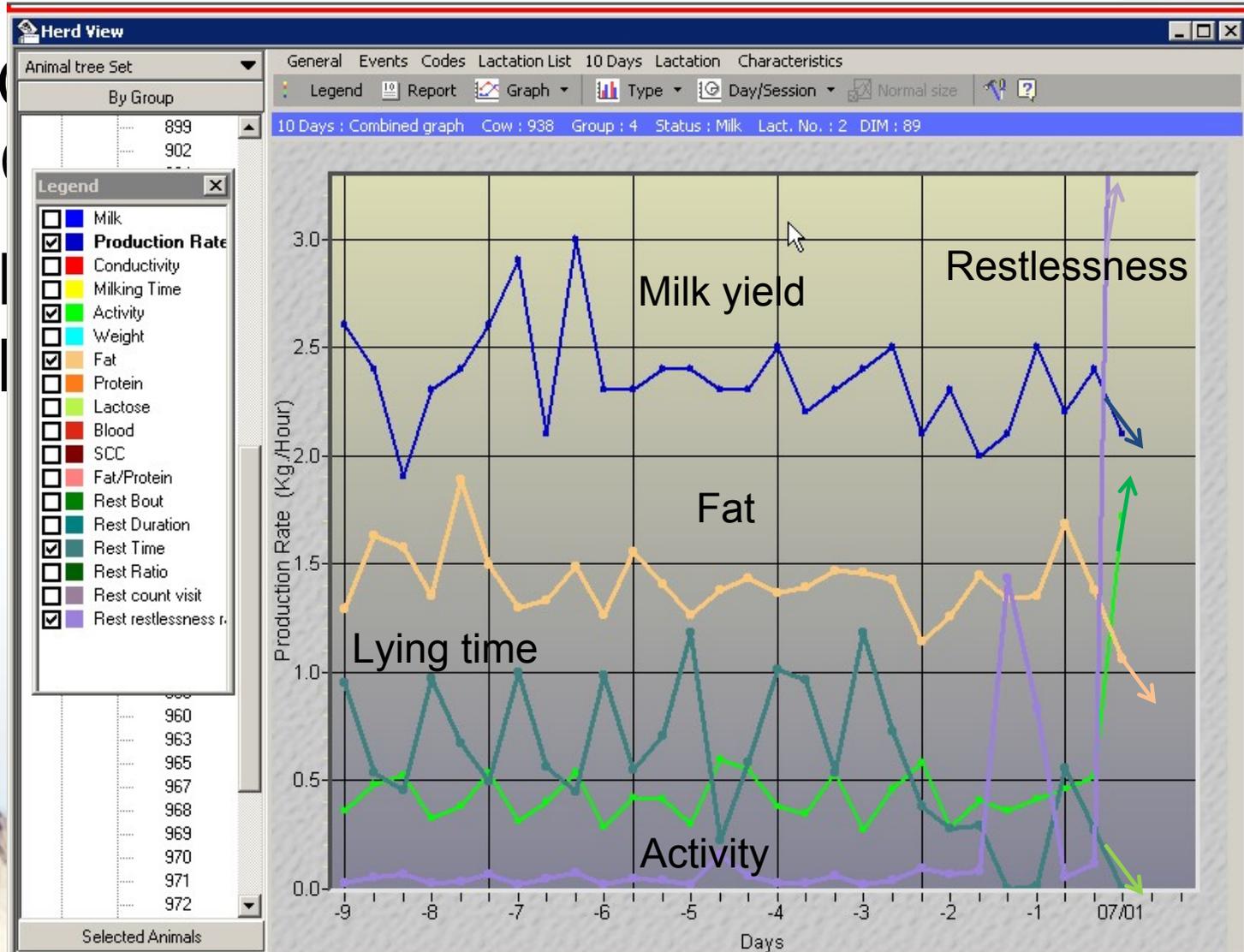


Feeding Management

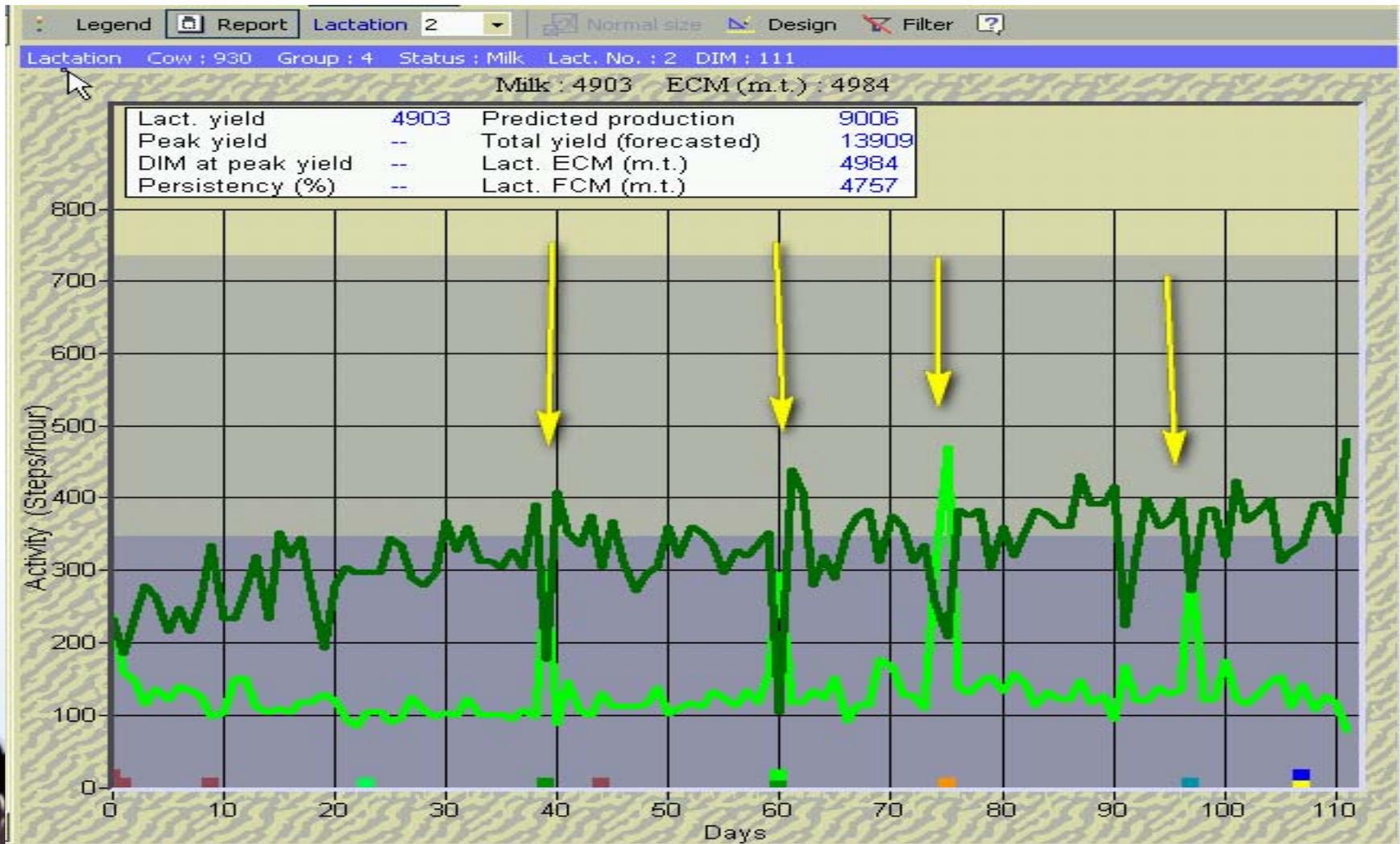
%Fat by Milking



Heat Detection



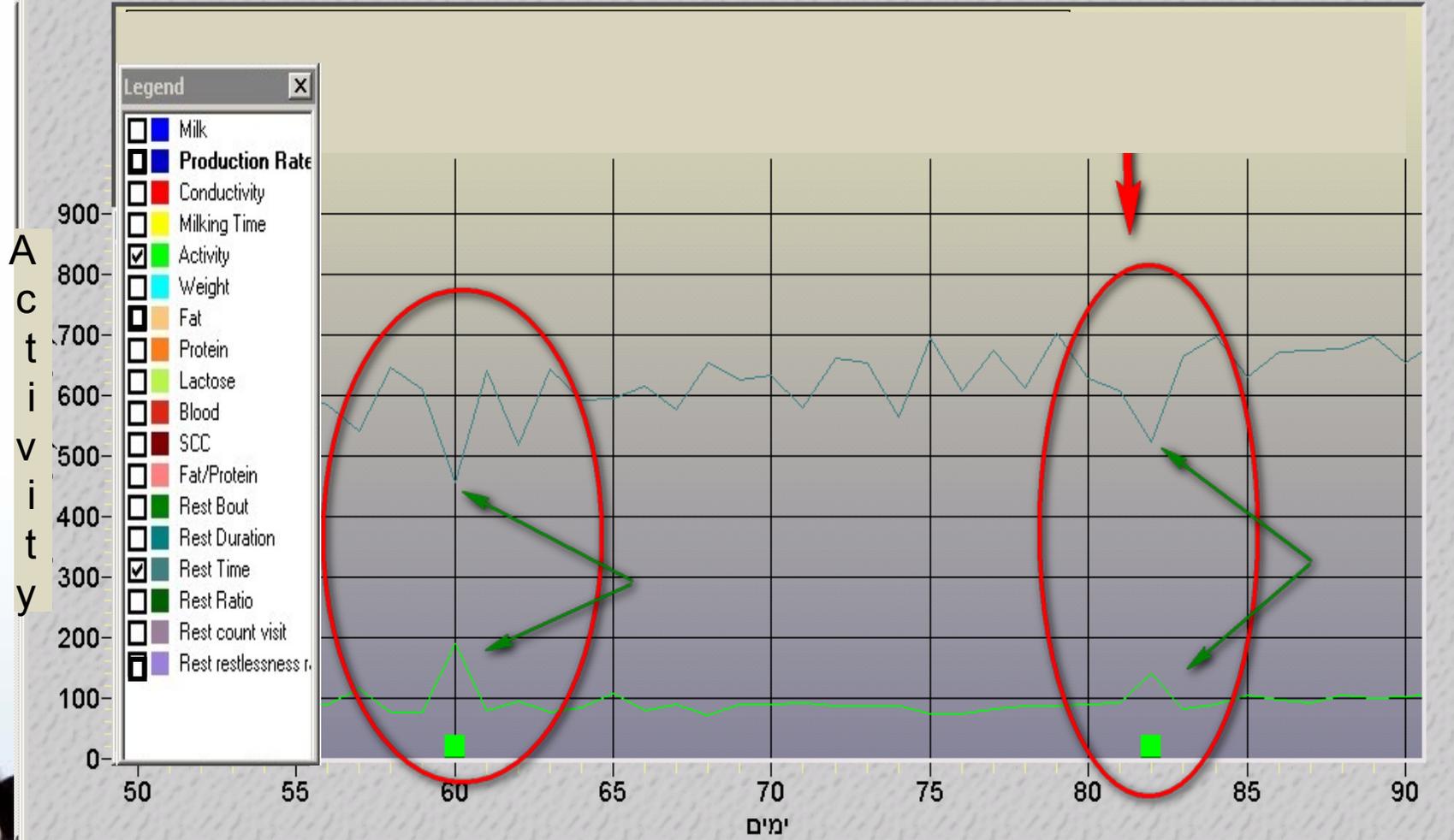
Normal Heat Behavior



Silence Heat

תחלובה פרה: 740 קבוצה: 4 שלוחה: חולבות מספר תחלובה: 9 ימים בתחלובה: 112

חלב: 2238 חמ"מ: 2042

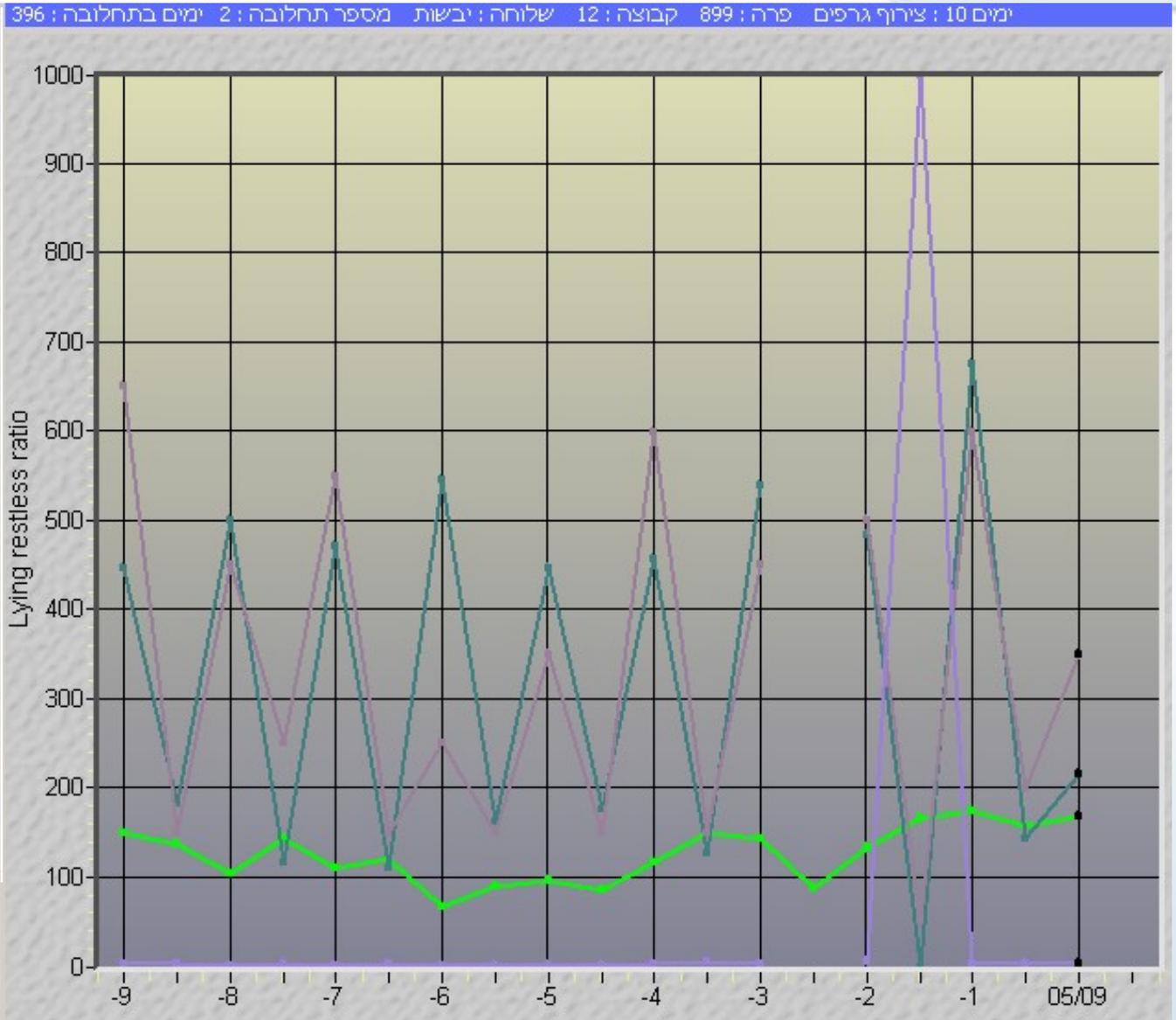


Detecting Calving Time

- Helpful tool for daily routine plan
- Attend expected difficult calving
- Cows behavior changes prior to calving



Detecting Calving Time



Legend

- Milk
- Production Rate**
- Conductivity
- Milking Time
- Activity
- Weight
- Fat
- Protein
- Lactose
- Blood
- SCC
- Fat/Protein
- Rest Bout
- Rest Duration
- Rest Time
- Rest Ratio
- Rest count visit
- Rest restlessness r.



Applied Research Development and Cooperation

afimilk™
The Heart of the Dairy Farm
www.afimilk.com



- Cow health monitoring – Afikim farm
- Heat detection free stalls barns –
Cooperation **with Volcani Center (Israel)** –
Meimad farm
- Welfare and Comfort group level
- Deviation parameters for Pasture
management – **South Africa**
- Pasture quality and availability information



S.A.E. Afikim Applied Research Team

- Improving calving time detection – Cooperation with Volcani Center (Israel)
- Heat detection in and management – Commercial farms - Germany and Poland
- Improve cow health and fertility monitoring – specification and timing – Integrated data
- Self feeding allocation – Afikim farm
- **Crazy Elephants ?!!!**

Jerusalem Zoo



Academic Cooperation

Uelph University (Canada)

- arly diagnosis of lameness cows
- arly detection of cows suspected for postpartum diseases - cooperation with Volcani Center



Academic Cooperation

Oregon State University (U.S.A.)

- Welfare and comfort – individual cow level
- Detect health problems and abortions

I.R.T.A. (Spain)

- Effects of group changing – behavior and production



Academic Cooperation

Volcani Center (Israel)

- Effect of group changing – Behavior, fertility and production

Virginia tec(USA)

- Genetic evaluation, Udder health

University of Florida(USA)

- Economic decision making in farm management



Thank you for your attention

