



Gembloux Agro-Bio Tech  
Université de Liège

# I-COWS

## exploring plant-animal interface by precision grazing

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Gramado, RS, Brazil  
August 2<sup>nd</sup> 2016





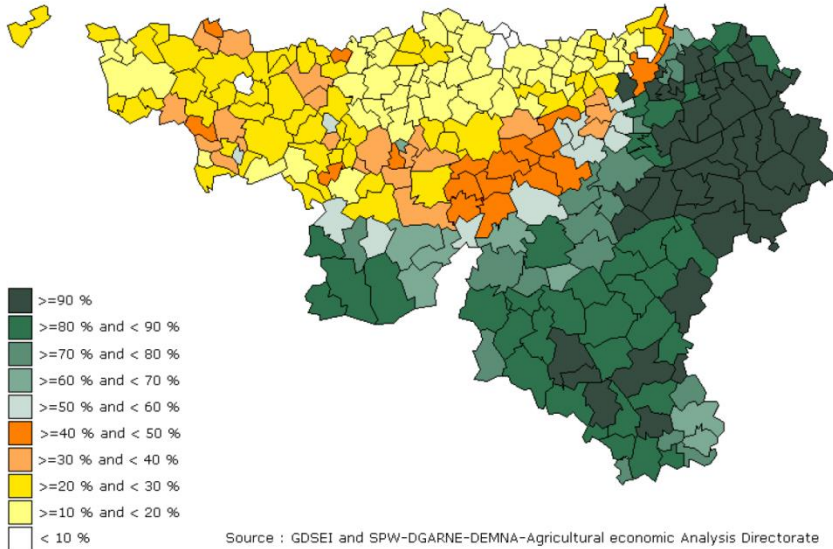
## **The EU milk sector prepares for the end of milk quotas**

Brussels, 26 March 2015

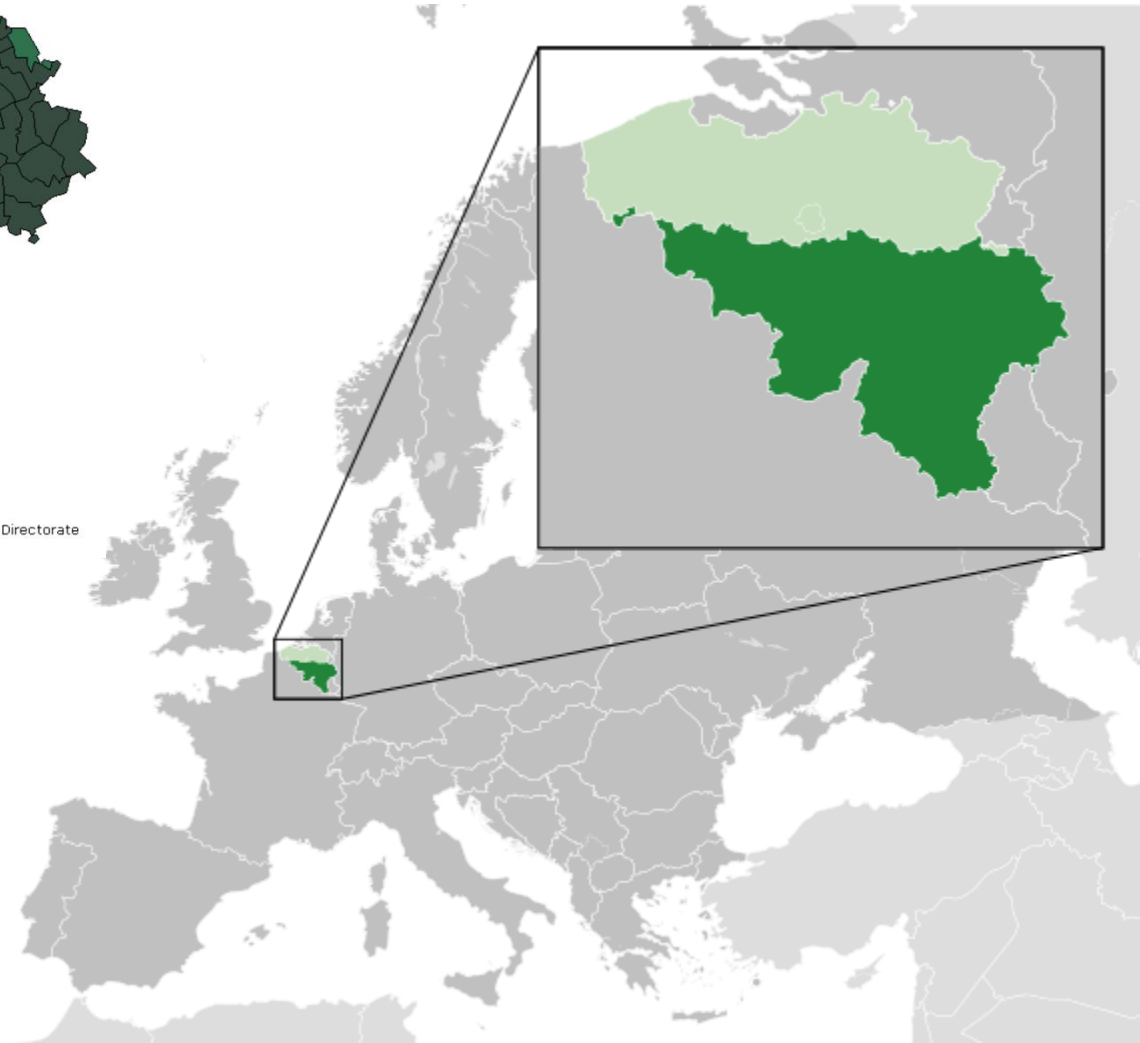
The EU milk quota regime comes to an end on March 31, 2015. First introduced in 1984 at a time when EU production far outstripped demand, the quota regime was one of the tools introduced for overcoming these structural surpluses. Successive reforms of the EU's Common Agriculture Policy have increased the market-orientation of the sector and, in parallel, provided a range of other, more targeted instruments to help support producers in vulnerable areas, such as mountain areas where the costs of production are higher. The final date to end quotas was first decided in 2003 in order to provide EU producers with more flexibility to respond to growing demand, especially on the world market. It was reconfirmed in 2008 with a range of measures aimed at achieving a "soft landing". Even with quotas, EU dairy exports have increased by 45% in volume and 95% in value in the last 5 years. Market projections indicate that the prospects for further growth remain strong – in particular for added-value products, such as cheese, but also for ingredients used in nutritional, sports and dietary products.

# Trends in dairy farming in Wallonia

Share of grasland in the communal UAA - 2011



Source : GDSEI and SPW-DGARNE-DEMNA-Agricultural economic Analysis Directorate



# Trends in dairy farming in Wallonia

## Le secteur laitier belge a poursuivi sa croissance en 2015

BELGA Publié le jeudi 07 juillet 2016 à 14h34 - Mis à jour le jeudi 07 juillet 2016 à 14h35



CONJONCTURE L'année 2015, marquée par la fin des quotas laitiers au niveau de l'Union européenne, a vu le secteur laitier belge poursuivre sa croissance, ressort-il de statistiques publiées jeudi par le SPF Economie.

"En dépit des nouvelles négatives en provenance du secteur laitier et de la baisse des prix du lait, les efforts fournis par le secteur laitier ces dernières années semblent porter leurs fruits. Les hausses des livraisons de lait après la suppression du quota et la tendance à l'internationalisation et à la spécialisation accrue dans certains produits laitiers se traduisent par une hausse constante de la production de fromage, de lait en poudre, de crème et de beurre", résume le SPF Economie.

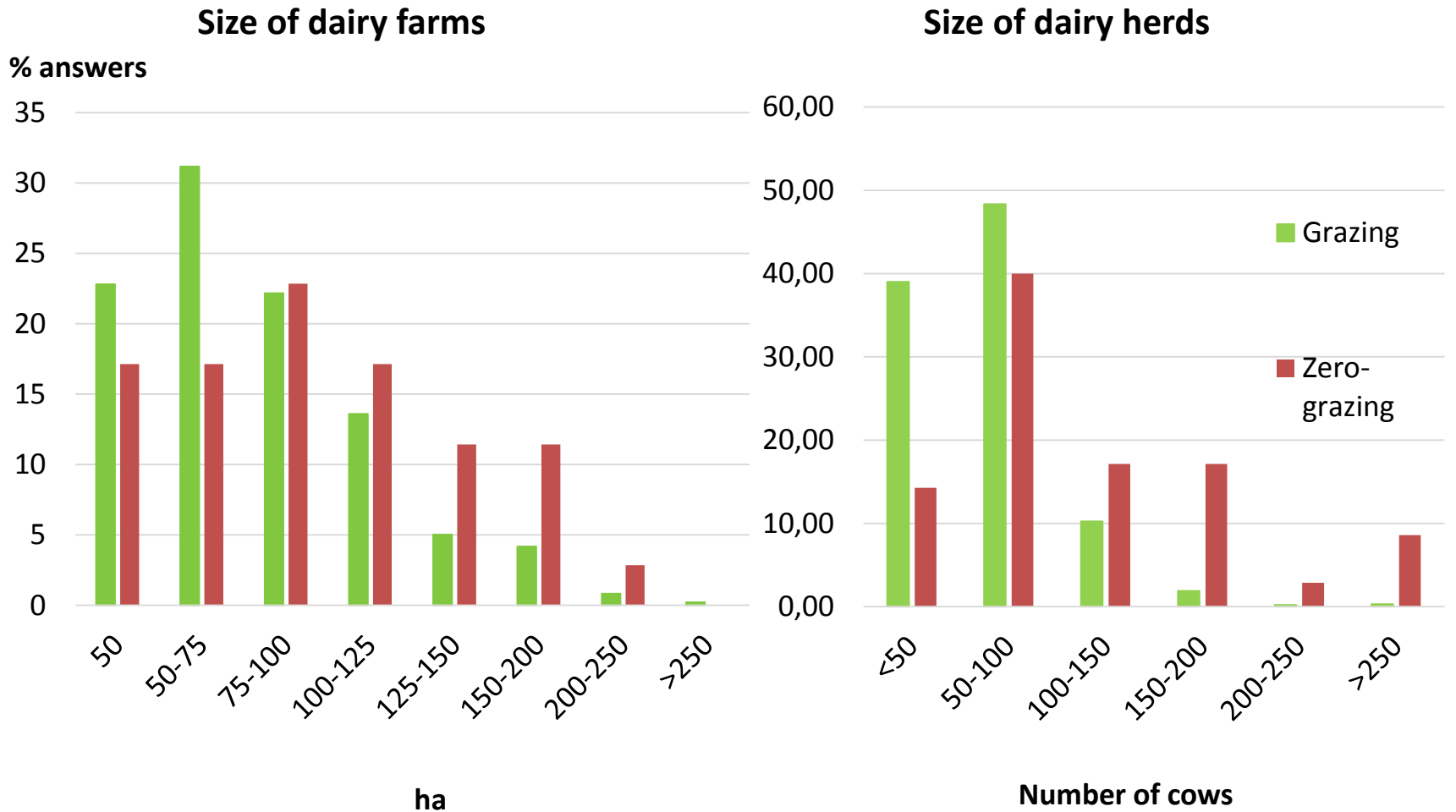
Ainsi, tant la production de beurre (+27% à 81.268 tonnes) que celle de lait en poudre (+22% à 231.699 tonnes) ont sensiblement augmenté par rapport à 2014. La production de lait de consommation (+1,5% à 899.501 tonnes) a également augmenté en 2015, comme celle de fromage (+18,6% à 95.988 tonnes) -en raison surtout de nouvelles capacités de production de mozzarella-, de produits laitiers frais (+8,6% à 544.125 tonnes) ou encore de glace (+6,4% à 71.148 tonnes). Le fromage de chèvre suit la même tendance positive (+22,21%, à 4.772 tonnes).

A l'inverse de cette tendance, le lait vitaminé (-10,2% à 39.191 tonnes) et le lait condensé et lactosérum (-12,2% à 71.406 tonnes) ont vu leur production reculer.

Cette hausse de la production, dans un contexte de fin des quotas laitiers européens, intervient alors que de nombreux éleveurs belges se plaignent depuis des années de prix insuffisants pour couvrir leurs frais de production.



# Trends in dairy farming in Wallonia

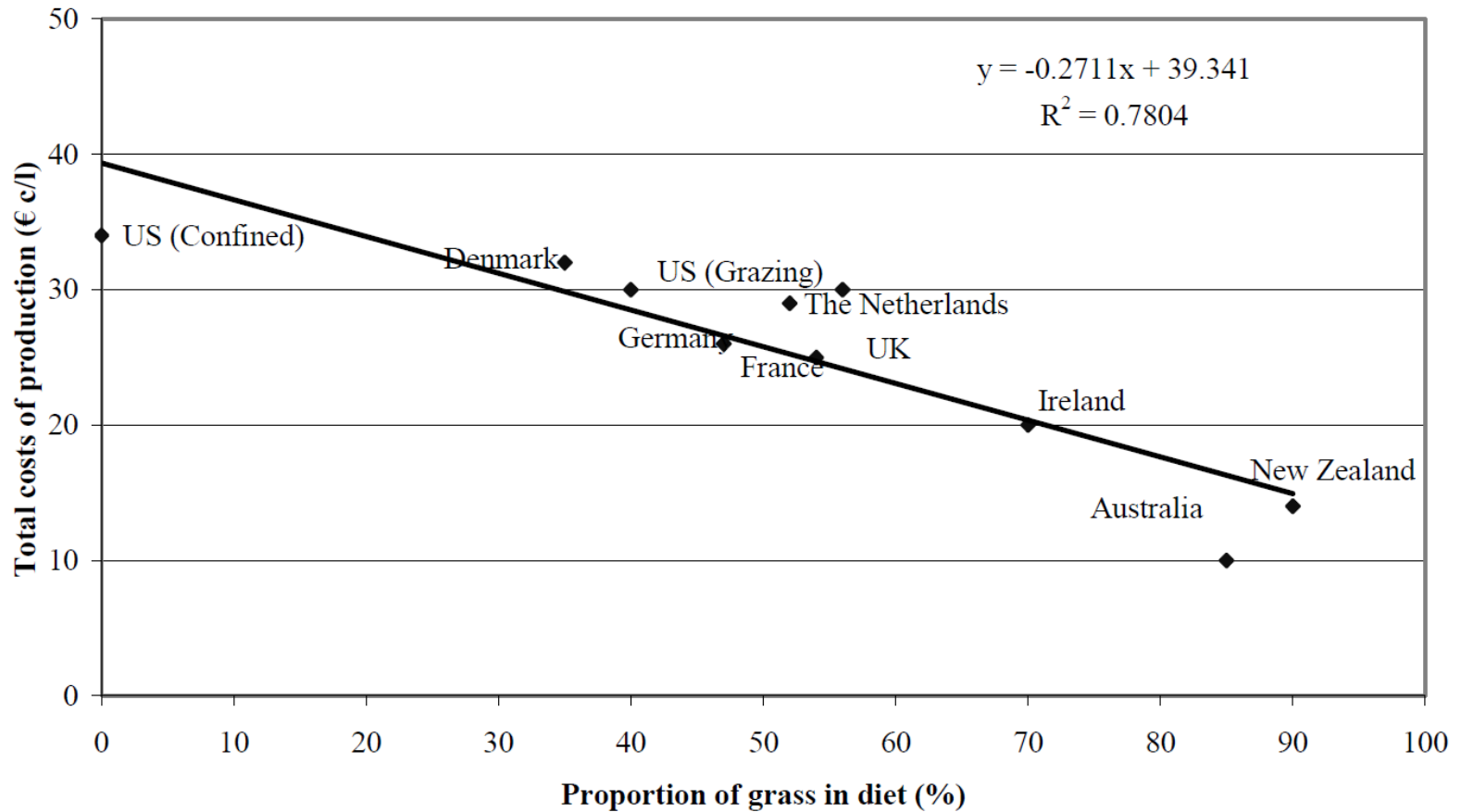


(Lessire et al., in press)



DeLaval

# Only one decade ago...



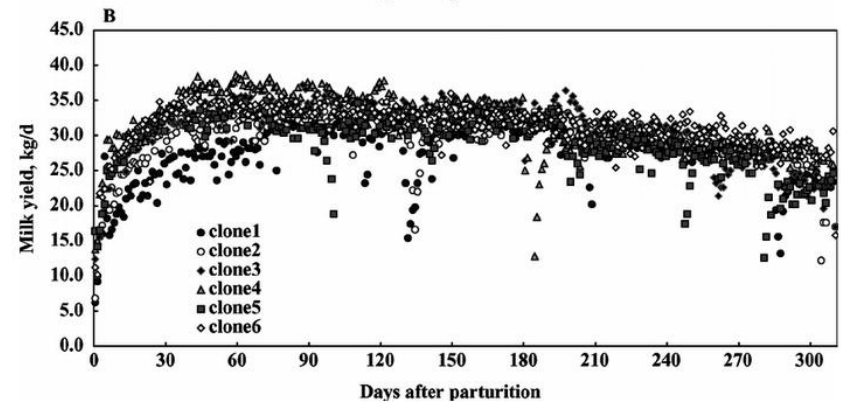
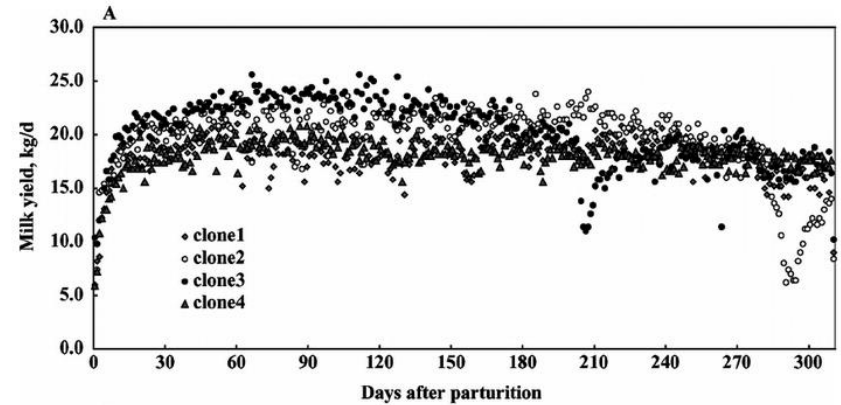


# So why is it so complicated?

- Grasslands and animals are multicomponent dynamic systems
- Static tools to manage dynamic resources
  - Fences
  - SR, grazing time, intensity
  - RPM, sward sticks

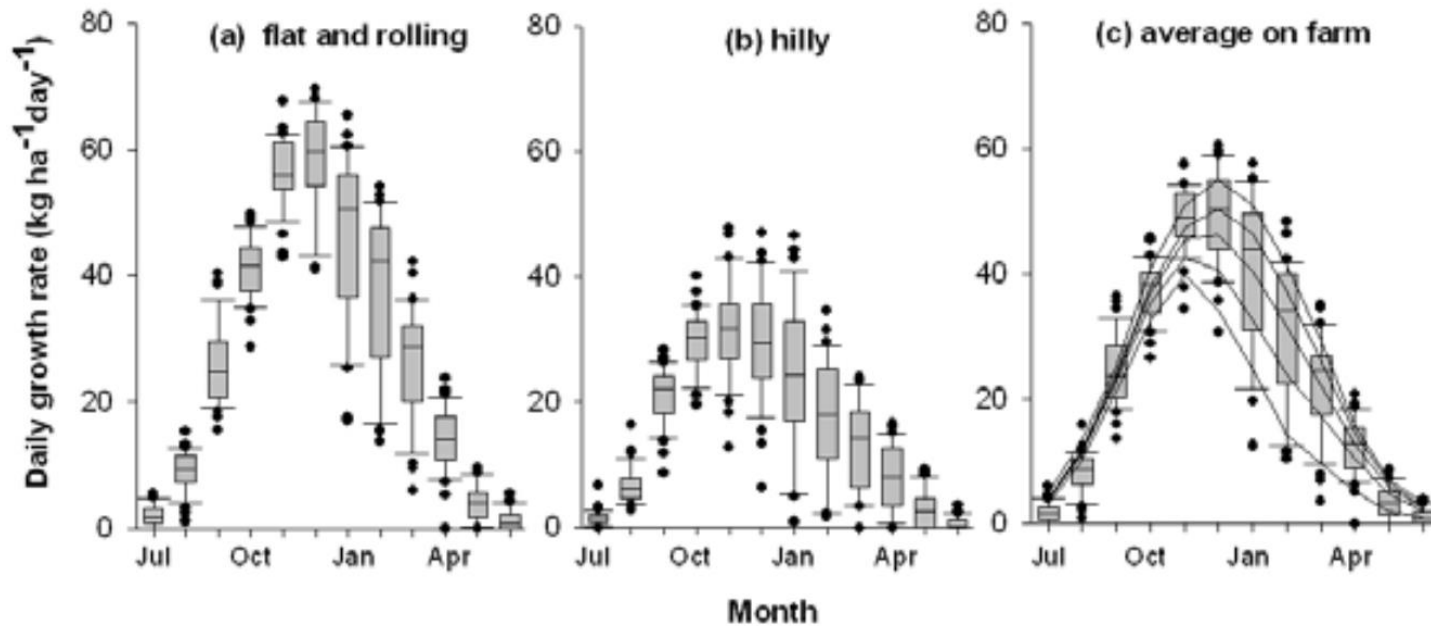


# Variability in milk production



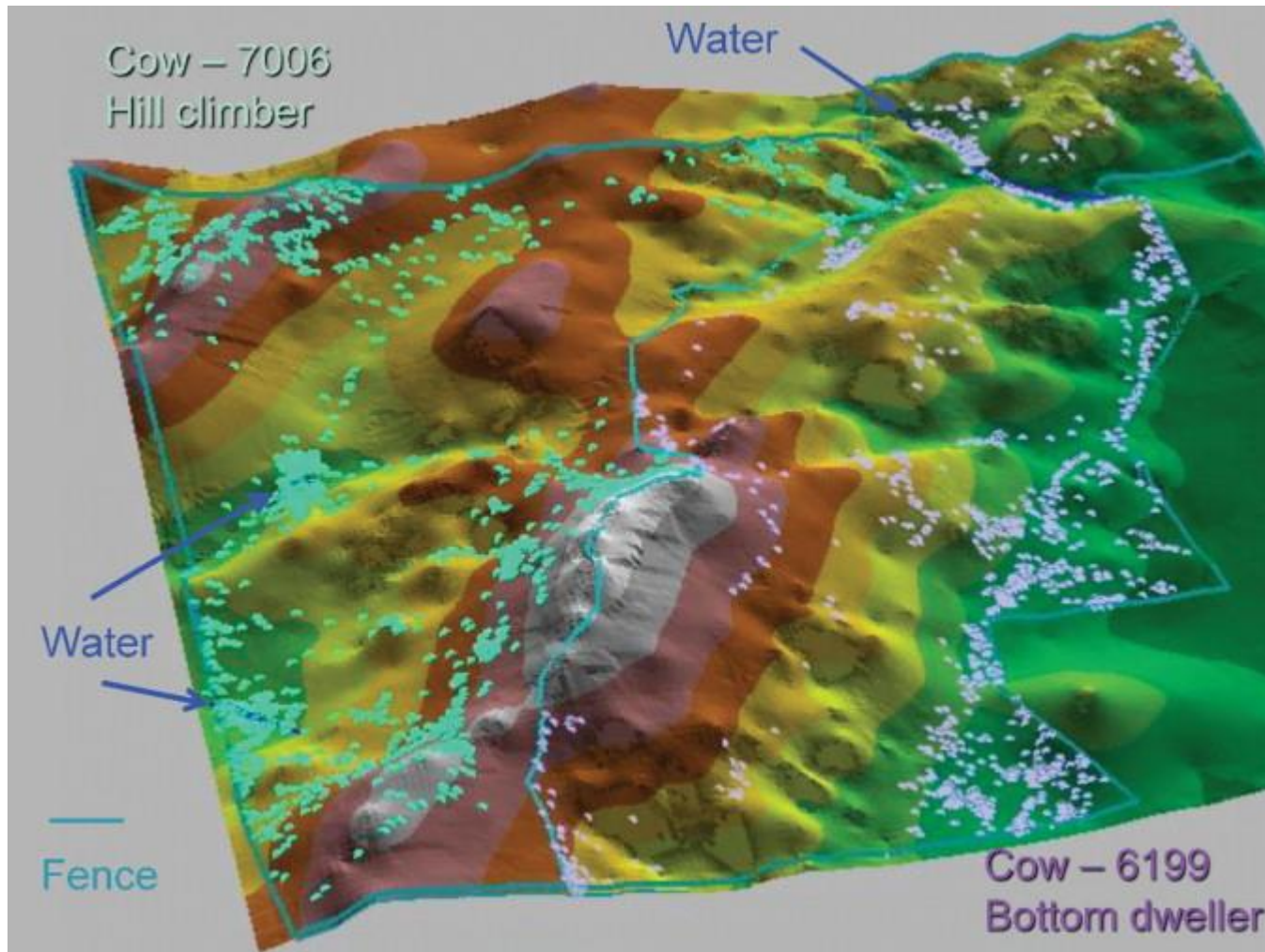
(Yonai et al, 2015. J. Dairy Sci.)

# Pasture growth rates



([Li et al., 2012. Proc. New Zealand Grassland Ass.](#))

# And when both combine...



F I GB USA MEX

**ONE SIZE  
DOES NOT  
FIT ALL**



Von links bügeln/ Iron inside out/  
repasser sur l'envers / 只熨反面

# Precision livestock farming

- Objective
  - Improve the sustainability of animal production by adapting the management to each individual in the herd
- Principles
  - Continuous, automated and in real-time monitoring of each individual animal => sensors
  - Communicate the data => IT
  - Convert sensors data (physical property) to usable animal related information => signal analysis
  - Compare information to a model of what is expected => science
  - Take action => decision support tool

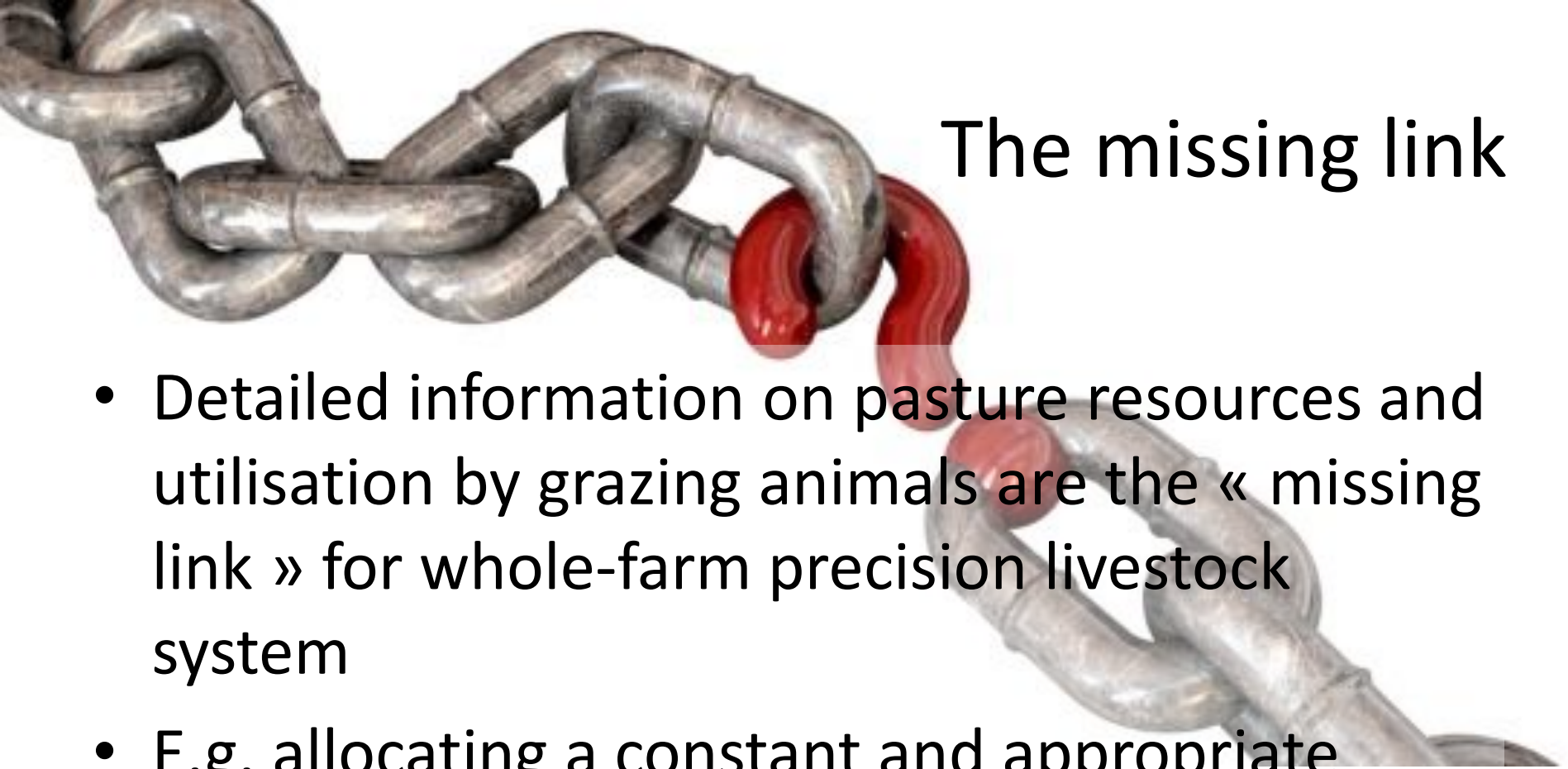
# PLF focusses on

- Health
- Reproduction



([Caja et al., 2016. J. Dairy Res.](#))

**Fig. 3.** Location of engineered devices for in situ data collection in a cow: (1) ear tag, (2) halter, (3) neck collar with counterweight, (4) reticulo-rumen bolus (in reticulum), (5) rear leg pedometer, (6) upper tail ring, (7) tailhead inject, and (8) vaginal bolus.



## The missing link

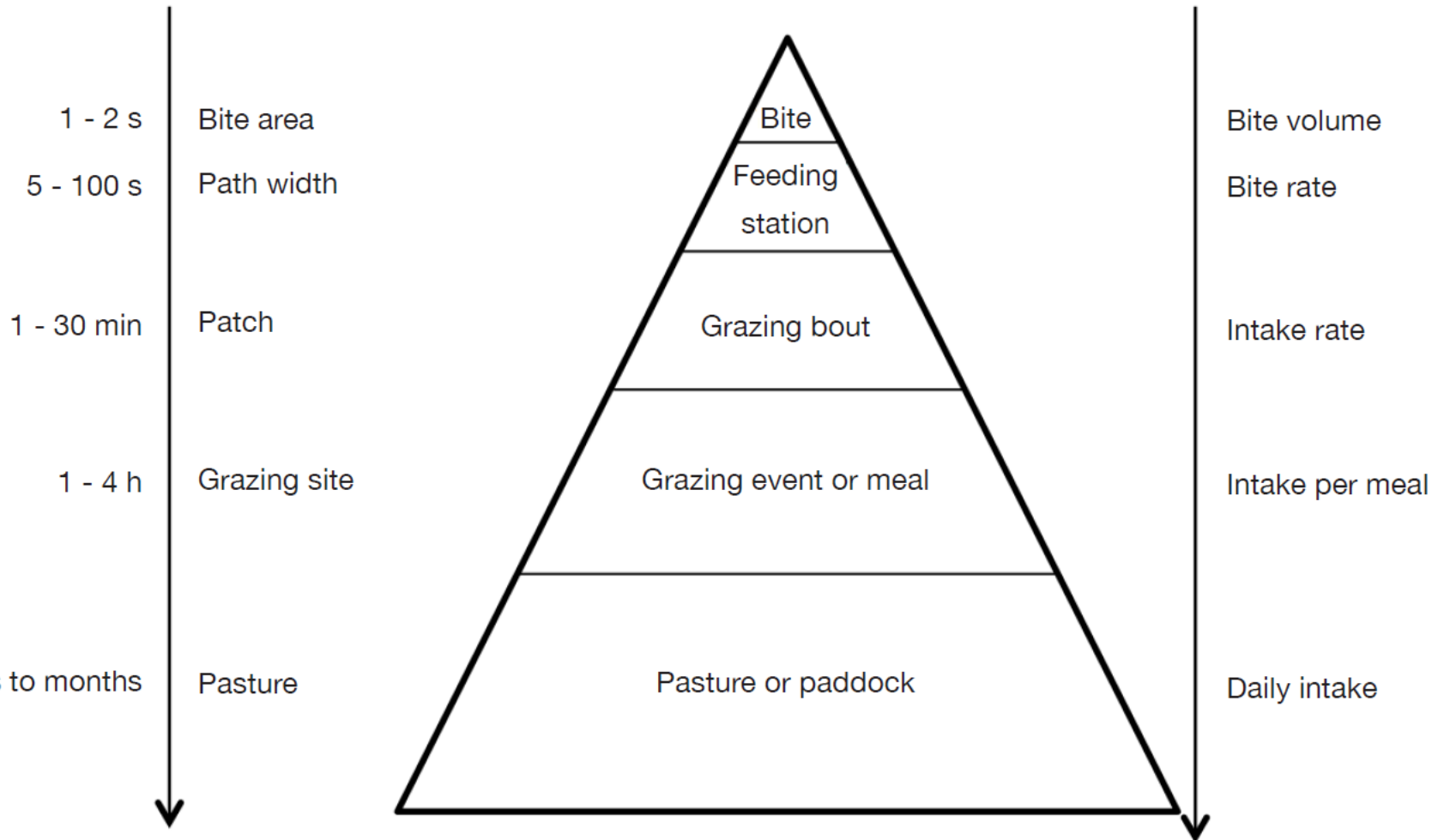
- Detailed information on pasture resources and utilisation by grazing animals are the « missing link » for whole-farm precision livestock system
  - E.g. allocating a constant and appropriate amount of pasture daily increase milk yields by 9 to 12% ([Fulkerson et al., 2005. Anim. Prod. Sci.](#))
- ➔ need for dynamic tools



# What is grazing?

Spatio-temporal scale

Animal intake level



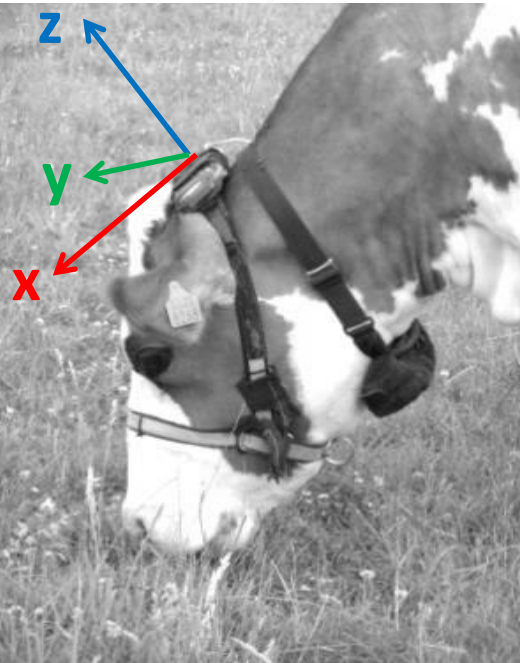
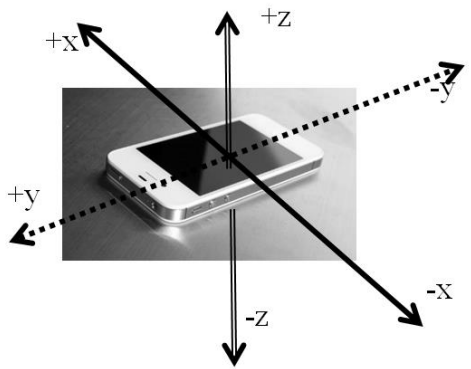
([Andriamandroso et al., 2016](#))

# Which sensors to monitor grazing ?

- Location
  - GPS
  - Wifi triangulation
- Posture
  - Accelerometers
- Head and jaw movements
  - Accelerometers

Hey guys!  
Maybe you can just  
use my phone...



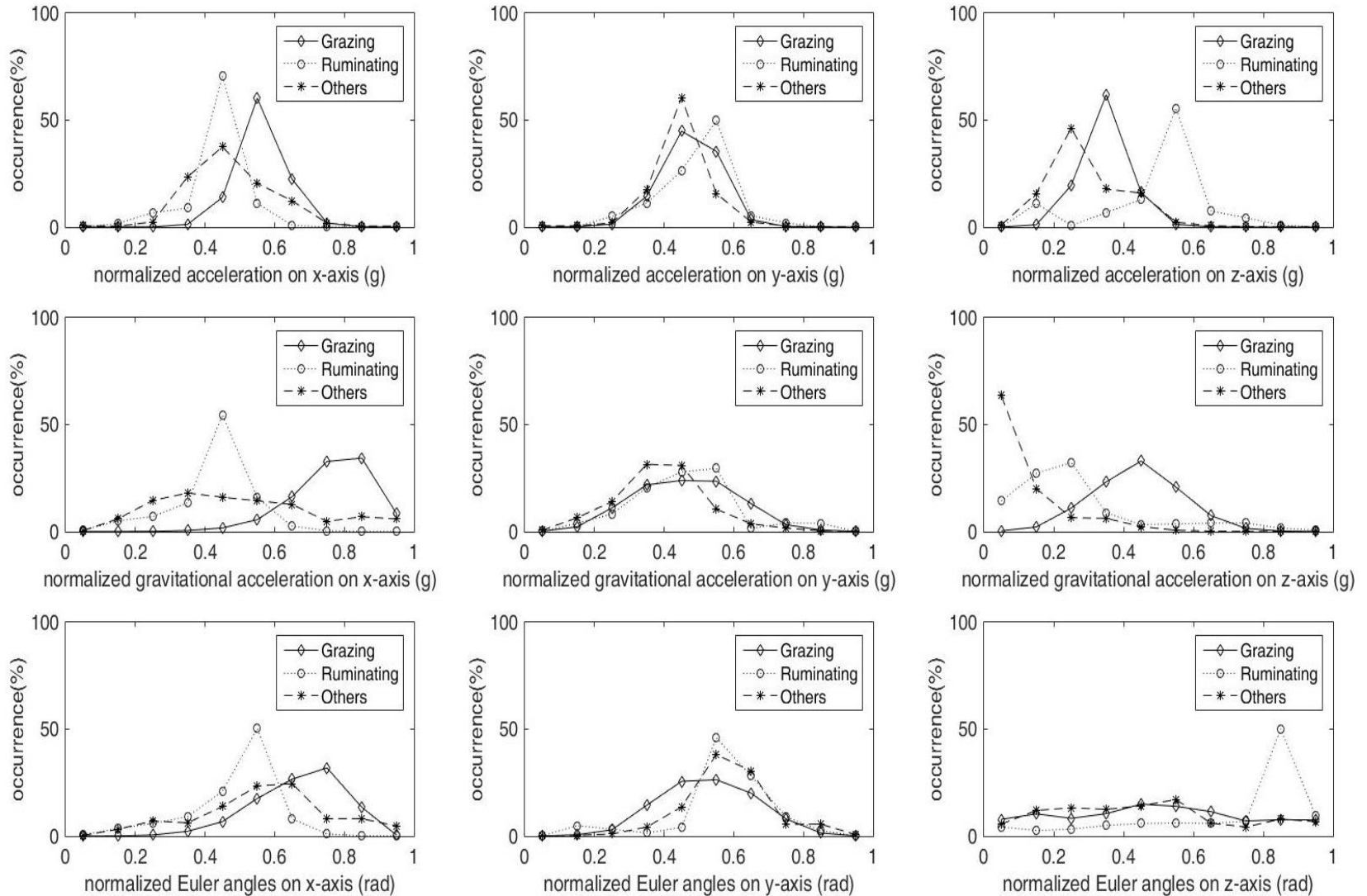


# Convert sensor signals into useful information

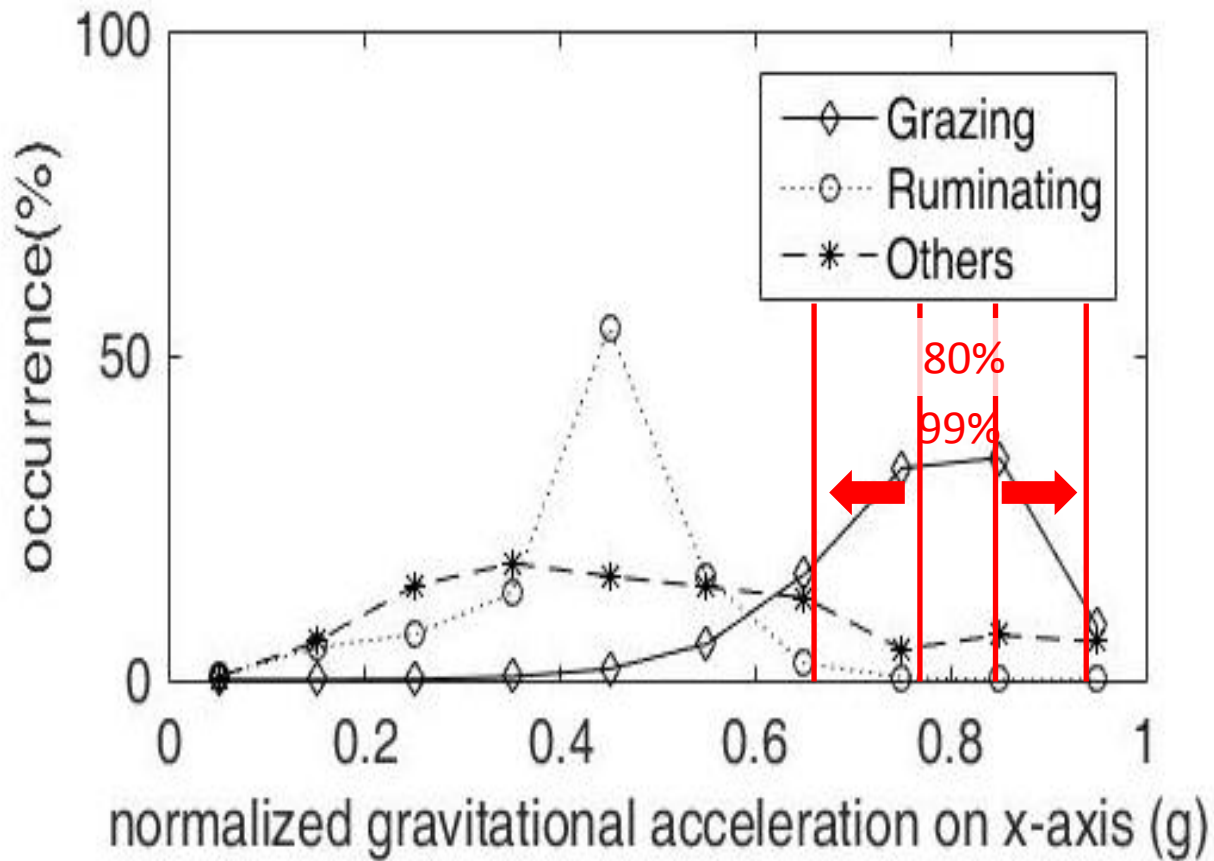
- How to discriminate unitary behaviour?
- Developing a « white-box » approach
  - « universal » for all cows
  - 7 sequences for calibration – 99 for validation
    - 17 cows, 4 breeds, 3 seasons, 3 sward heights
    - >50 hours of video tapes to analyze using Cowlog®



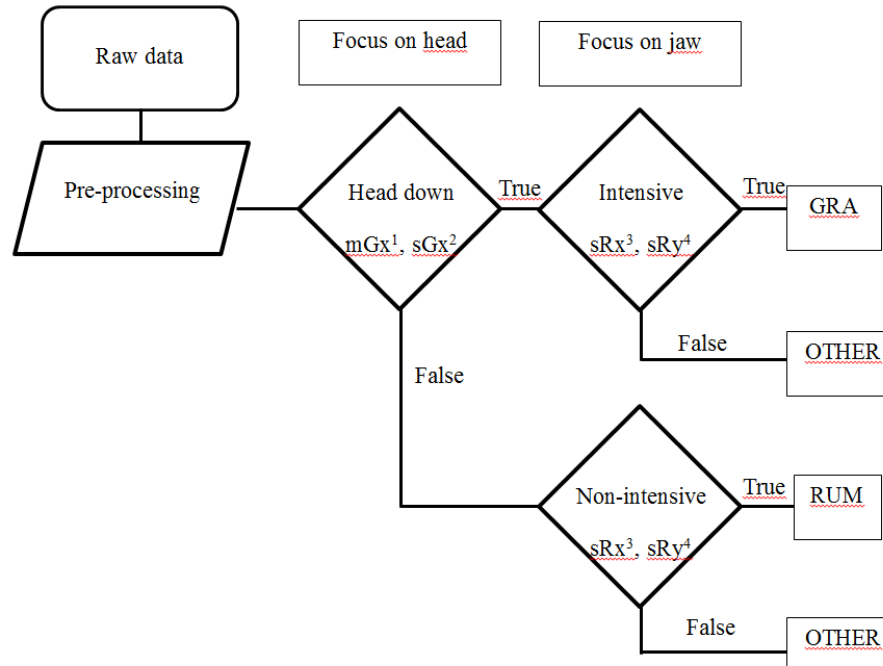
# Choosing the signals



# Finding thresholds



# Algorithm accuracies



<u>Behaviors</u>	<u>Sensitivity (%)</u>	<u>Specificity (%)</u>	<u>Precision (%)</u>	<u>Accuracy (%)</u>
<u>Grazing</u>	91.1	90.9	93.5	91.0
<u>Ruminating</u>	53.1	99.4	84.5	96.5
<u>Other</u>	87.6	87.5	79.1	87.6



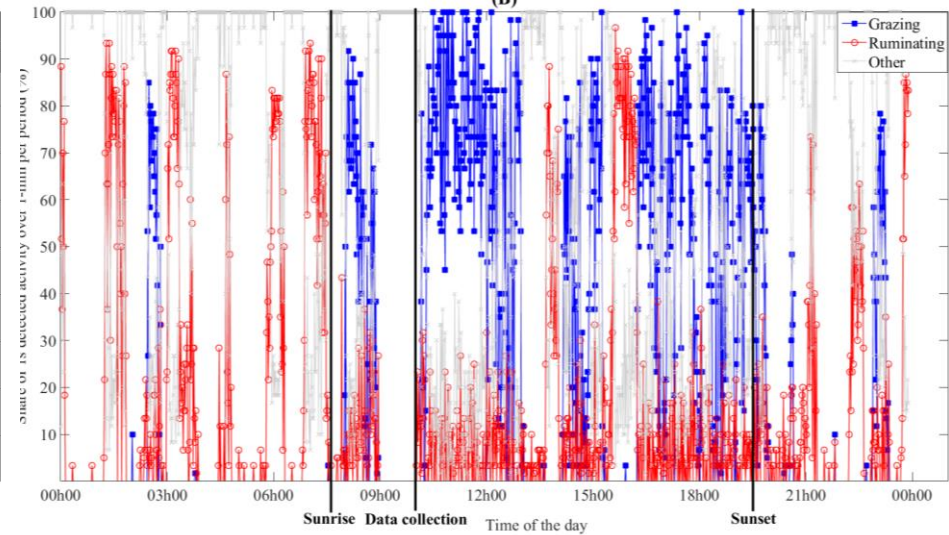
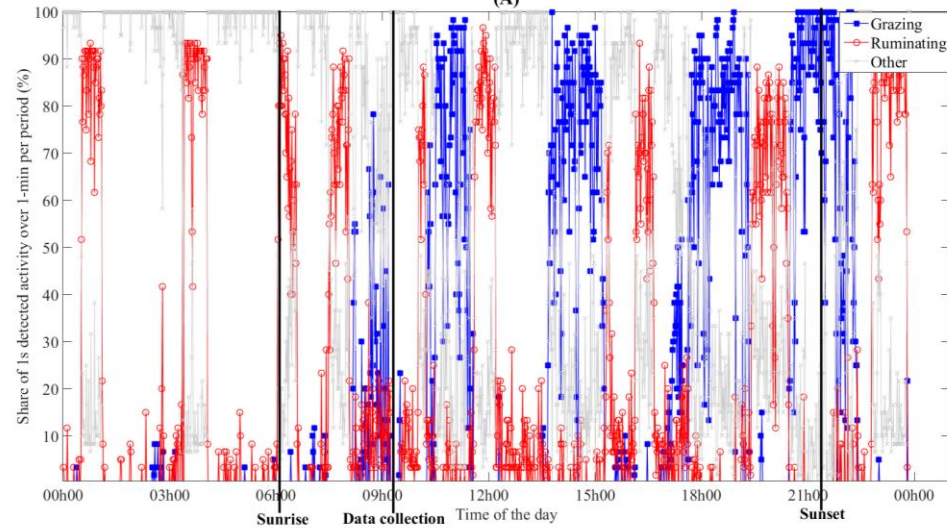
# How did my cow spend the day?

5 cm

15 cm

(A)

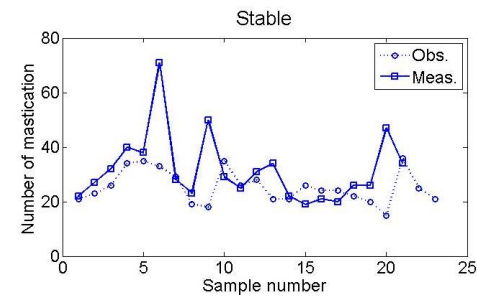
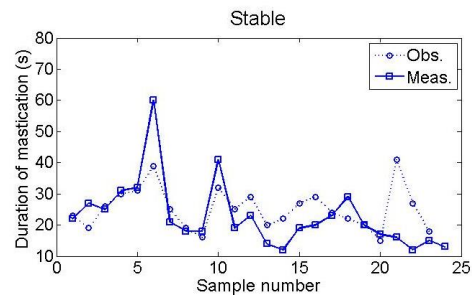
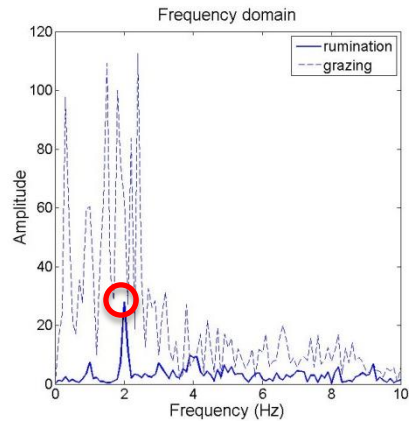
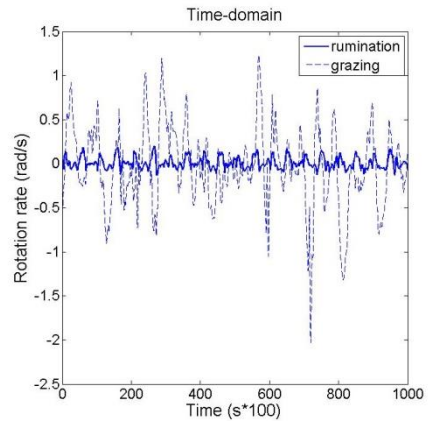
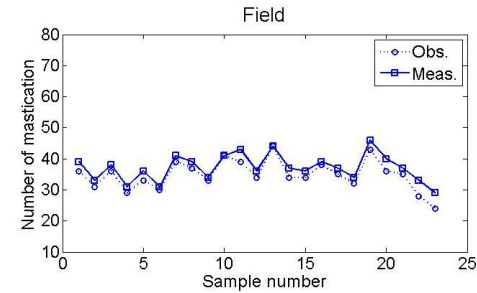
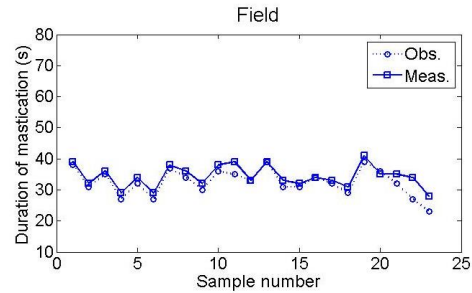
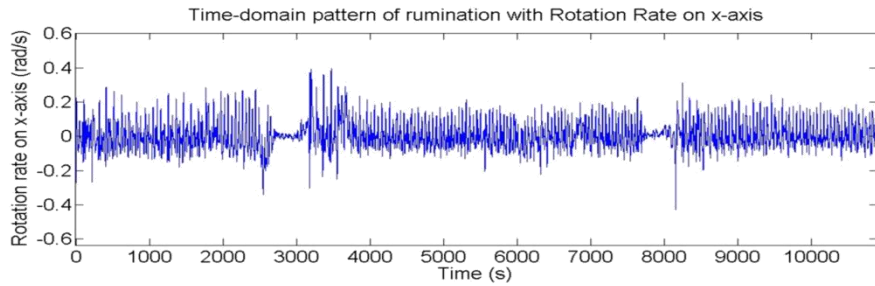
(B)



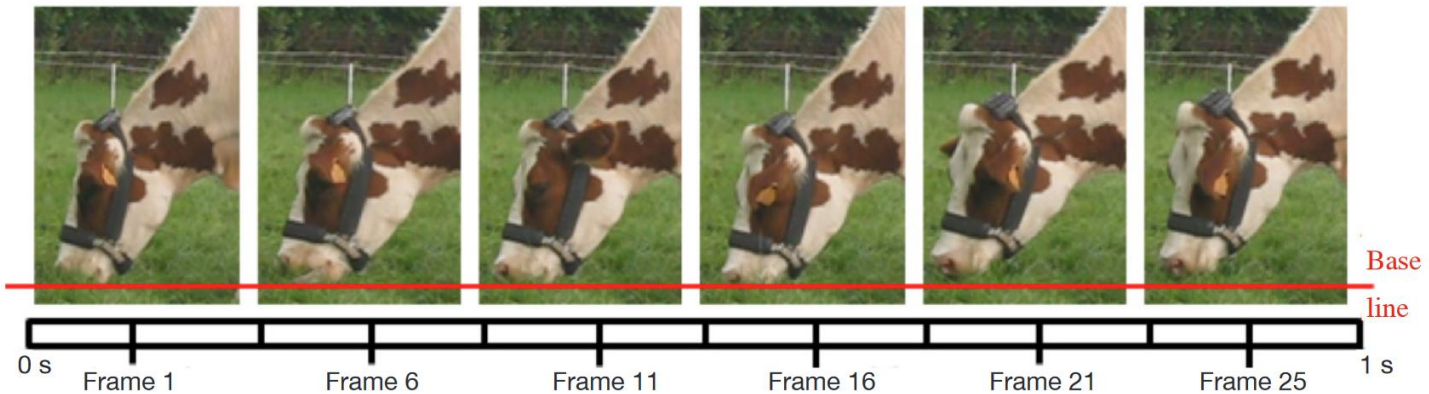
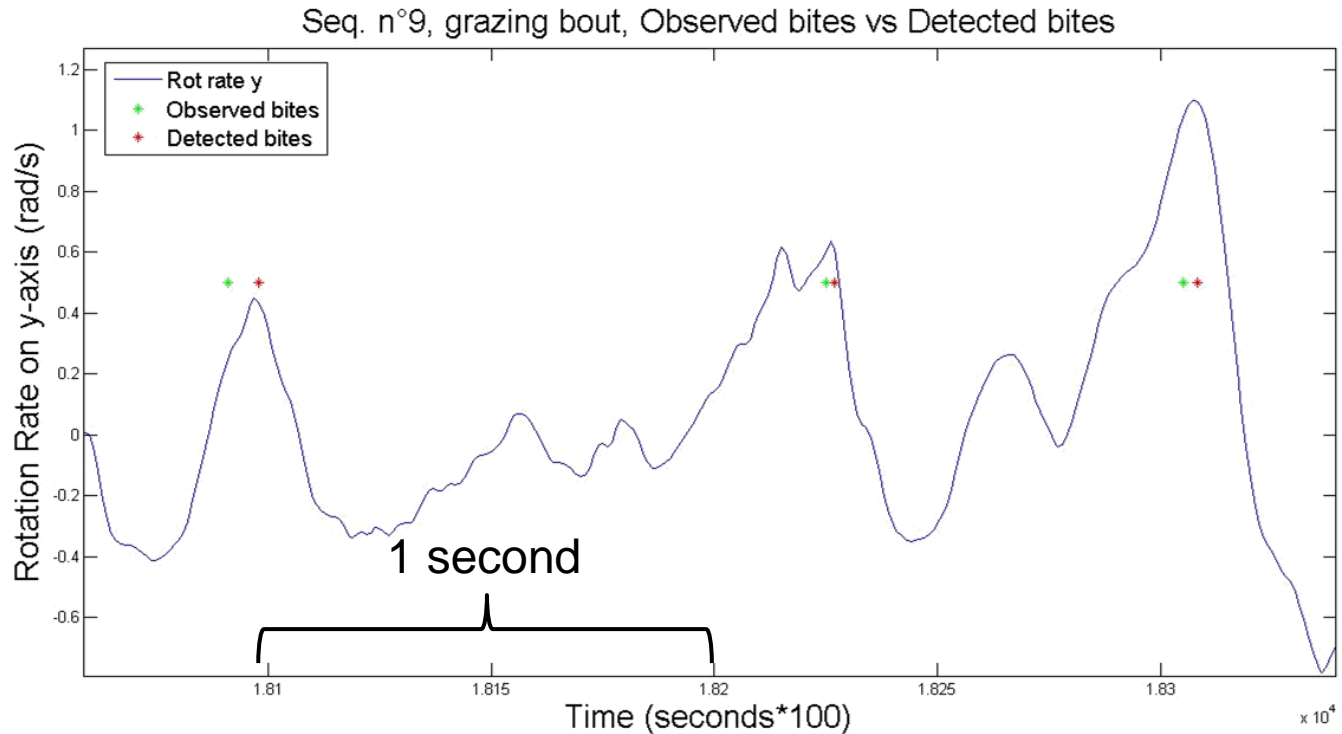
# Going for bites and chews



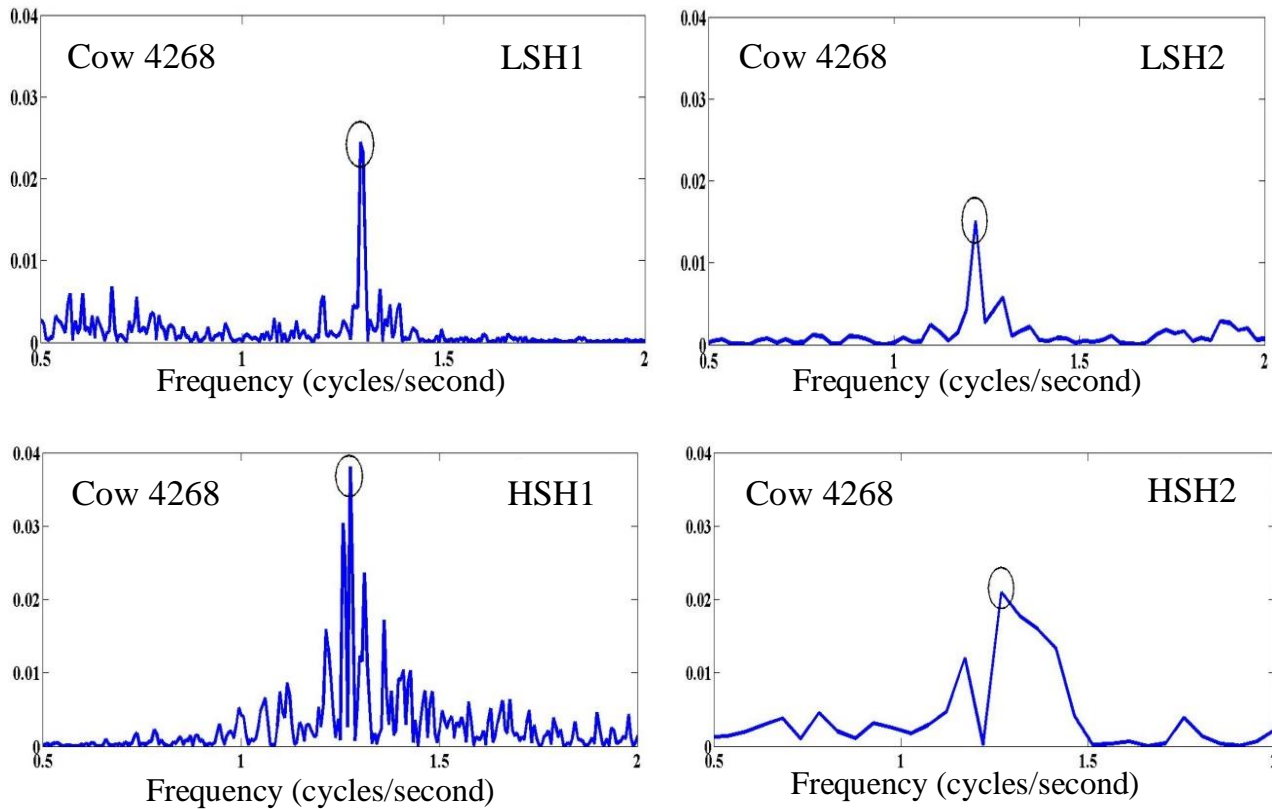
# Decomposing rumination



# Detection of uprooting bites



# Decomposing grazing

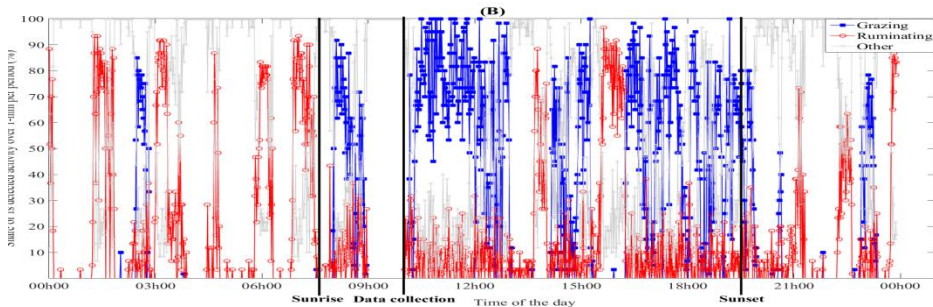
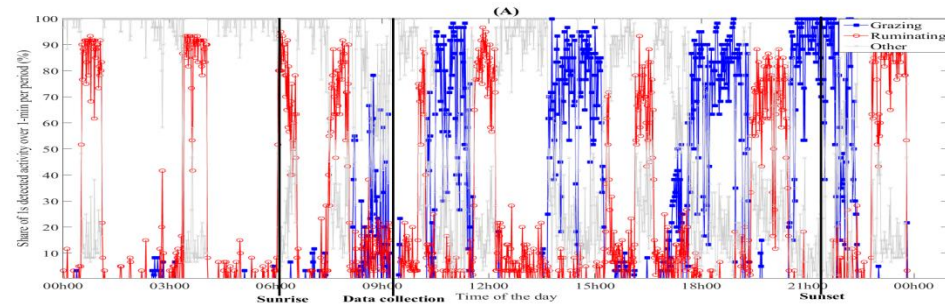


LSH1 and HSH1 for July/August 2014, LSH2 and HSH2 for September/October 2014

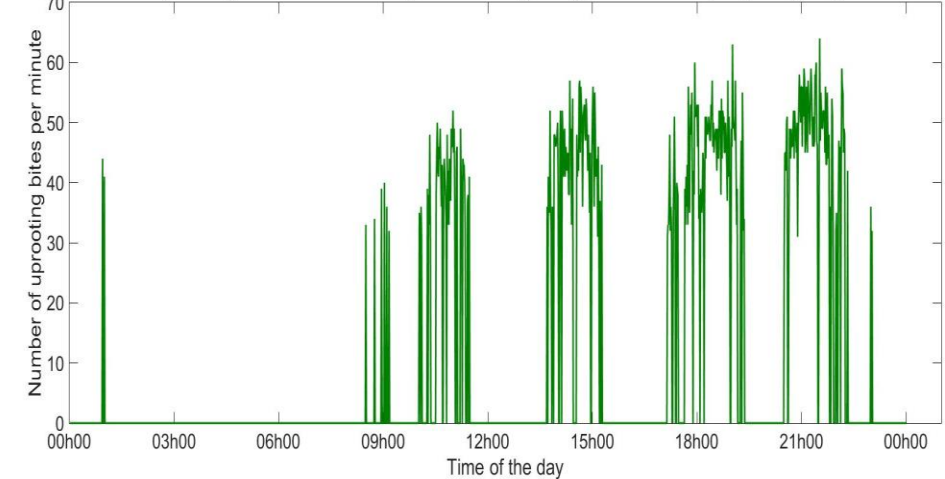
# Back to the question : how did my cow spend the day?

5 cm

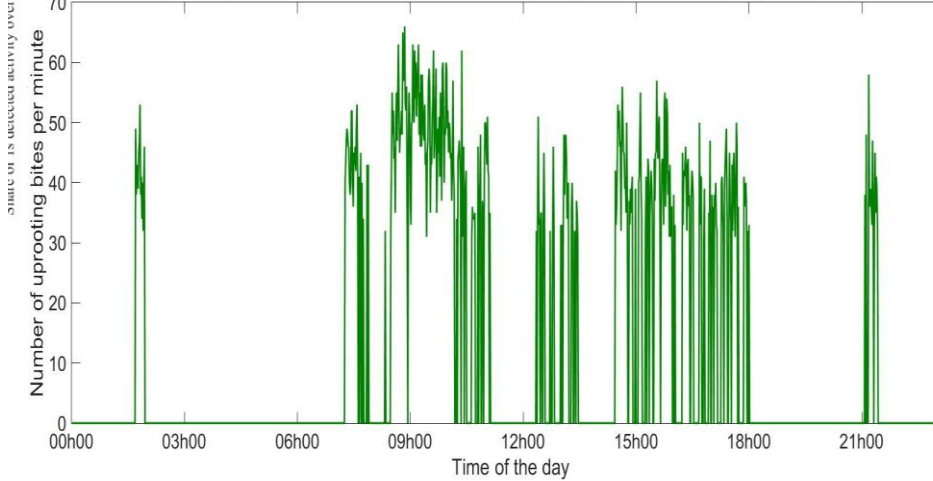
15 cm



Uprooting bites evolution during 24h for cow grazing pasture at 5cm pre-grazing height

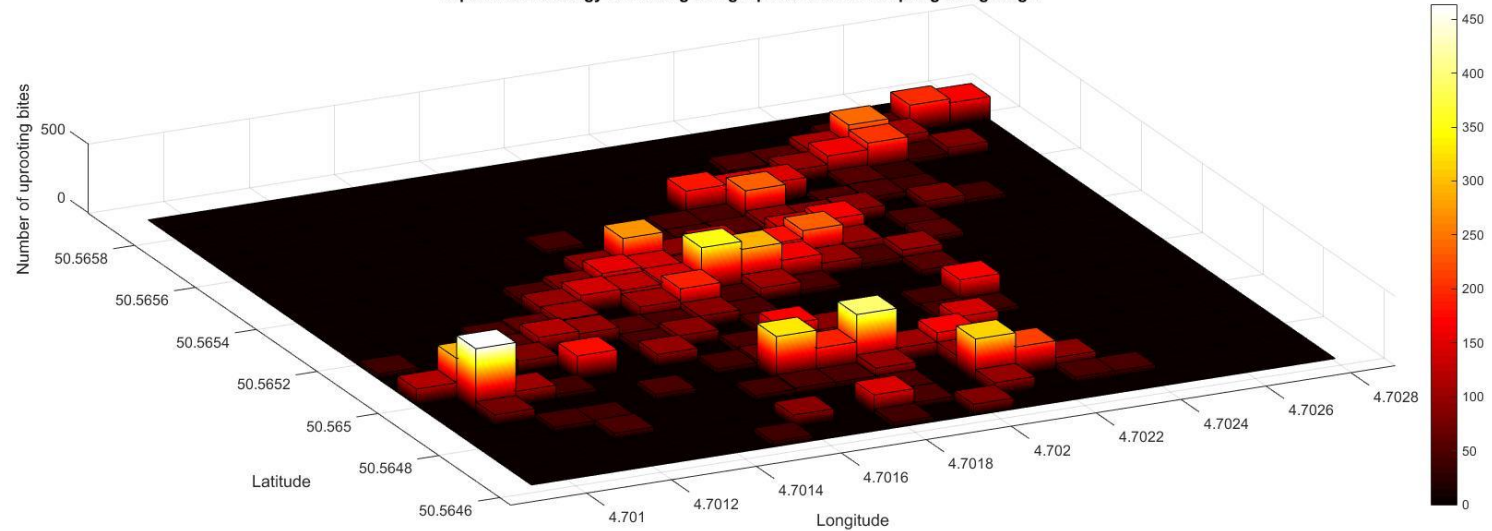


Uprooting bites evolution during 24h for cow grazing pasture at 15cm pre-grazing height

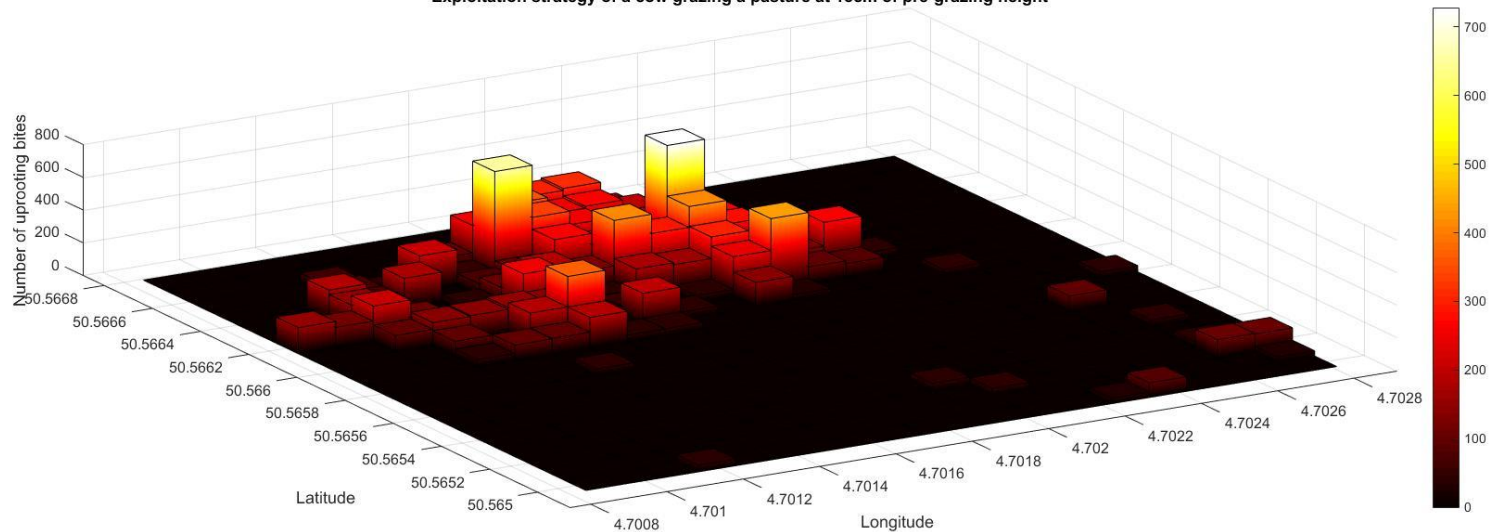


# Combining with GPS location data

Exploitation strategy of a cow grazing a pasture at 5cm of pre-grazing height

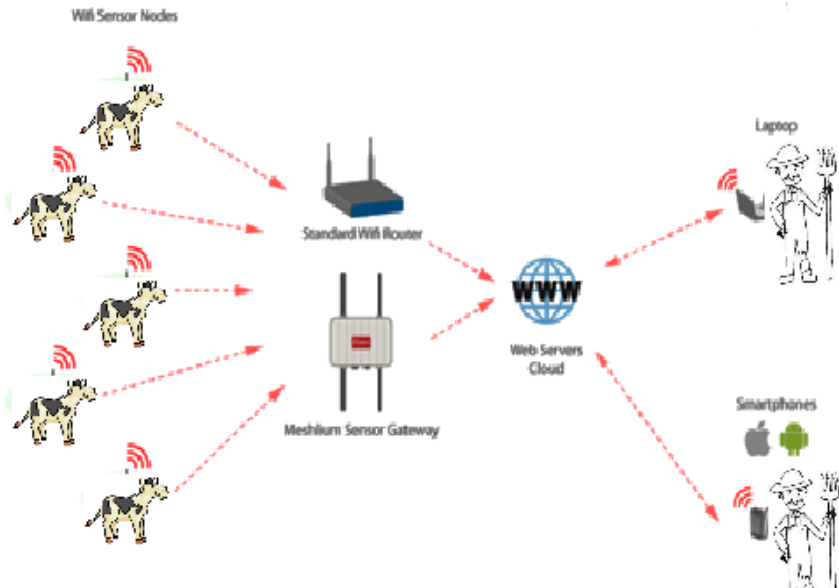


Exploitation strategy of a cow grazing a pasture at 15cm of pre-grazing height



# Further developments

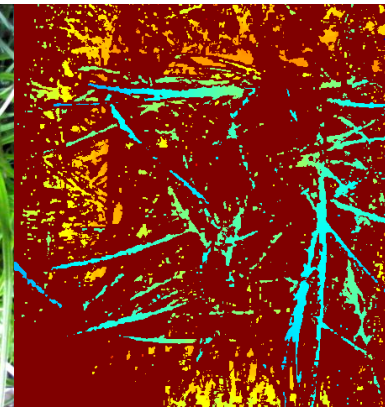
- Silvopastures
- Global monitoring network and IoT applications for decision-support tools
- Xtra sensors (microphones)
- Combination with virtual fences
- The codes for the algorithms will be made available





# Conclusion

- The link is closing in from the animal side
- But, still waiting for developments in pasture monitoring to get closer to intake
- Options to be investigated:
  - Geolocated RPM, drones, 3D laser scanners, 3D TOF cameras



**Thank you for your attention!**

