Coping with risks by enhancing adaptive capacities of biological components in the system: research strategy in the livestock sector

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INTERNATIONAL CONFERENCE/CONFERENCE INTERNATIONALE

Coping with risks in agriculture: What challenges and prospects?

Faire face aux risques en agriculture : Quels enjeux, quelles perspectives ?

Coping with risks by enhancing adaptive capacities of biological components in the system: research strategy in the livestock sector

Stéphane Ingrand, Inra, « Animal physiology and livestock farming system » PHASE Department

INRA SCIENCE & IMPACT

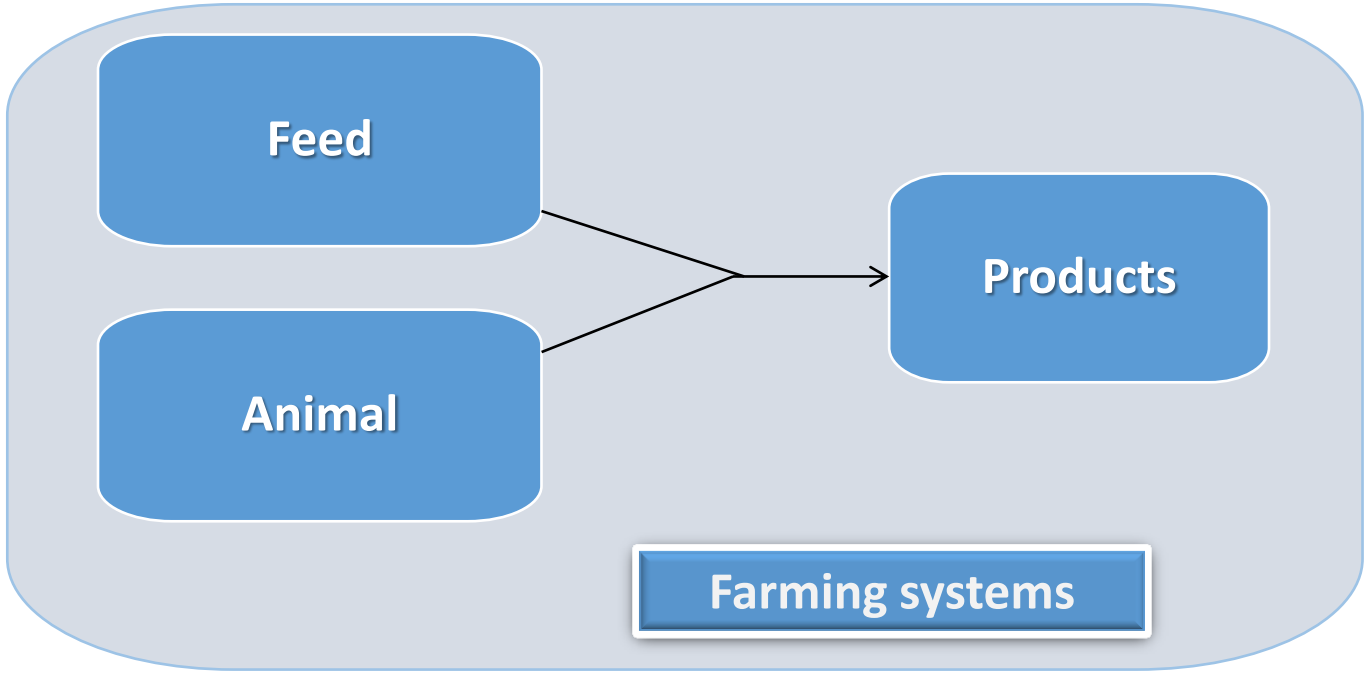
February 22-23 2018 - Collège des Bernardins, Paris

PHASE's strategic plan, 2016-2020

Objective: **to contribute to the shift towards multi-effective livestock farming systems, by producing knowledge at different scales and by associating :**

- The principles of **agroecology**: stimulation of natural processes
- Predictive approaches in biology: models and decision-support tools

4 thematic fields (TF)

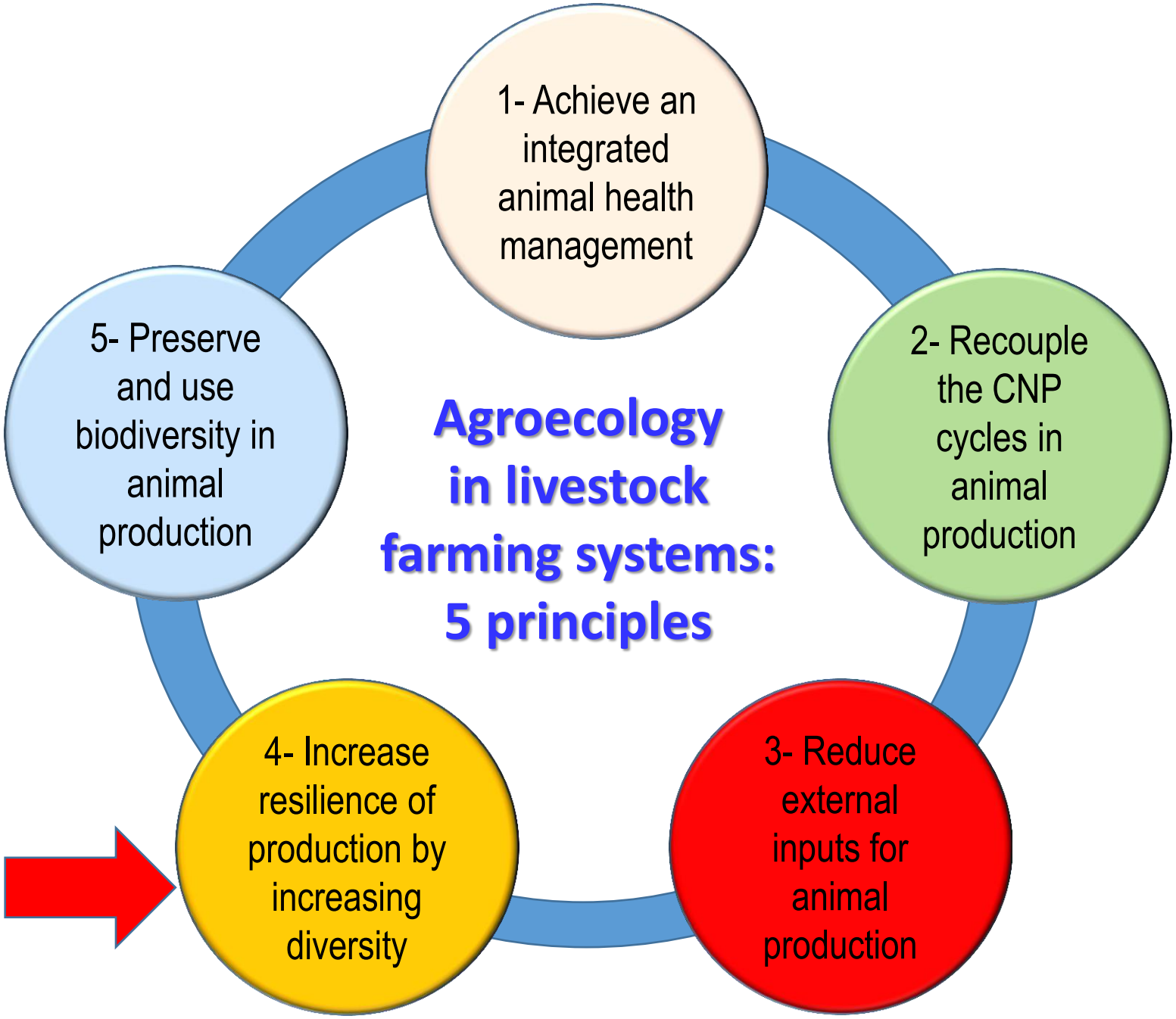


Thematic field: farming systems

Objective: to define combinations of resources, animals and farming practices, taking the environment into account, to conciliate productive, economic and environmental performances, while maximizing animal welfare and health.

Priorities

- **Identification of bottle-necks** to design innovative systems to cope with climatic hazards (milk/agroforestry), water quality (aquapony), economic volatility (hitech organic pig), health status (zero antibio), animal welfare (fat liver without forced feeding, no castration in pigs).
- **Identifying some indicators for robustness, resilience and efficiency (animal, group, system)**
- **Understanding synergies/antagonisms between elements within the system**
- **Producing methods for multicriteria assessment of new systems**



Dumont et al, 2013

3 scientific + 1 « societal » challenges

❶ **Early levers to drive phenotypes and products and favour coadaptation between animals and the environment**

❷ **Models and biomarkers to anticipate and drive processes**

- Model the dynamic interactions between levels of organization and between functions
- Produce validated biomarkers of efficiency, robustness, product quality

➔ To improve high-throughput phenotyping, precision livestock farming

❸ **Diversity to enhance** efficiency, robustness et resilience

Assuming that "diversity of items (resources, animal, products) within a system increases its capacity to face unpredictable events »

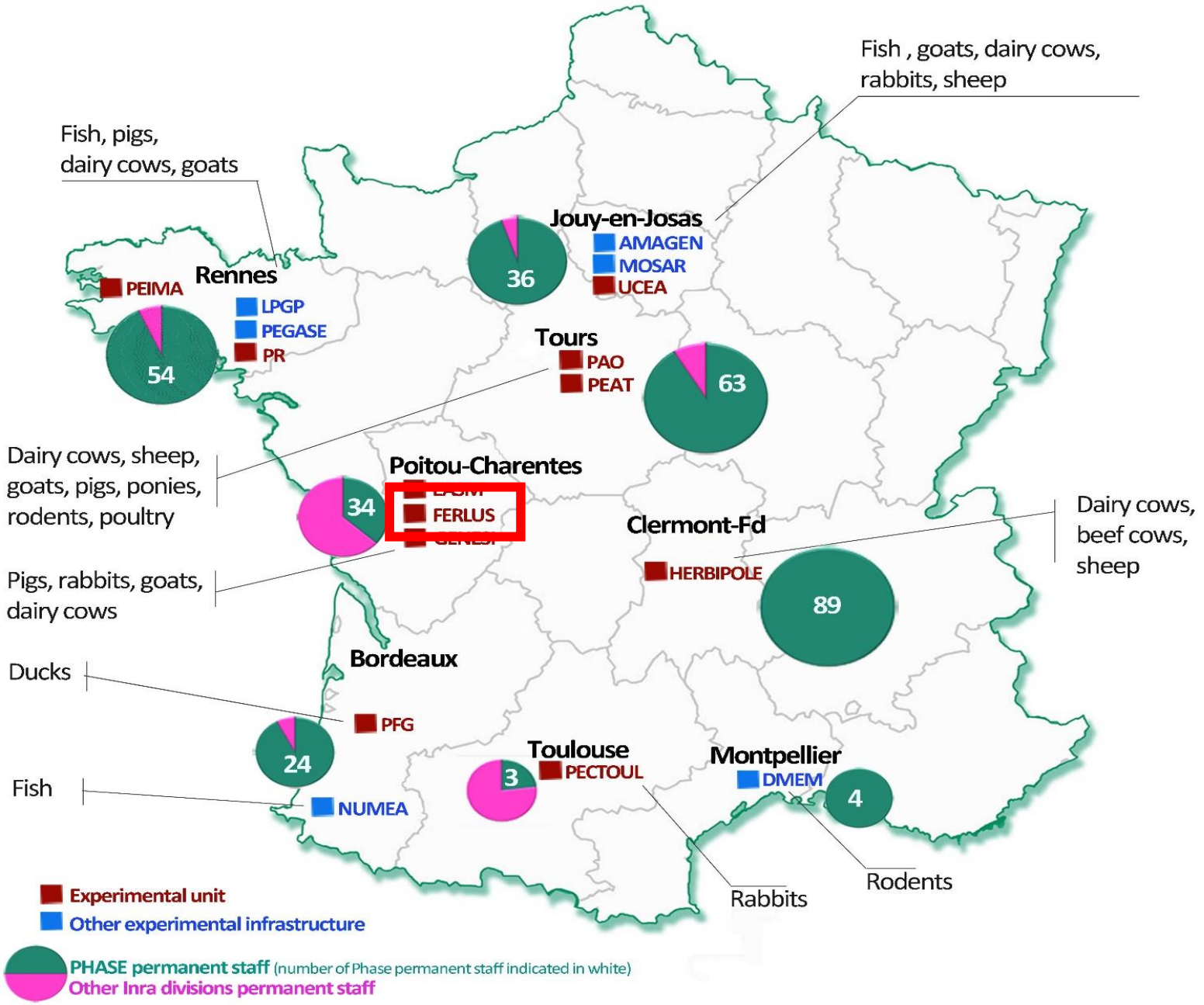
➔ Propose rules for managing farming systems, which are based on the diversification of biotechnical elements.

❹ **Perception of livestock farming systems and research involving animals**

Example n°1:
A long-term experiment

OasYs : a dairy system designed to have a low sensitivity to climatic hazards

Experimental facilities of PHASE Department



The main innovations in the « OasYs » system

Diversification

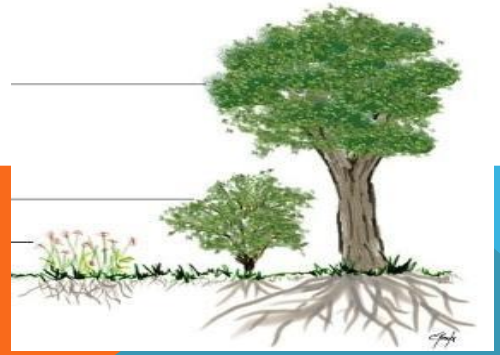
Species, mixed crops

Breed, calving period

Functions

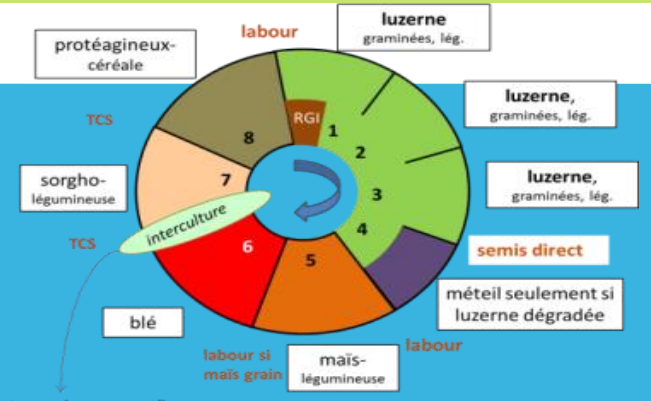
Valorisation in all dimensions

verticale 3D



Time 4D

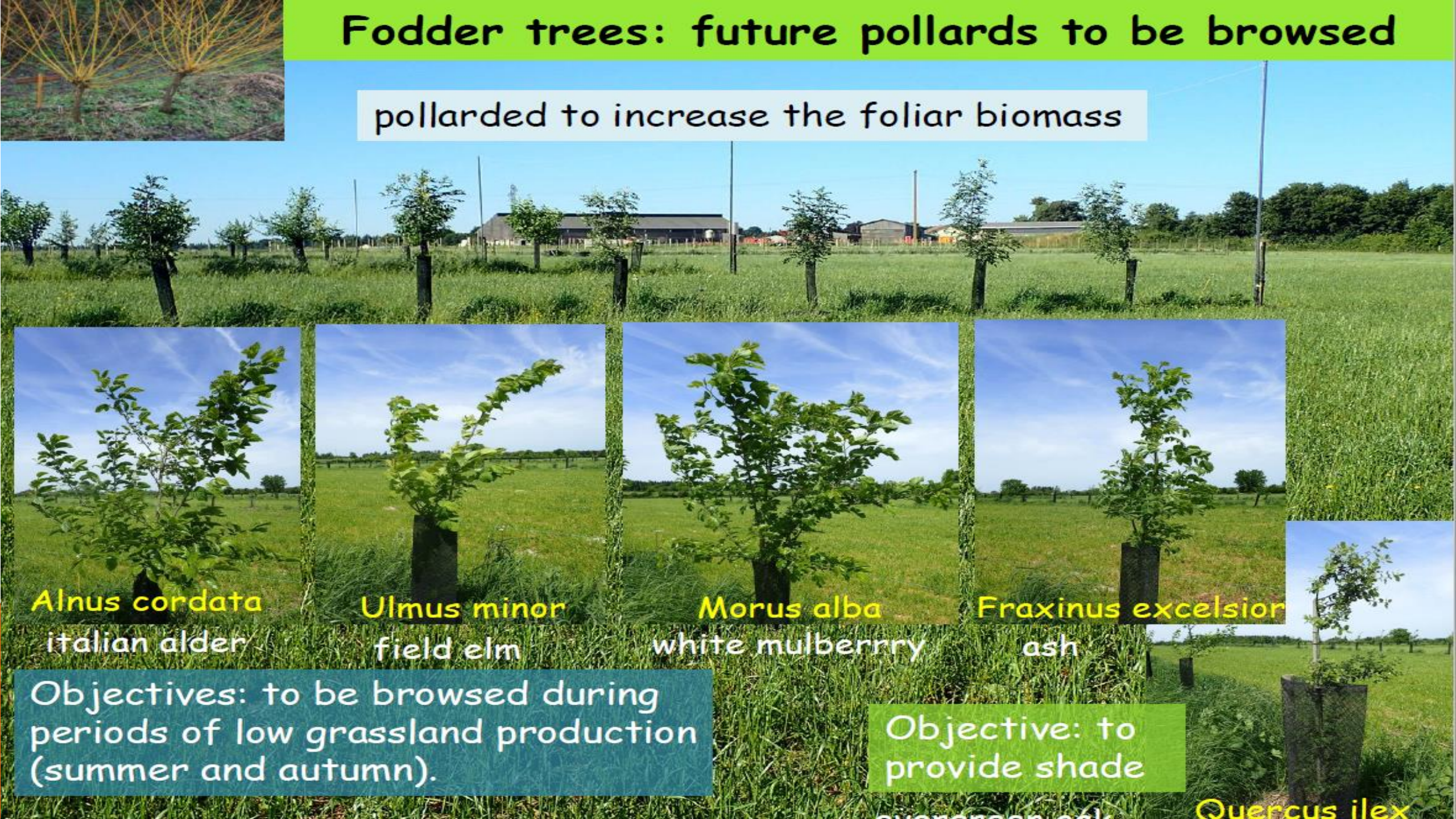
Crops succession



Lactation duration

Fodder trees: future pollards to be browsed

pollarded to increase the foliar biomass



Alnus cordata
italian alder

Ulmus minor
field elm

Morus alba
white mulberrry

Fraxinus excelsior
ash

Objectives: to be browsed during periods of low grassland production (summer and autumn).

Objective: to provide shade

Quercus ilex

Example n°2: a PhD thesis

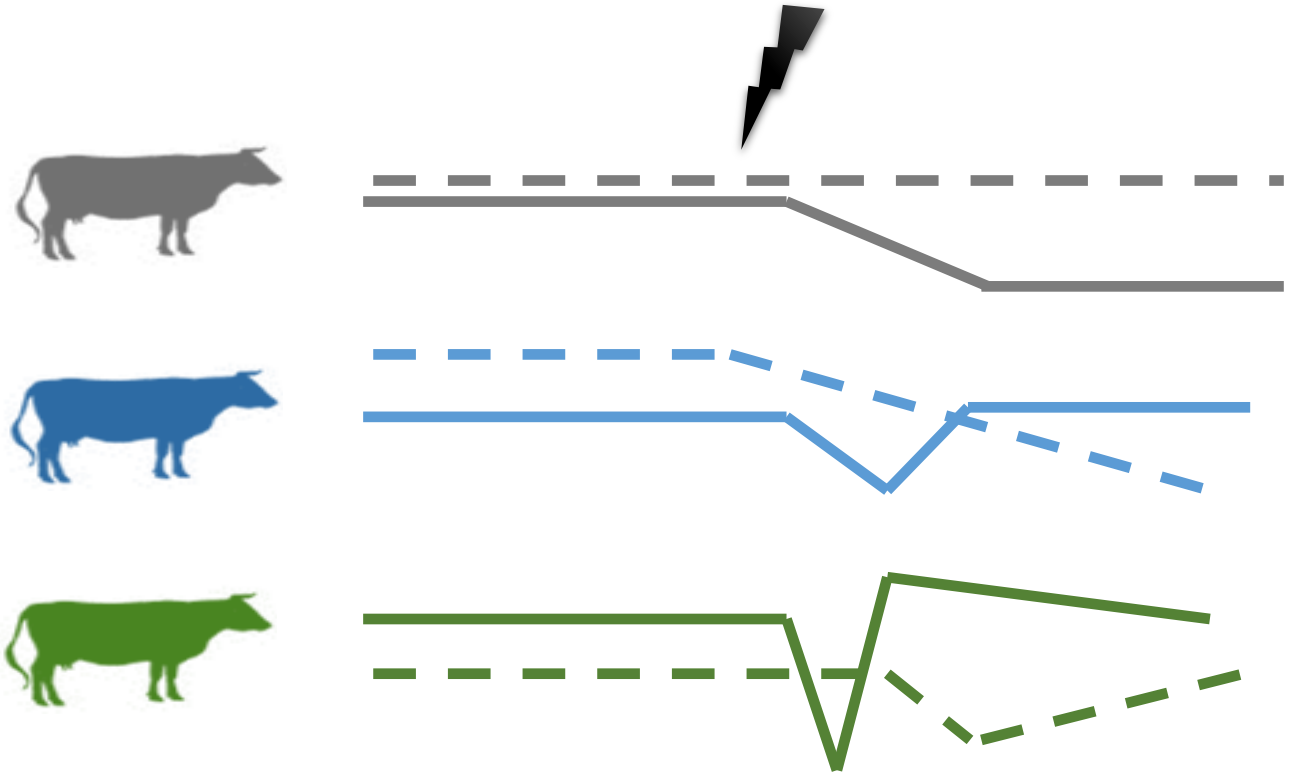
Assessing robustness of dairy cows

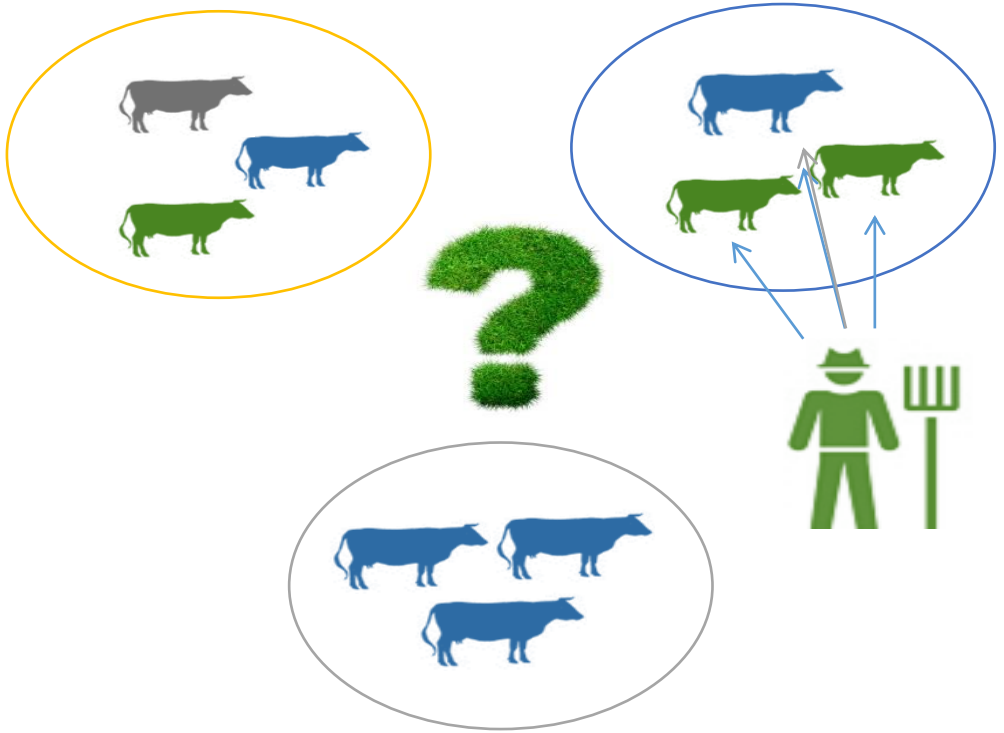
Emilie Ollion (2015)
Fabienne Blanc & Stéphane Ingrand, supervisors

Scientific context

- Herd scale

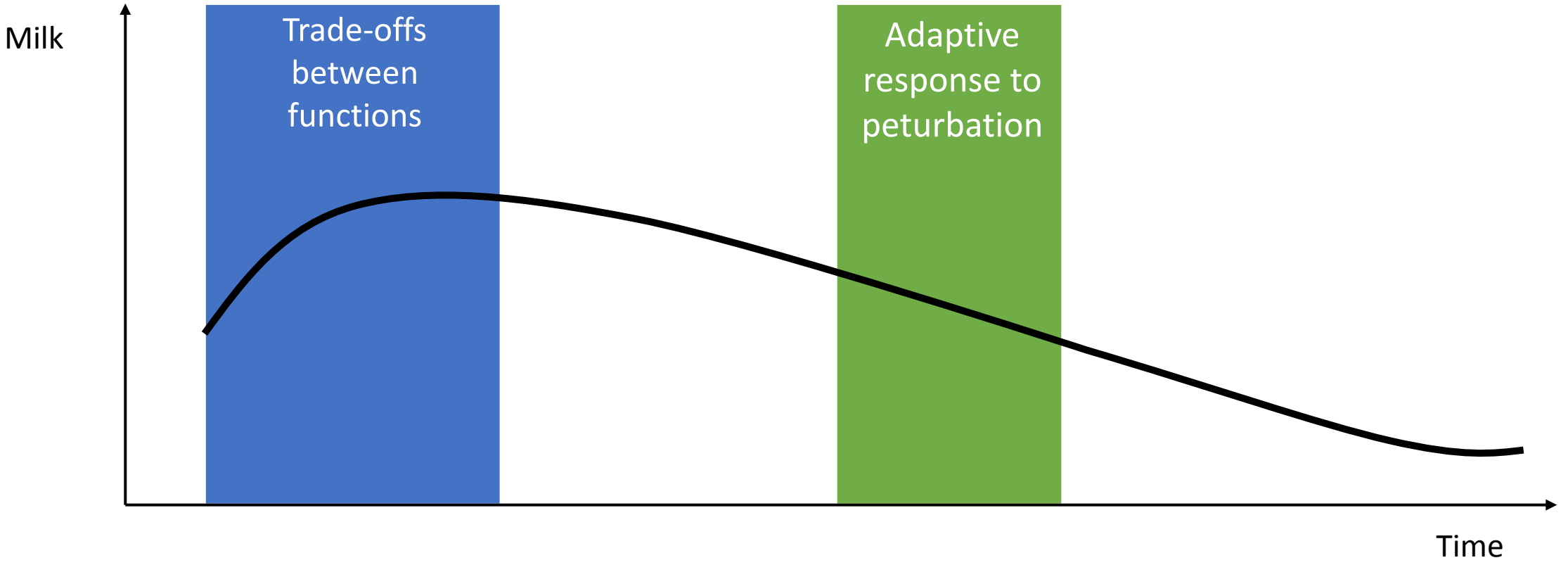
➔ Individual diversity + accurate practices: stabilisation of production and revenue (Puillet et al. 2011, Cournut et al. 2012, Blanc et al. 2013)





Method

To develop a method for characterising adaptive responses to perturbations based on the identification of trade-offs between biological functions in early lactation



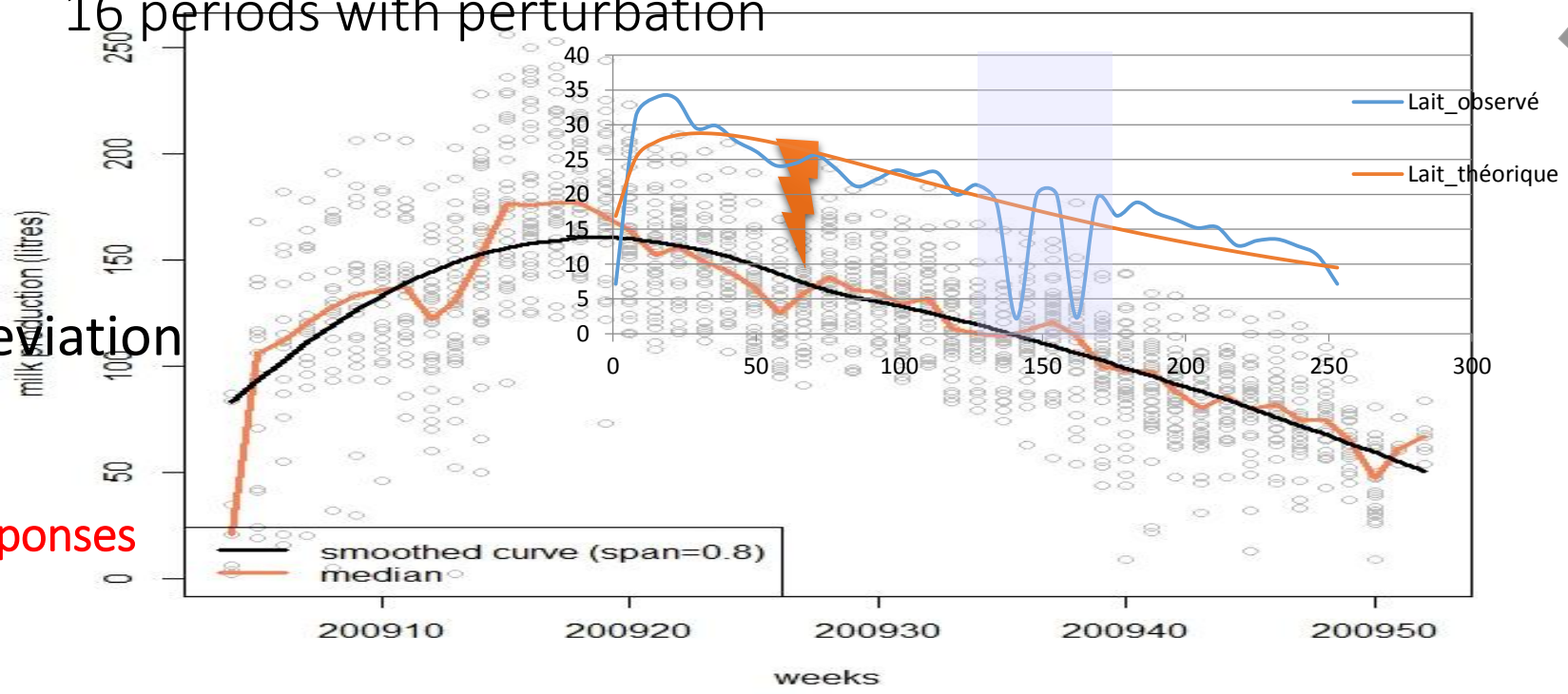
Characterisation of adaptive responses

- Detection of perturbations at herd's scale:

16 periods with perturbation

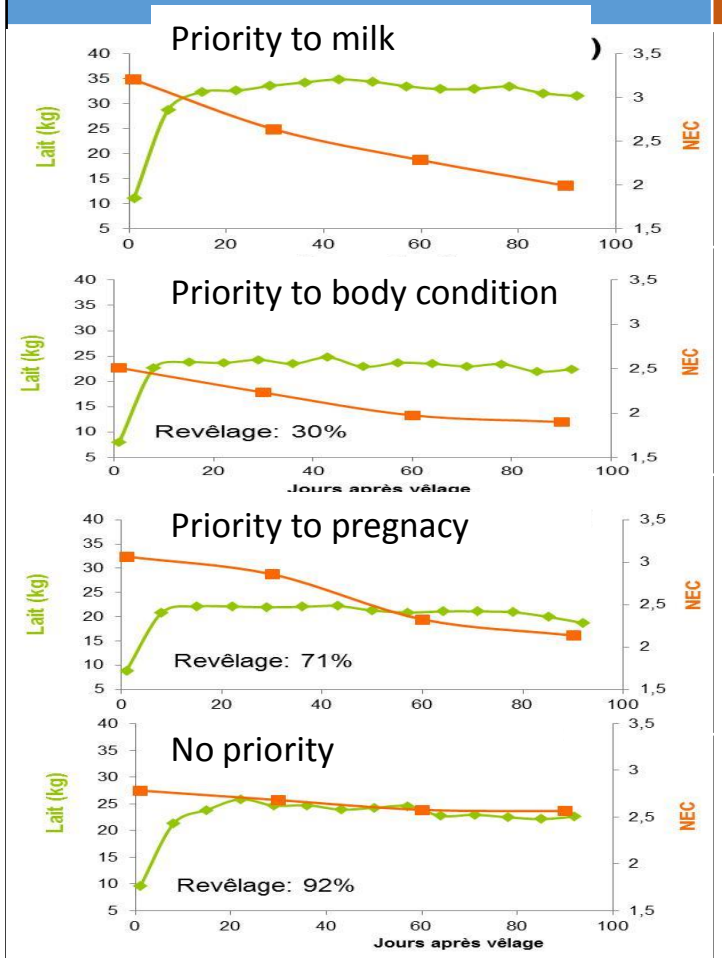
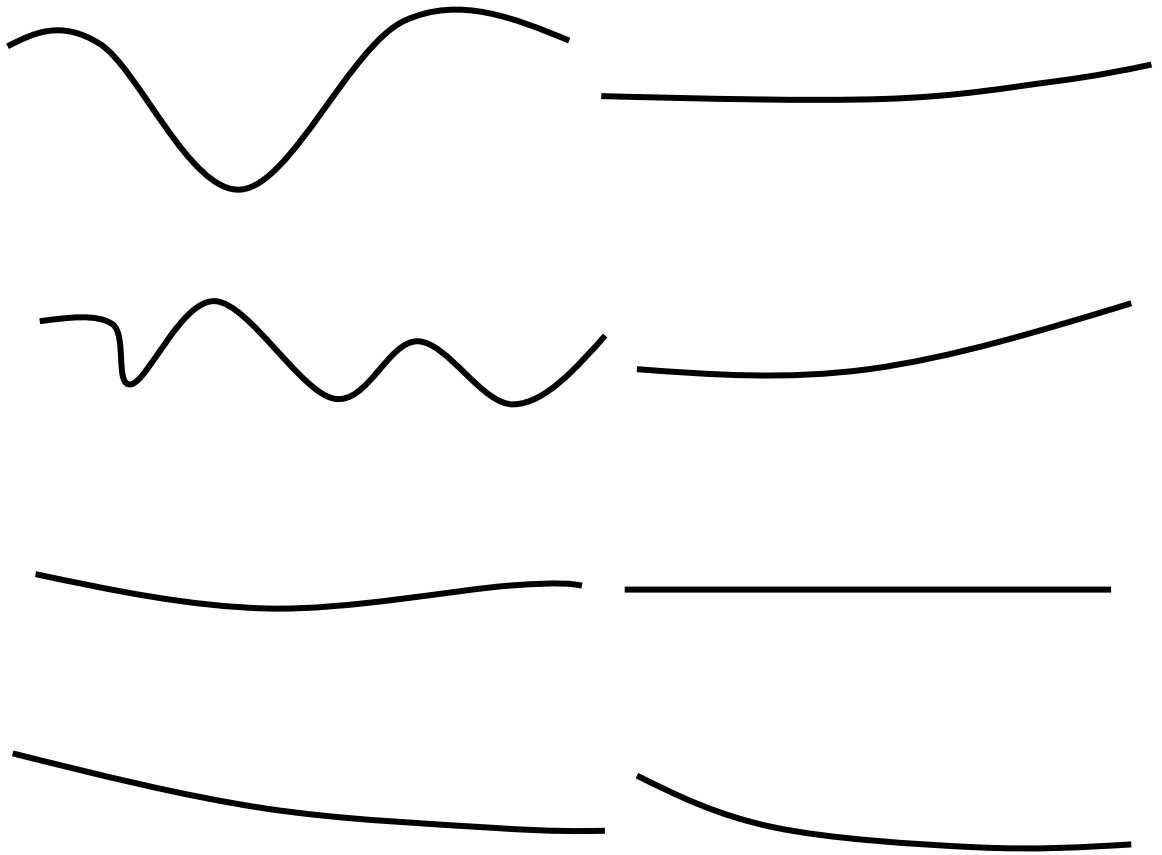
- At animal scale:
  - Reference curve
  - Indicateurs of deviation

➔ 4 profiles of adaptive responses



Données Inra Mirecourt, 2009

Relationships between adaptive responses to perturbation and trade-off between functions

Trade-off profiles	Adaptive responses (milk and body condition)	Corr (%)
		66% 100% 66% 71%

Concluding remarks…

Need to monitor systems in hazardous environment

→ precision farming as a tool for agroecological transition

Diversity as a lever to cope with risks:

→ what are the conditions?

- « position paper » in progress

  (another paradigm for researchers in animal science)

- a PhD thesis concerning crossbreeding in dairy herds