# The robustness of dairy cows analyzed through the profiles of their adaptive responses

E. Ollion, S. Ingrand, J.M. Trommenschlager, S. Colette-Leurent, F. Blanc

26th of August 2014, 65th EAAP meeting, Copenhagen
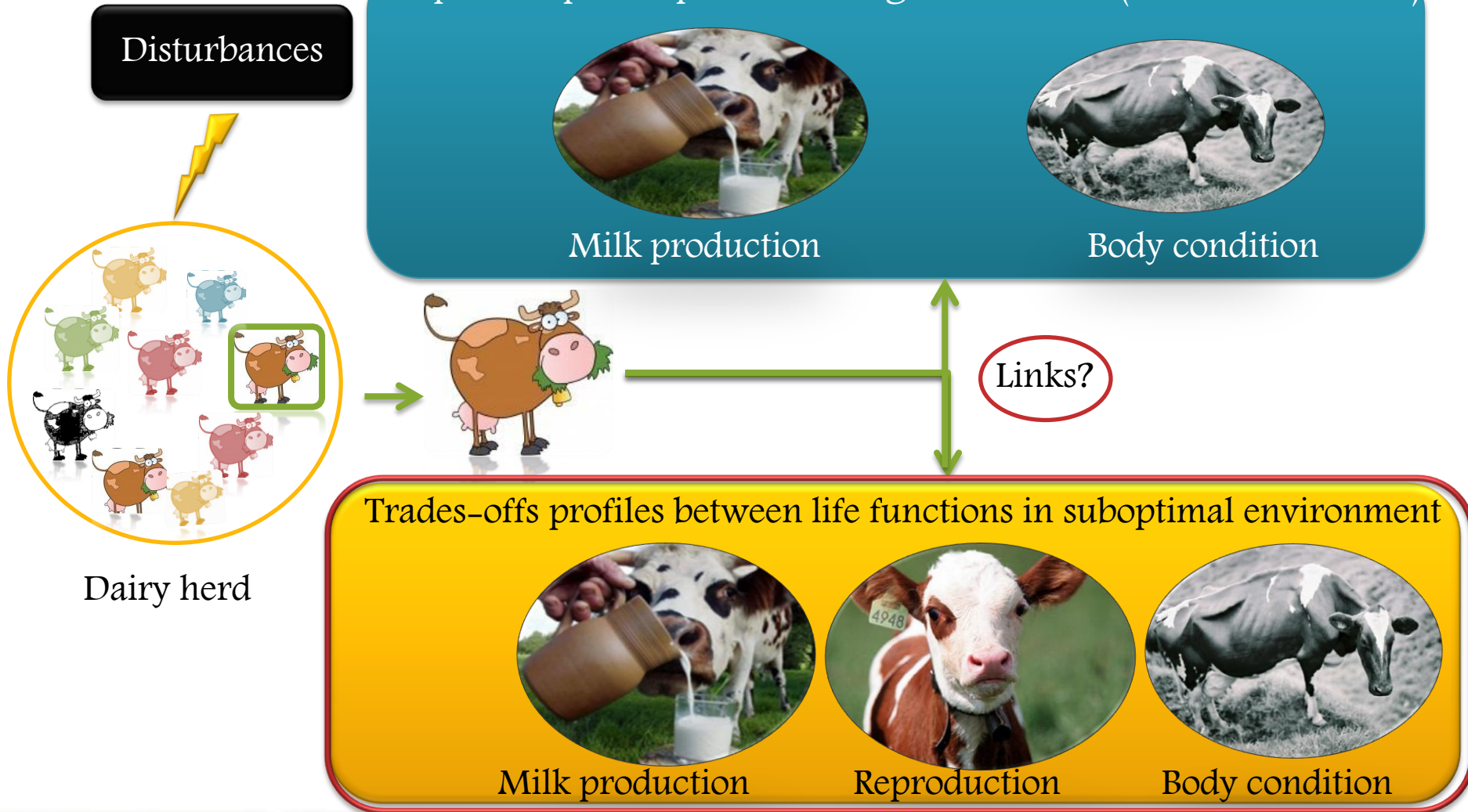
Contact: emilie.ollion@vetagro-sup.fr

# Scientific issues

◆ Robustness: ability to maintain within the herd despite environmental variability

➔ Cope with farmer production expectations
➔ Give appropriate adaptive responses in disturbed situations

◆ Conceptual framework : In case of suboptimal nutritional environment, dairy cows' adaptive responses account for trade-offs between life functions (Friggens and Newbold, 2007)

◆ Objective: method to screen the diversity of adaptive responses accounting for the trade-offs between life functions

# Work organization

Disturbances

Adaptive responses profiles during disturbances (Ollion et al, EAAP 2013)

Milk production

Body condition

Dairy herd

Links?

Trades-offs profiles between life functions in suboptimal environment
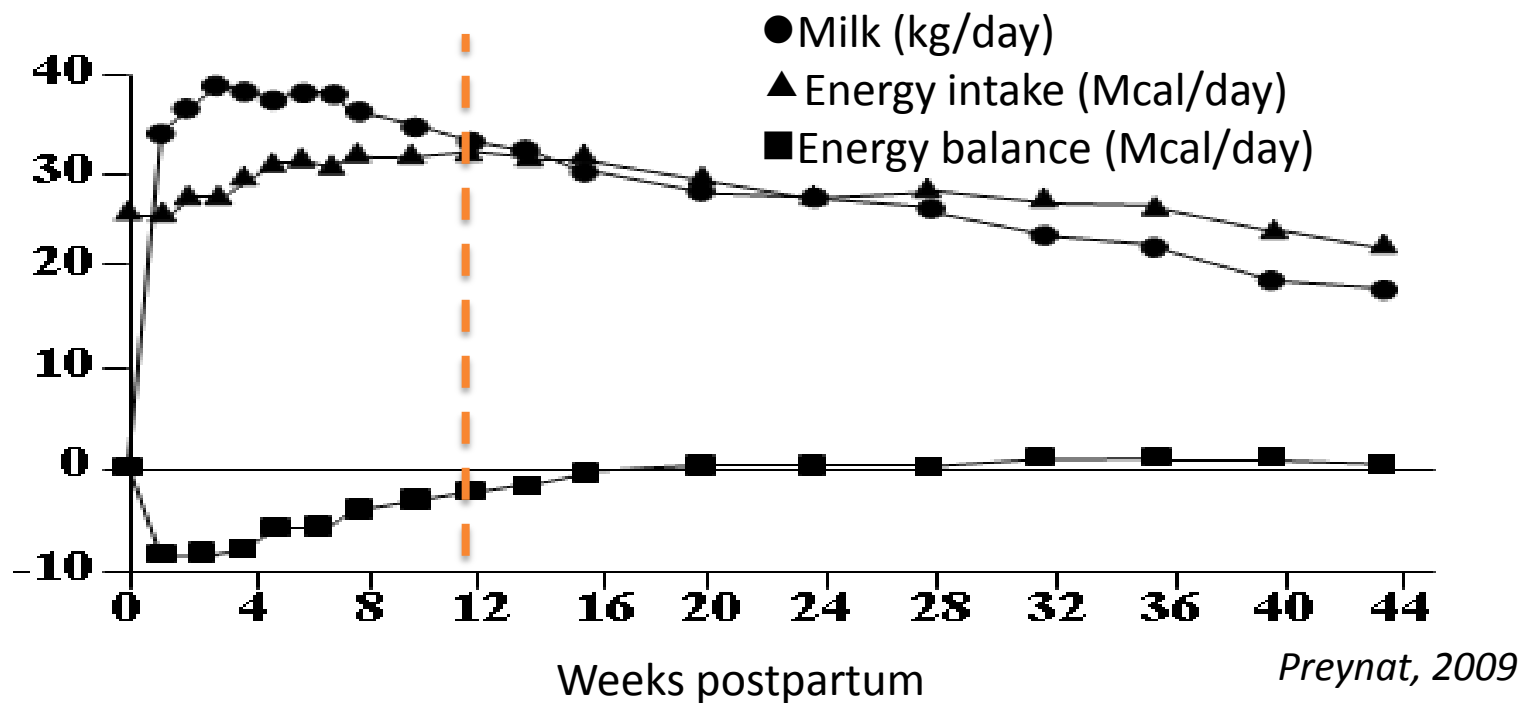
Milk production

Reproduction

Body condition

# Phenotyping trade-offs profiles

◆ Data from dairy experimental units of Inra Mirecourt (2002-2012) and Le Pin-au-Haras (2006-2011)

- 489 statistical individuals (1lactation/cow)
- Information about: milk production, body condition score, reproduction events, individual characteristics (breed, parity, age at first calving….)

# Phenotyping trade-offs profiles

◆ Data from dairy experimental units of Inra Mirecourt (2002-2012) and Le Pin-au-Haras (2006-2011)

- 489 statistical individuals (1lactation/cow)
- Information about: milk production, body condition score, reproduction events, individual characteristics (breed, parity, age at first calving….)
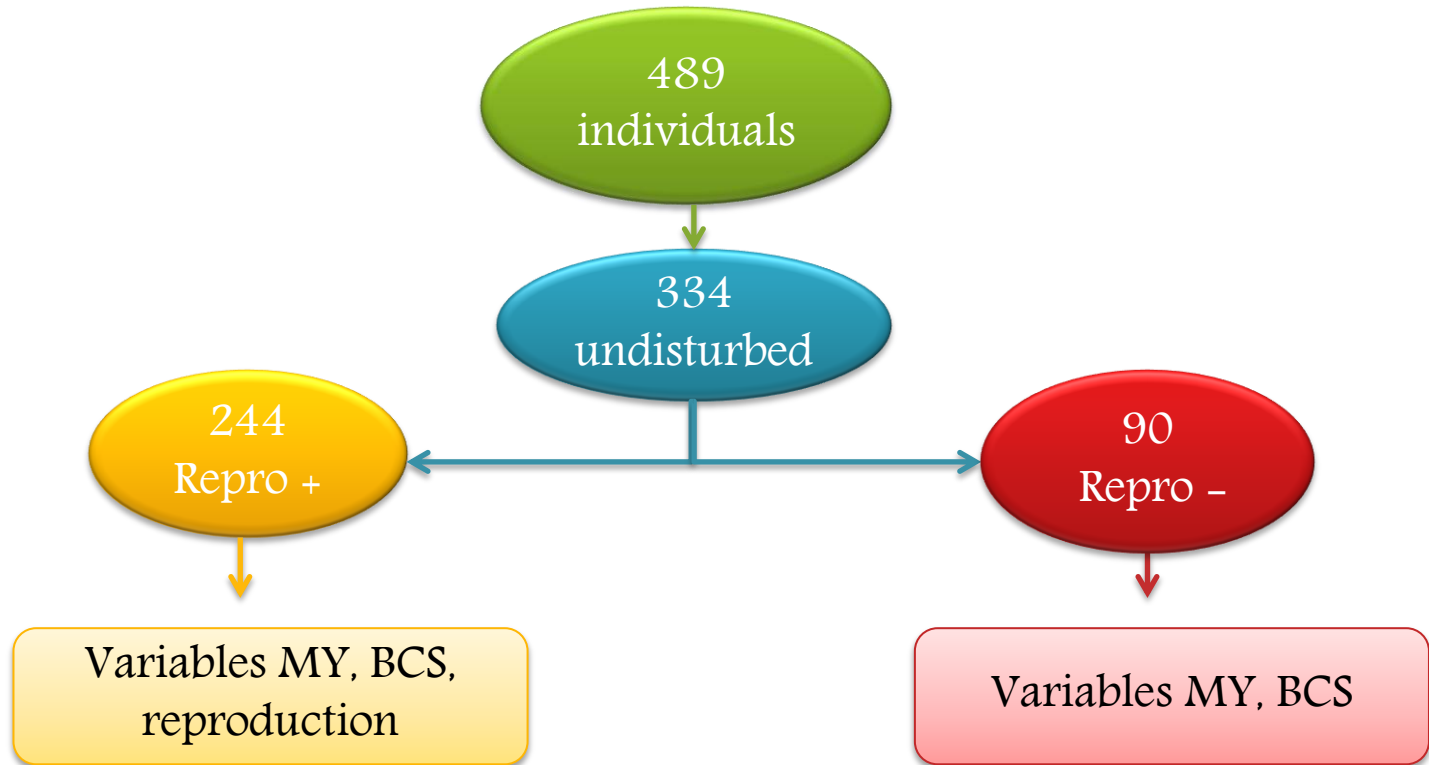
◆ Study period: calving to 90 days post partum: suboptimal nutritional period (negative energy balance)

# Phenotyping trade–offs profiles



● Milk (kg/day)
▲ Energy intake (Mcal/day)
■ Energy balance (Mcal/day)

Weeks postpartum

*Preynat, 2009*

◆ Study period: calving to 90 days post partum: suboptimal nutritional period (negative energy balance)
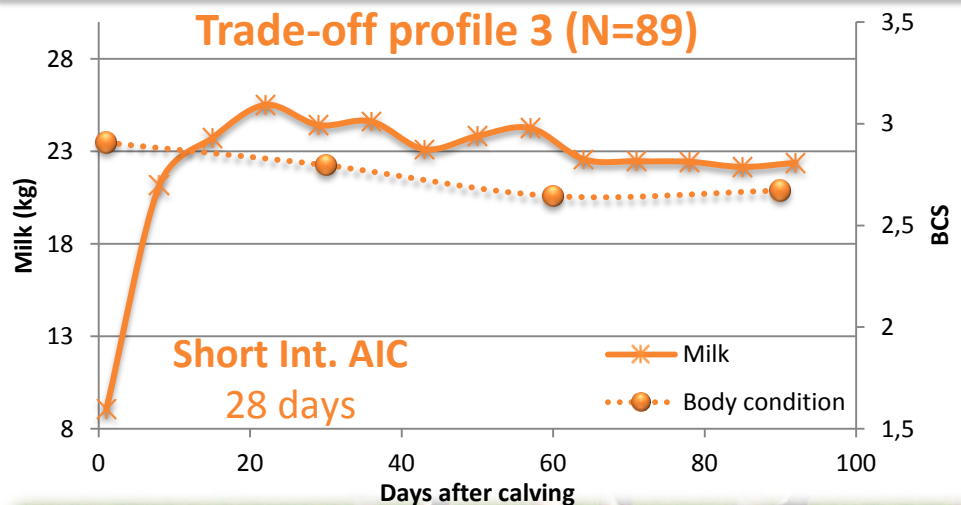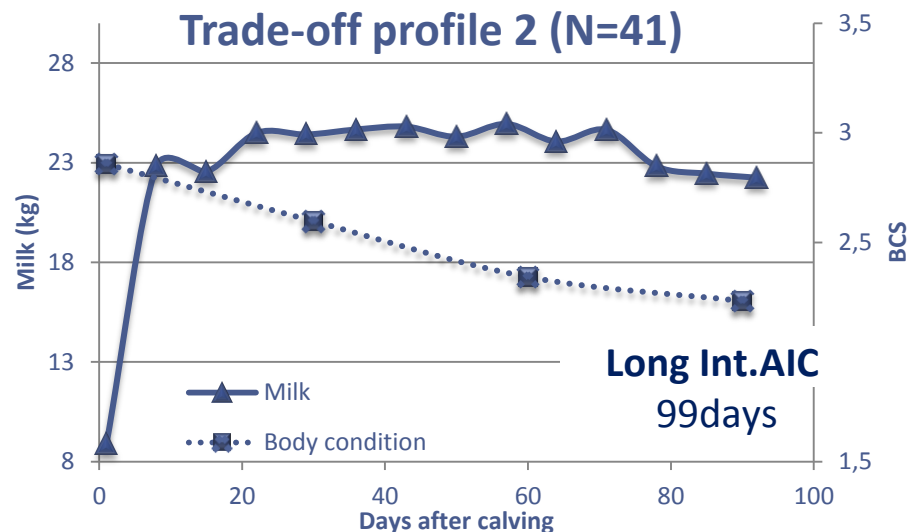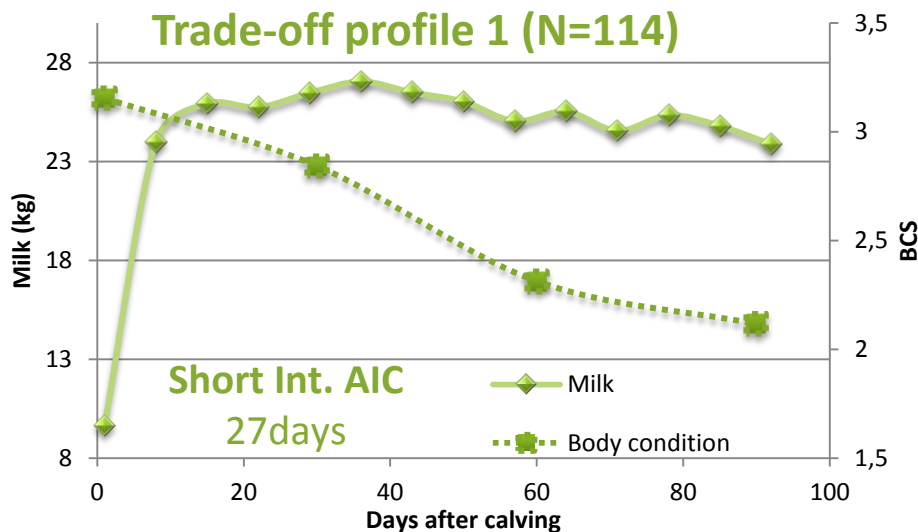
# Phenotyping trade-offs profiles

◆ Data from dairy experimental units of Inra Mirecourt (2002–2012) and Le Pin–au–Haras (2006–2011)

- 489 statistical individuals (1lactation/cow)
- Information about: milk production, body condition score, reproduction events, individual characteristics (breed, parity, age at first calving….)

◆ Study period: calving to 90 days post partum: suboptimal nutritional period (negative energy balance)

# Phenotyping trade–offs profiles basing on dynamics of MY, BCS and on reproduction
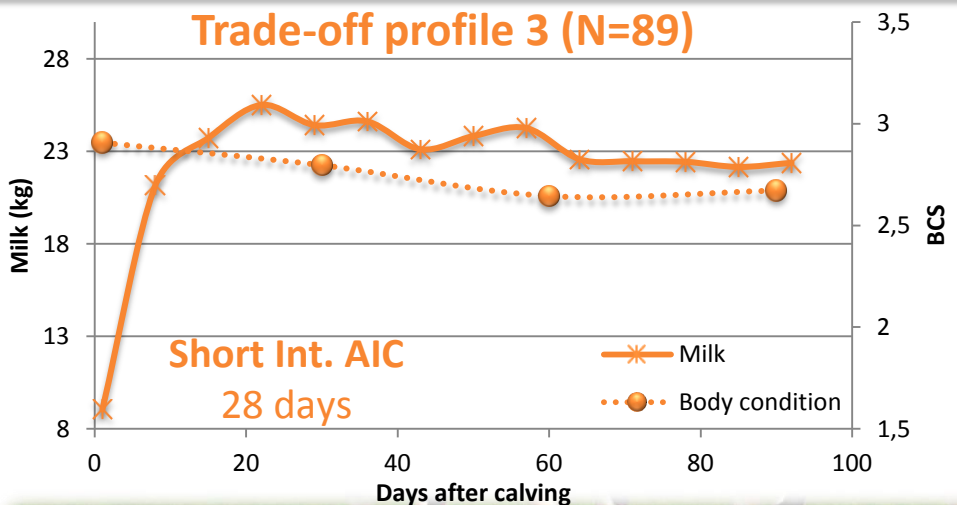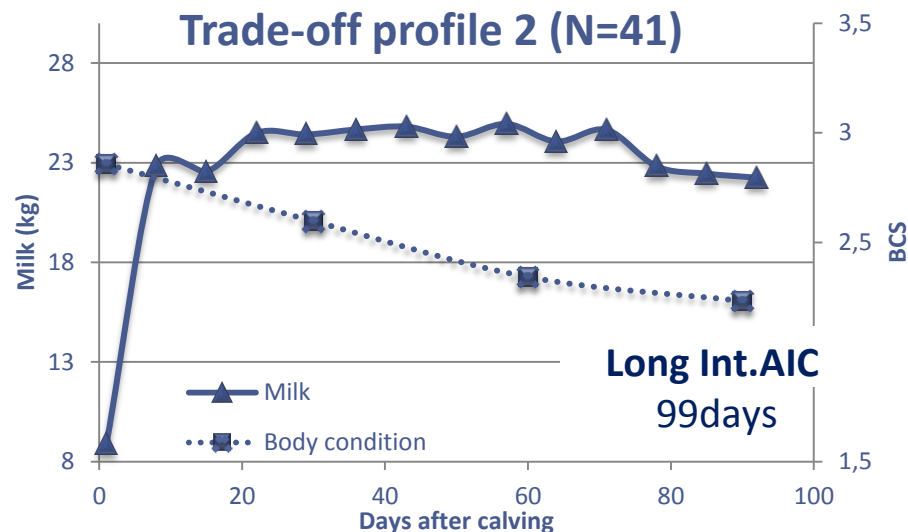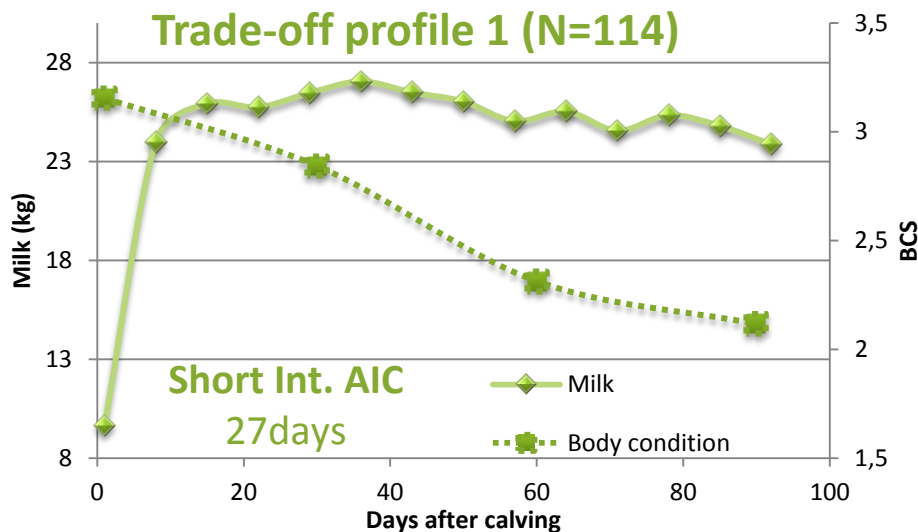


**489 individuals**

**334 undisturbed**

**244 Repro +**

**90 Repro –**

Variables MY, BCS, reproduction

Variables MY, BCS

◆ PCA and clustering method ➔ Trade–offs between life functions

# Results: Trade-offs profiles in Repro + cows



**Trade-off profile 1 (N=114)**

Short Int. AIC
27days

Milk (kg) — Days after calving — BCS

— Milk
⋯ Body condition

**Trade-off profile 2 (N=41)**

Long Int.AIC
99days

Milk (kg) — Days after calving — BCS

— Milk
⋯ Body condition

**Trade-off profile 3 (N=89)**

Short Int. AIC
28 days

Milk (kg) — Days after calving — BCS

— Milk
⋯ Body condition

# Results: Trade-offs profiles in Repro + cows



**Trade-off profile 1 (N=114)**

Short Int. AIC
27days

Milk
Body condition

**Trade-off profile 2 (N=41)**

Long Int.AIC
99days

Milk
Body condition

**Trade-off profile 3 (N=89)**

Short Int. AIC
28 days

Milk
Body condition

◆ Trade-off 1

- BCS ↘ ↘
- BCS$_{calving}$ > average
- Short repro period (NbAI–)

# Results: Trade-offs profiles in Repro + cows


Trade-off profile 1 (N=114)
Short Int. AIC 27days
Milk
Body condition


Trade-off profile 2 (N=41)
Long Int.AIC 99days
Milk
Body condition


Trade-off profile 3 (N=89)
Short Int. AIC 28 days
Milk
Body condition
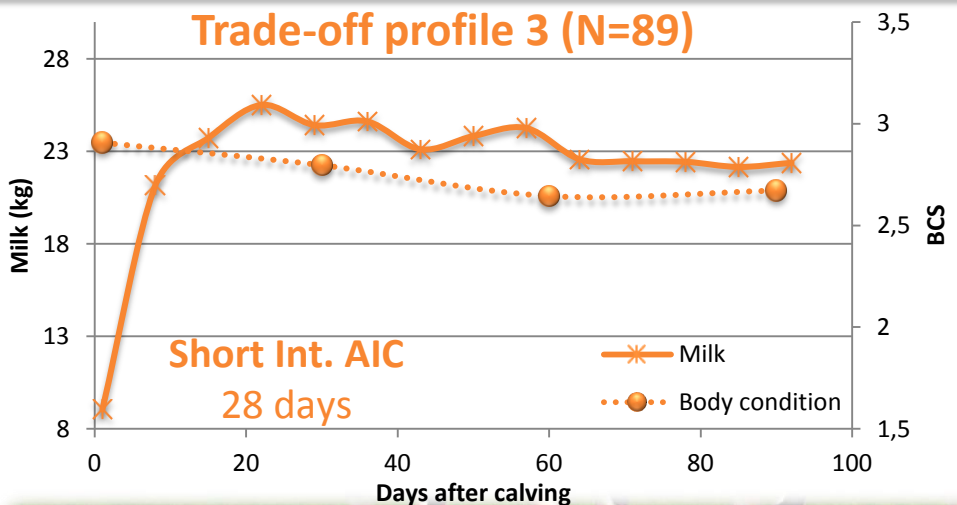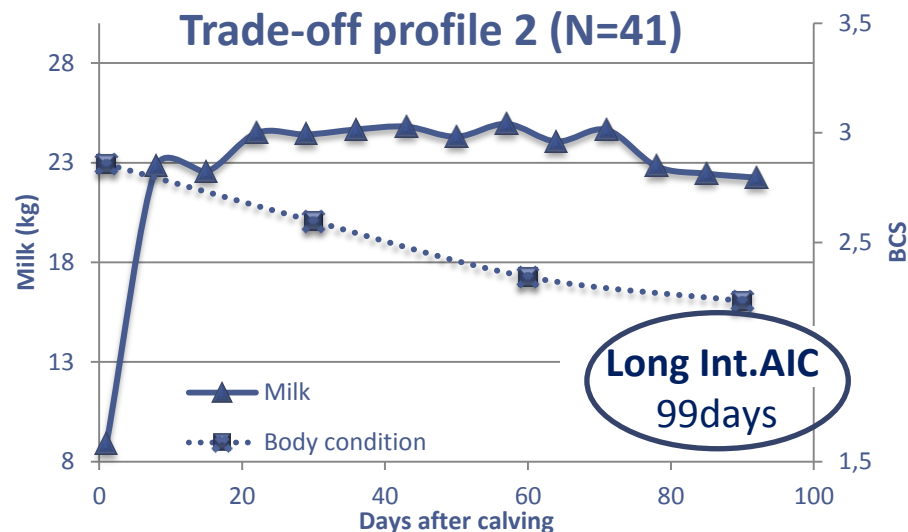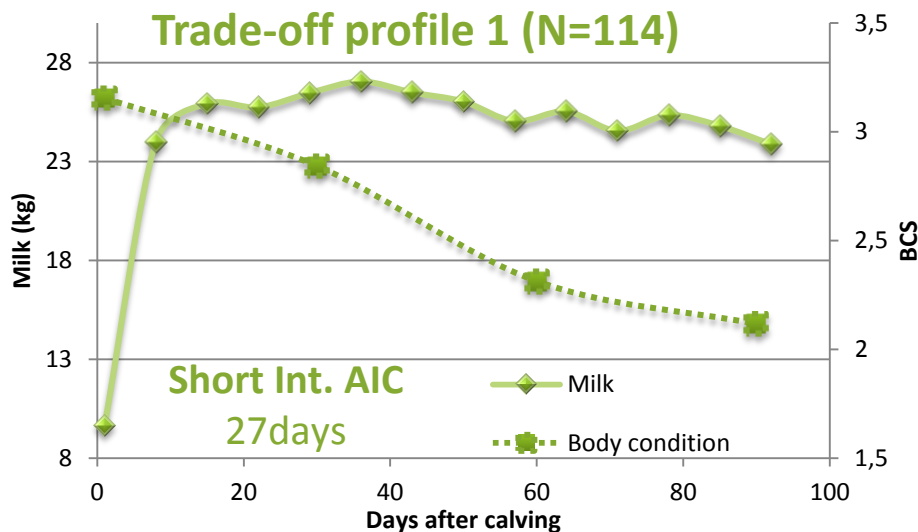
◆ Trade-off 2

- Long repro period(Nb AI +)
- $BCS_{calving}$ < average
- Interval calving-milk peak<average

# Results: Trade-offs profiles in Repro + cows



Trade-off profile 1 (N=114)

Short Int. AIC 27days

Milk (kg) / BCS / Days after calving

— Milk
···· Body condition



Trade-off profile 2 (N=41)

Long Int.AIC 99days

Milk (kg) / BCS / Days after calving

— Milk
···· Body condition



Trade-off profile 3 (N=89)

Short Int. AIC 28 days

Milk (kg) / BCS / Days after calving

— Milk
···· Body condition
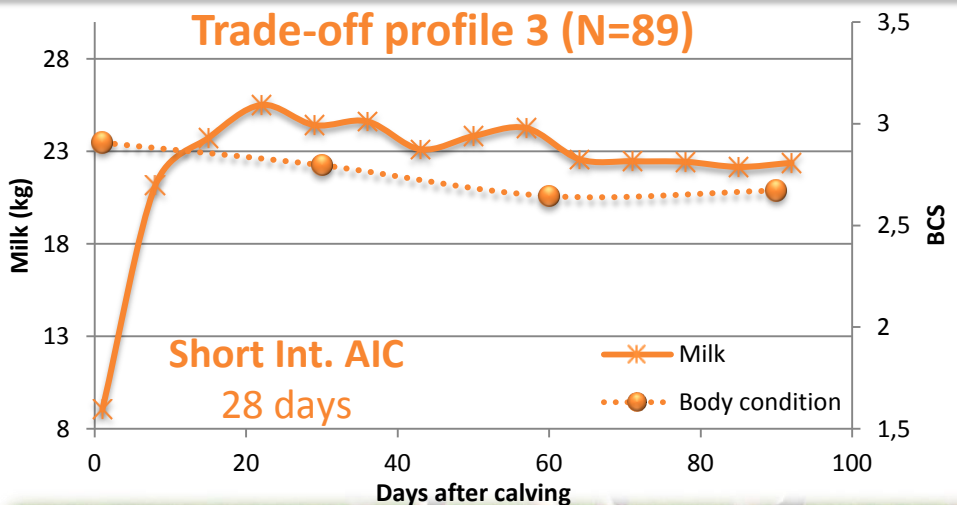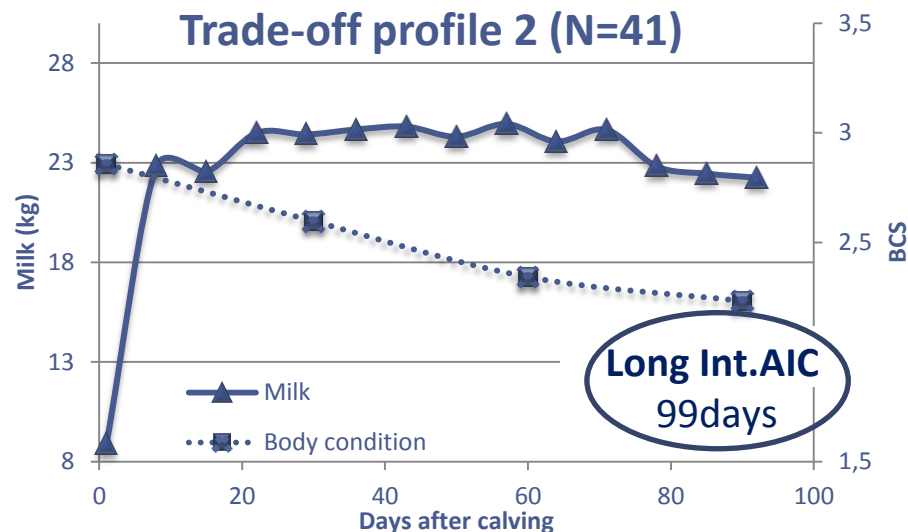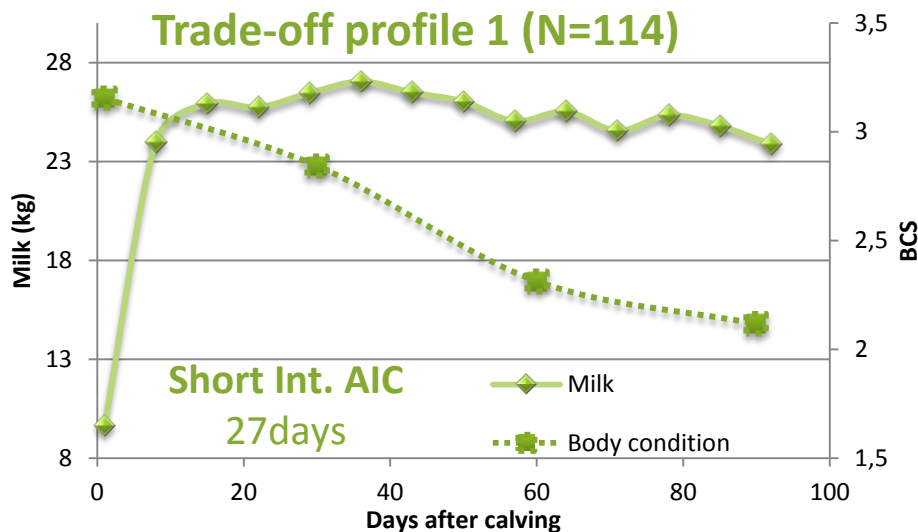
◆ Trade-off 3

- BCS stable
- BCS>average
- Short repro period

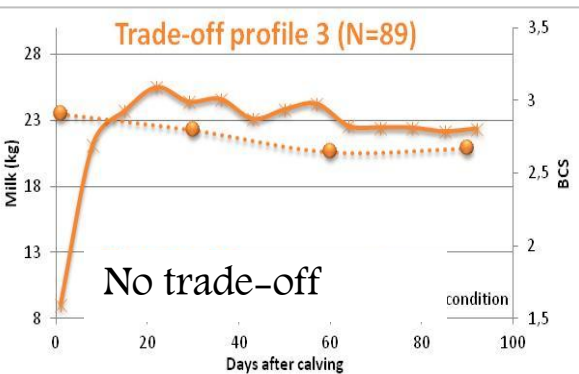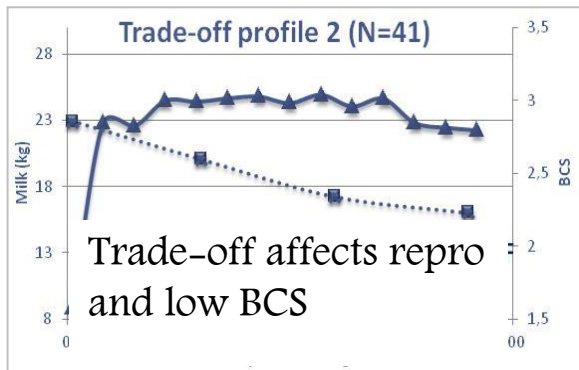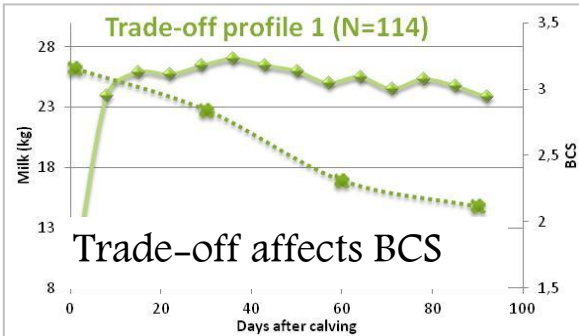# Results: links between trade-off and adaptive response profiles

◆ Reminder: 4 main adaptive response profiles for cows Repro +:

- Same dataset
- Disturbed period
- Similar method of characterization based on MY and BCS dynamics

◆ Significant link for individuals who succeeded reproduction (Test X²: p-value=0.026)

◆ No significant link for individuals who failed reproduction (p-value=0.550)

# Links between profiles (cows repro +)

**Trade-offs between life functions from 0 to 90 days postpartum**

**Adaptive responses to disturbances (>90 days postpartum)**



Trade-off profile 1 (N=114)

Trade-off affects BCS

Trade-off profile 2 (N=41)

Trade-off affects repro and low BCS

Trade-off profile 3 (N=89)

No trade-off

( - )  ( + )  ( + )  ( - )  ( - )  ( + )  ( + )

**Adaptive response 1**
No effect on Milk
decline of BCS

**Adaptive response 2**
No effect on Milk and no
BCS flexibility

**Adaptive response 3**
Flexible : Milk drop and
rebound decline of BCS

**Adaptive response 4**
No effect on BCS with
flexible Milk
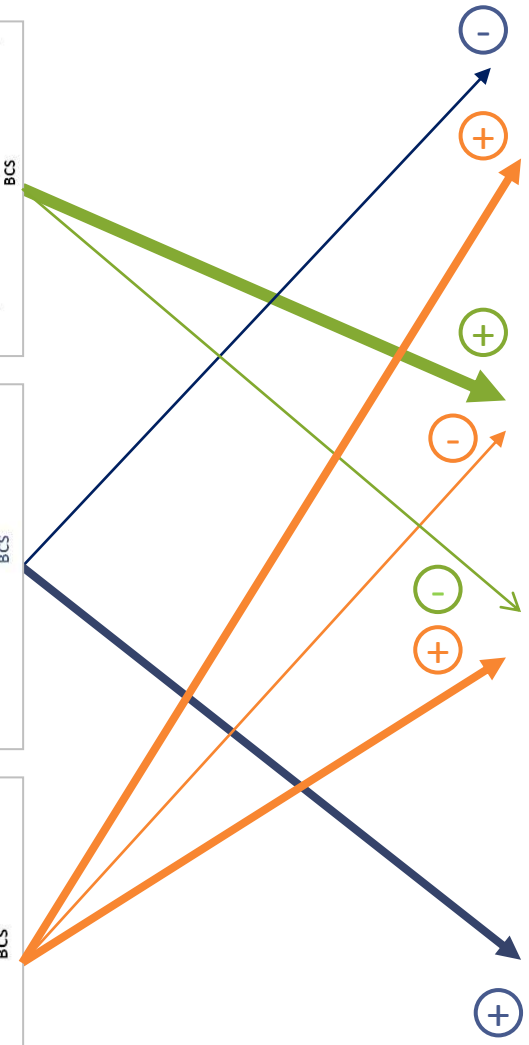
# Conclusions

◆ 27% of cows were non pregnant at 90 days post partum: no links between profiles

◆ 3 main trade-offs profiles highlighted for pregnant animals

◆ Significant links with adaptive responses profiles despite the data
→The observation of trade-offs between life functions during identified situation can be a source of information to anticipate cow adaptive response in disturbed situation

◆ Profile stability? Long term analysis on individual careers

◆ A method that can be improved and validated with high-throughput phenotyping data

◆ Detection and valorization of this diversity by farmers : toward more robust systems to environmental variability

# Acknowledgements

◆ Thank you for your attention



◆ Thanks to all the people who participated to this work: Claire Agabriel, Luc Delaby, Olivier Martin, Sylvie Cournut…