

Potential of Precision Livestock Farming in small ruminant farming systems

Morgan-Davies, C*., Gautier, J.M., González-García, E., Halachmi, I., Caja López, G., Molle, G., Kenyon, F., Grøva, L., Lagriffoul, G., Schmoelzl., S., Wishart, H., Waterhouse, T., McCracken, D.

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Outline

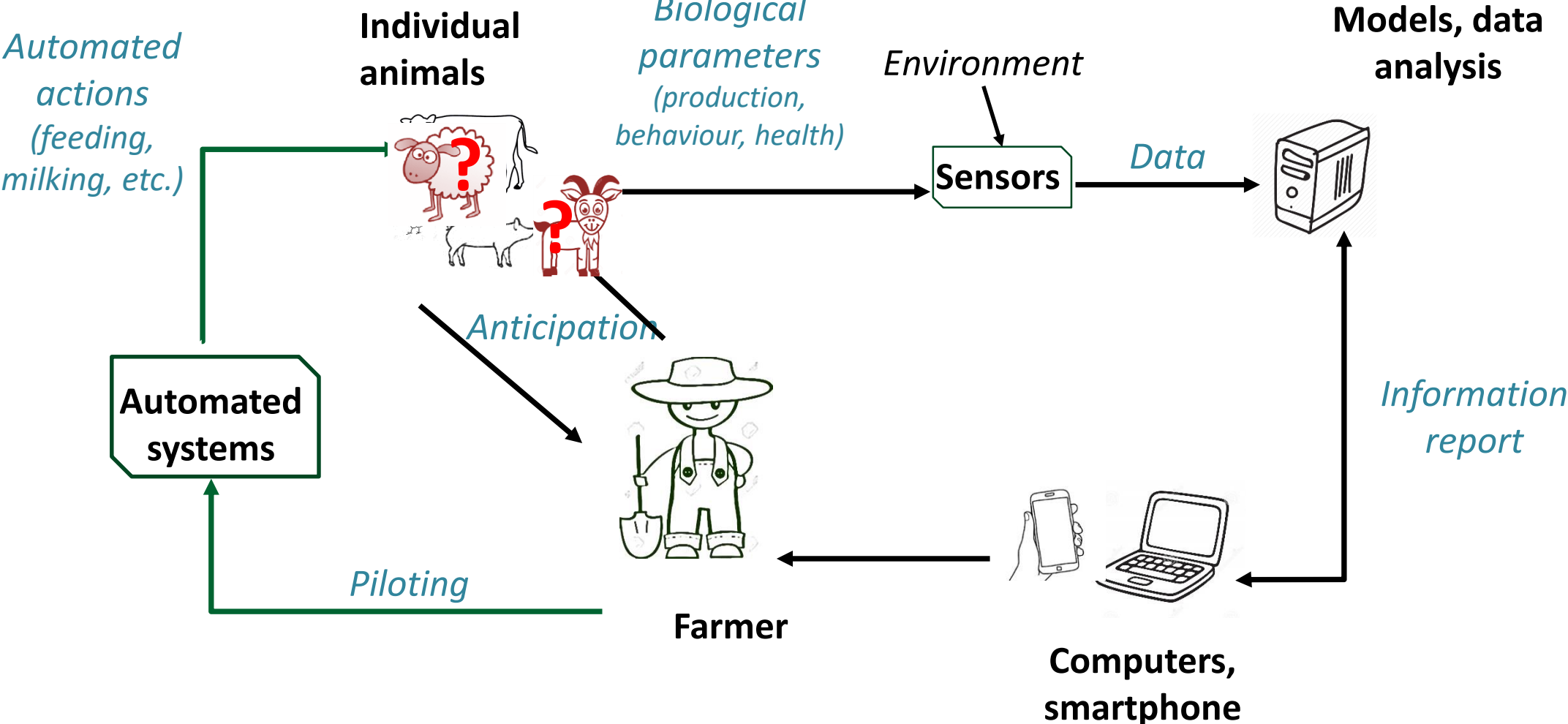
1. Definition of PLF
2. Small Ruminant systems
3. PLF & SR?
4. What exists already
5. Issues
6. The future?



Precision Livestock Farming

- “The ‘sensor-based’ **individual** animal approach” (Halachmi, 2019)
- Management of livestock by continuous automated real-time **monitoring** of production/reproduction, health, welfare and environmental impact (Berckmans, 2017)
- Farming using equipment, data or software which allows the use of information at an **individual** level for targeting decisions, inputs and treatments more precisely (Morgan-Davies et al., 2015).

Precision Livestock Farming



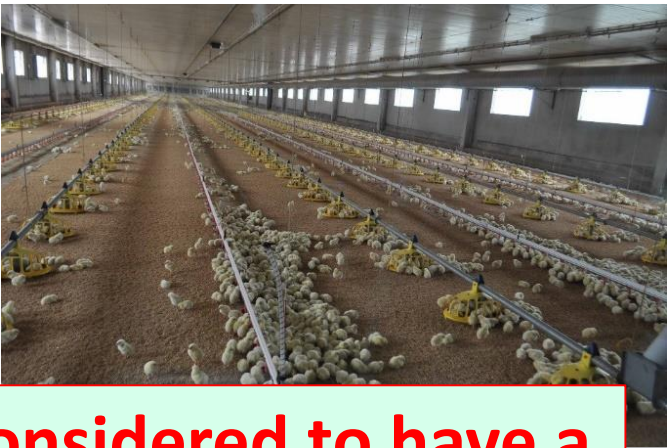
Adapted from Ingrand et al., 2018 (69th EAAP)

PLF applications?

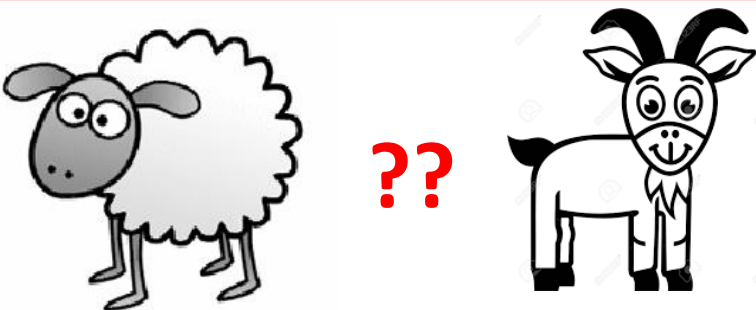
- Widely adopted in management of high-value animals and/or more industrialised farming systems

- Pigs
- Dairy cows
- Beef cattle

Milk production
Heat detection
Disease detection
Environmental quality



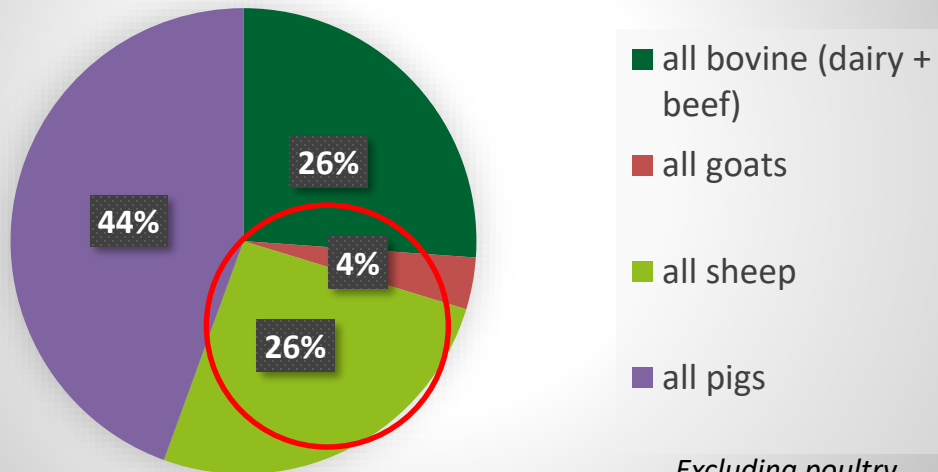
BUT.... what about species where animals are considered to have a lower individual value or with less economic interest or in extensive management systems?



Small Ruminant Systems

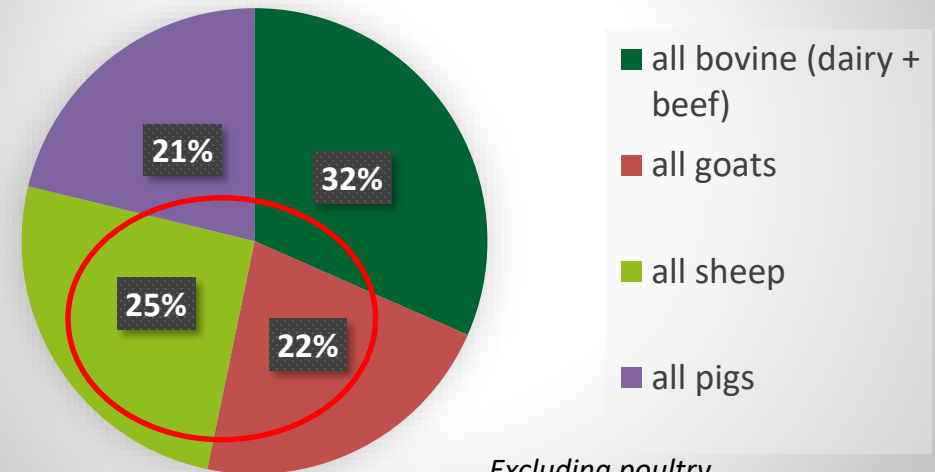


% of livestock in Europe (heads) – Eurostat 2015



Excluding poultry

% of livestock in the world (heads) – FAOSTAT 2015



Excluding poultry

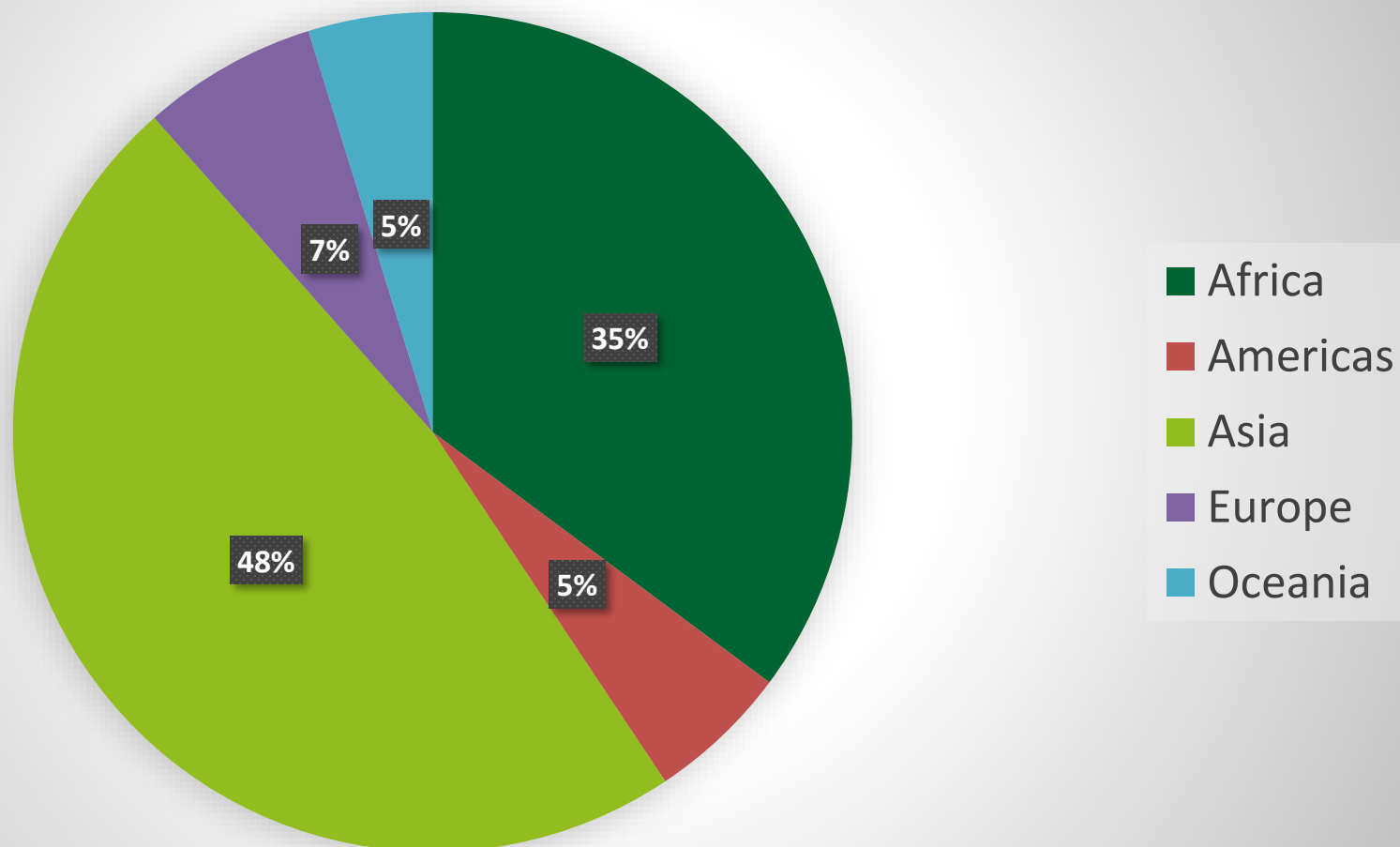
Type of production

- Dairy vs meat vs wool + multi-purpose
- Intensive / semi-intensive / extensive

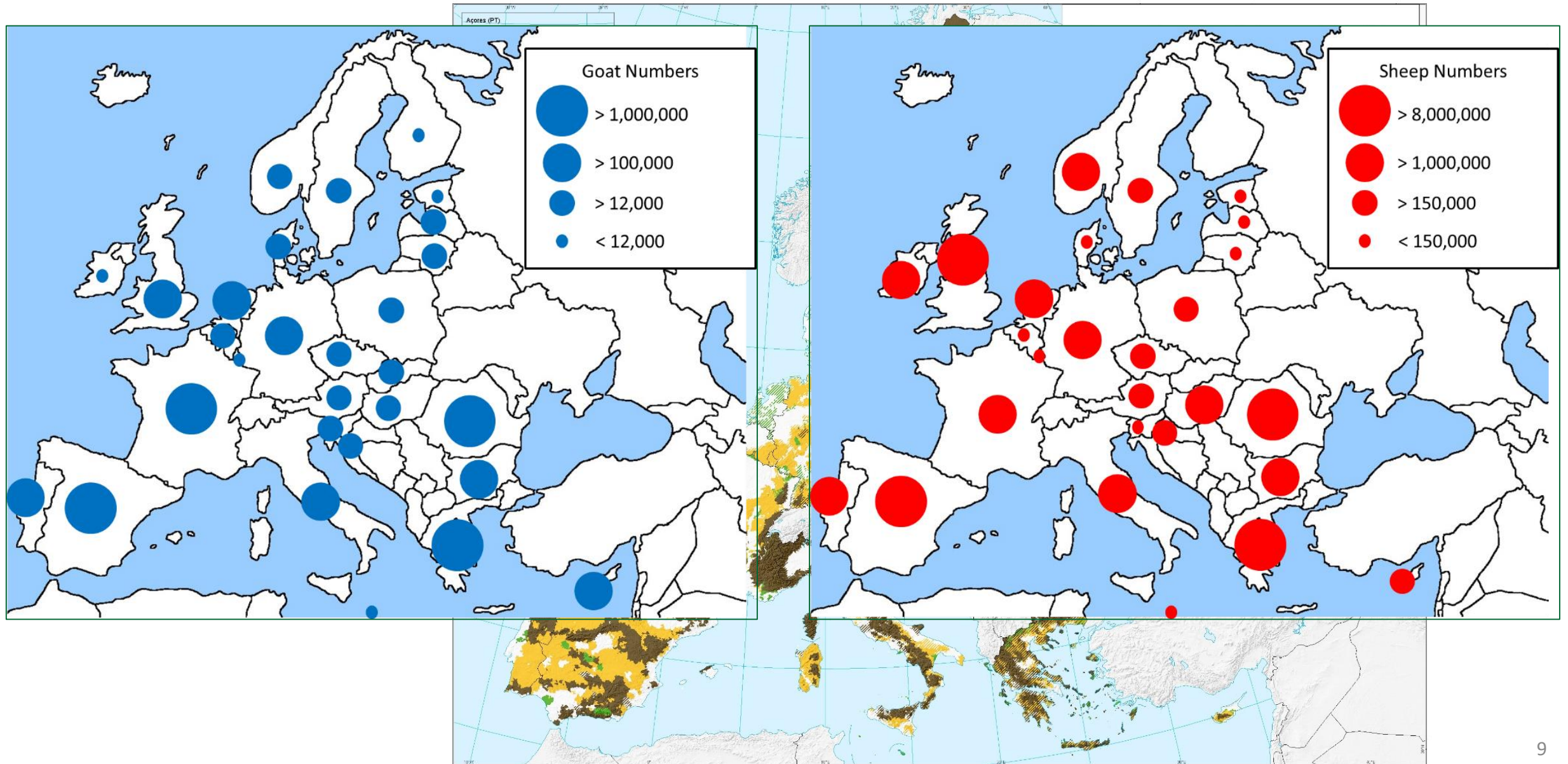


Small Ruminants in the world?

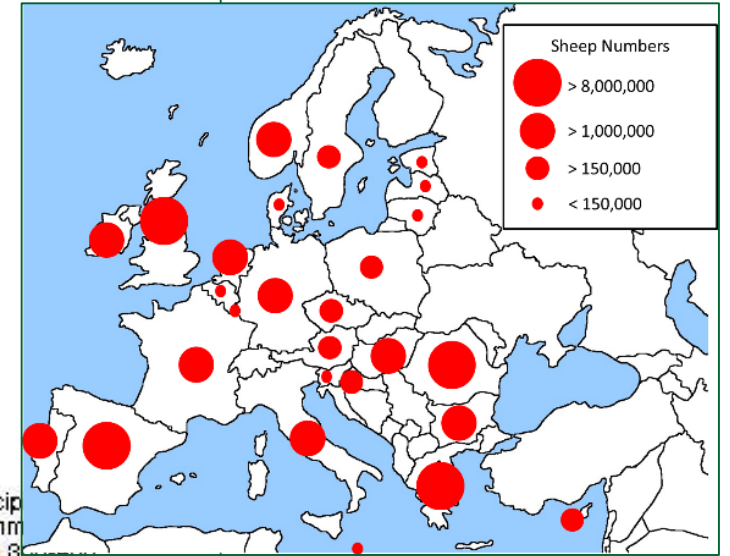
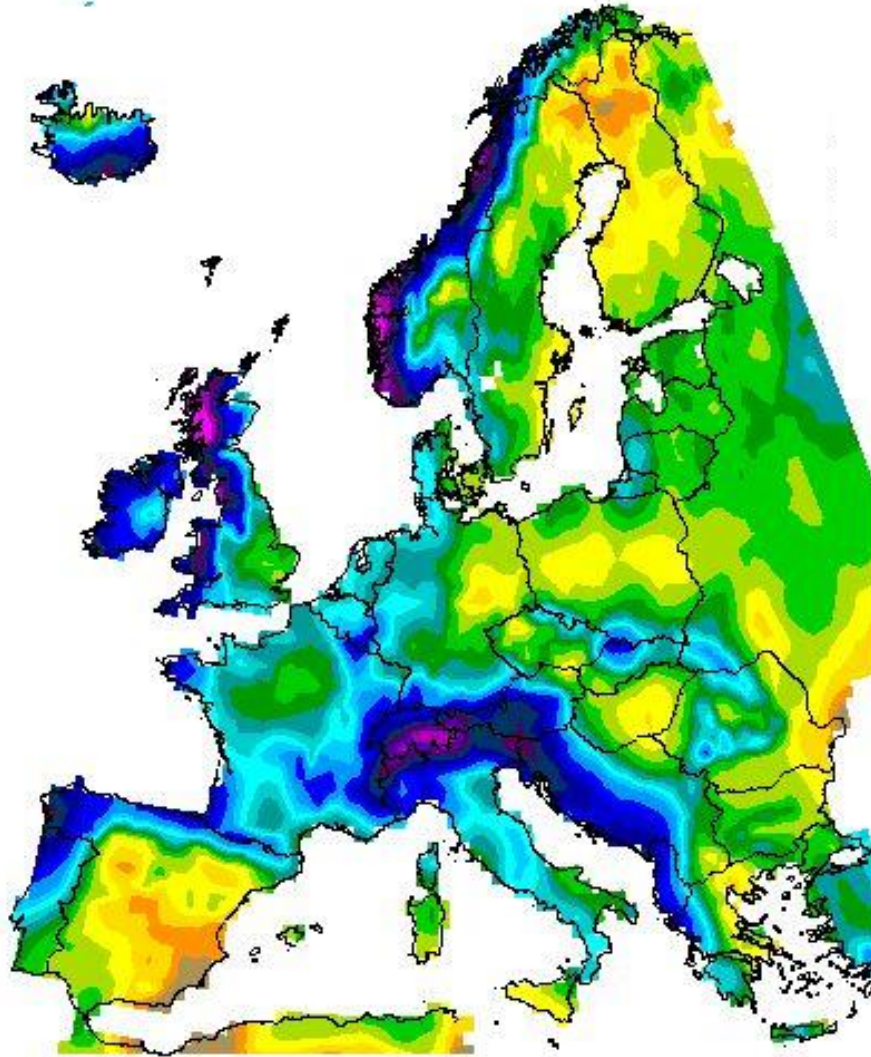
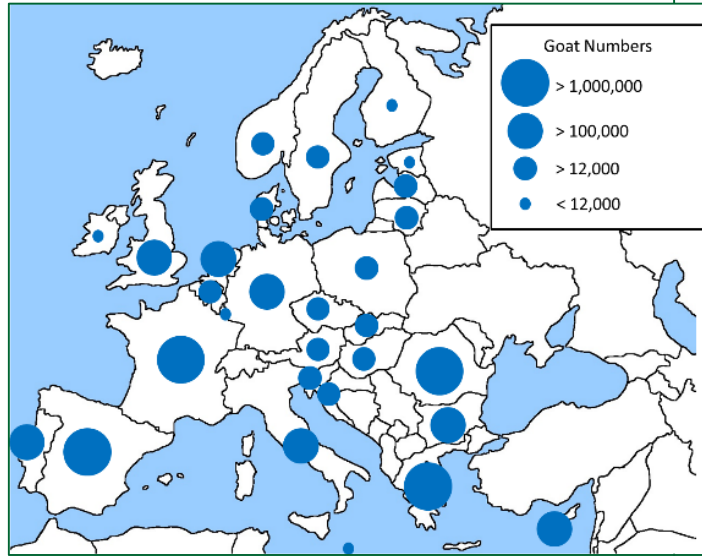
Number of sheep & goats in world – FAOSTAT 2015



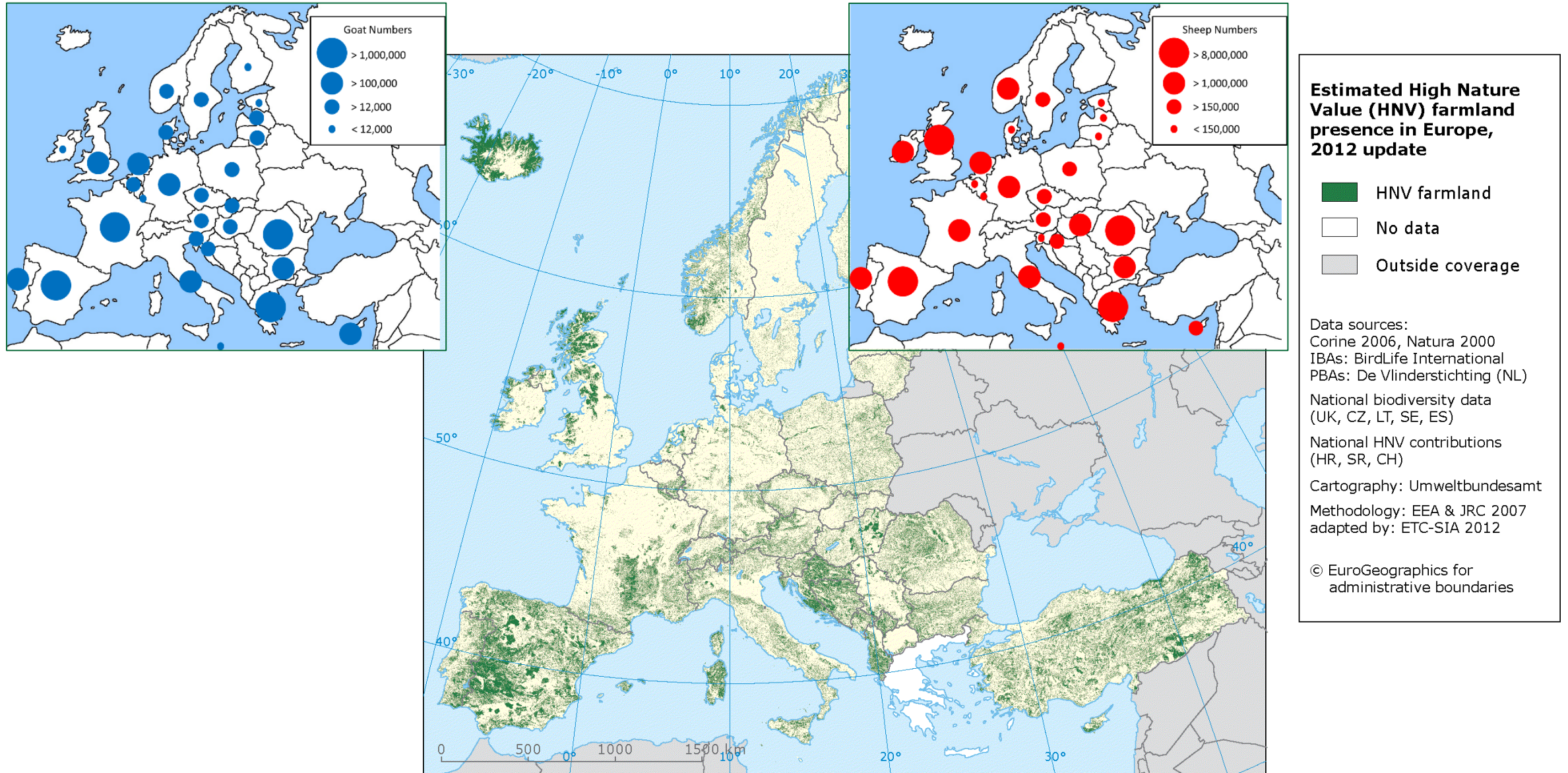
In Europe?



In Europe



In Europe – High Nature Value



Important aspects of SR

- Environment/biodiversity
- Social/Cultural
 - Employment – 1.5 million (7%)
 - High-quality traditional products
- In Europe – rangeland
- Perceived as more valuable



Challenges

- Rangeland/remotely based
- Harsher environment/survival issues
- Welfare
- Diversity of systems
- Batch level
- Sector less organised
- More traditional/ageing sector
- Lack of labour
- Less efficiency/low productivity
- Low level of income



Challenges



PLF tools for...

- Rangeland/remotely based
Monitoring (production, welfare)
- Harsher environment/survival issues
Monitoring Alerts/warning systems
- Welfare
Alerts/warning systems
- Diversity of systems
Common protocols for collection or monitoring
- Batch level
Individual monitoring
Data to inform farmer individually
- Sector less organised
Benchmarking Efficiency gain
- More traditional/ageing sector
Younger generation interest?
Better life/work balance
- Lack of labour
Time saving
Alerts/warning systems
- Less efficiency/low productivity
Monitoring
Efficiency gain
- Low level of income
Diversification

So...do current PLF tools exist for Small Ruminants?

- 2004 EU legislation on EID – RFID
- Wearables, sensors, EID readers, weighcrates, algorithms, etc.

- **2 main types:**

- RFID tags/bolus with fixed/mobile readers
- Wearables (eg. collars, sensors on/in animals)



Potential for PLF applications

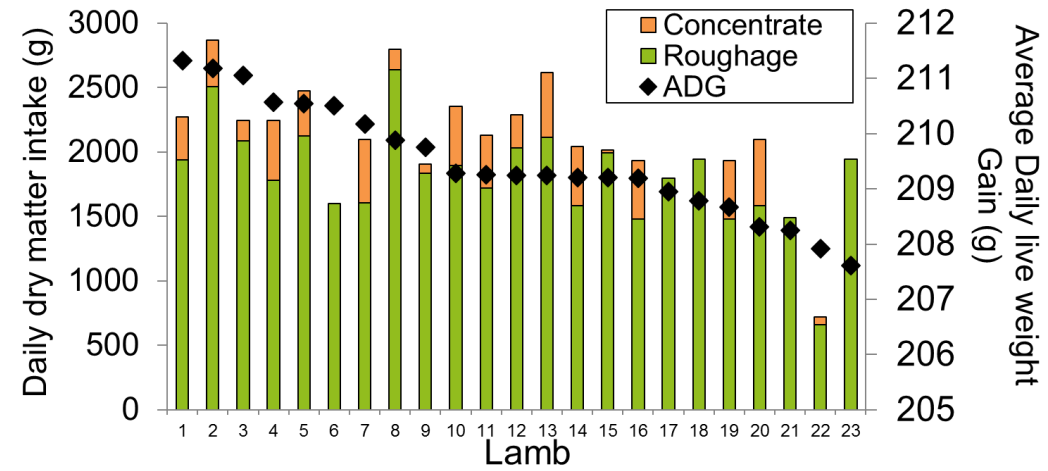
- Feed & water intake, growth
- Grazing behaviour
- Fencing
- Health/disease management
- Reproduction management
- Social behaviour



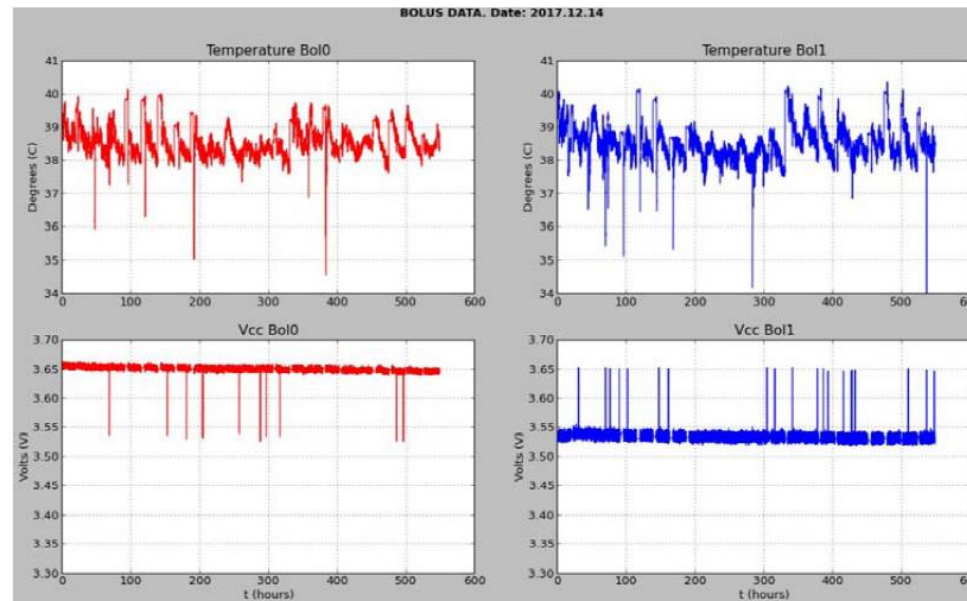
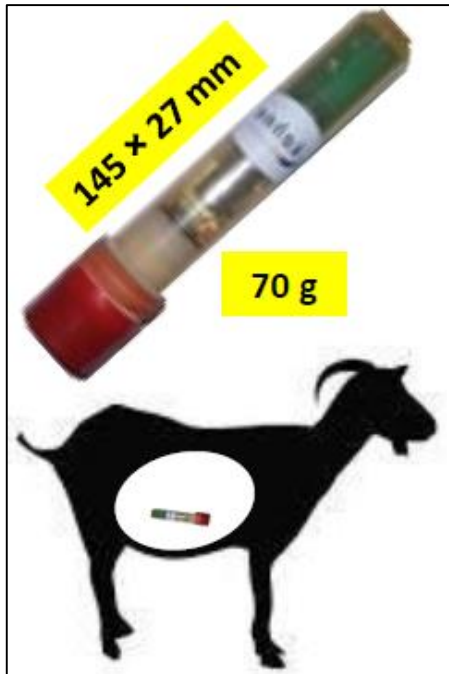
Potential for PLF applications

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Wishart & Lambe, 2019 (SRUC, UK)



Oliver et al. 2016; 2018 (UAB, Spain)

Outdoor weight monitoring

Walk Over Weigh (WoW)

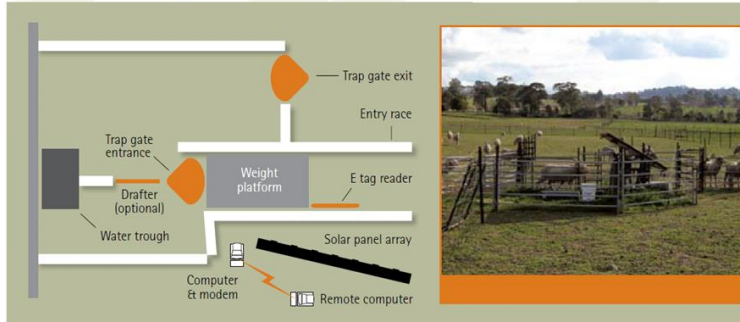
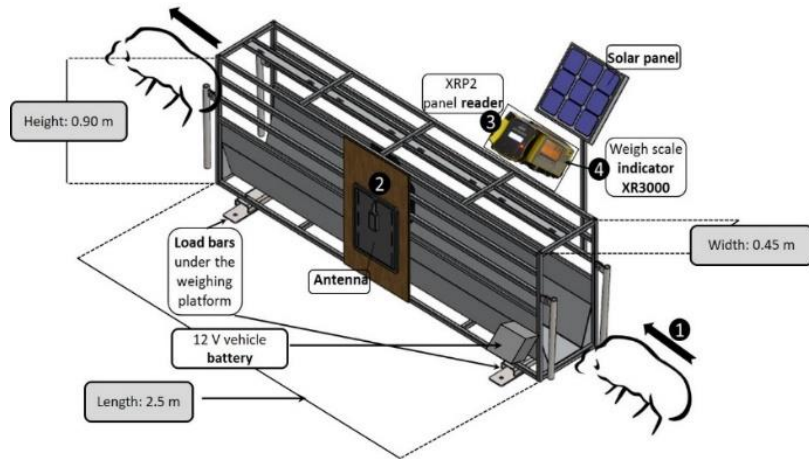
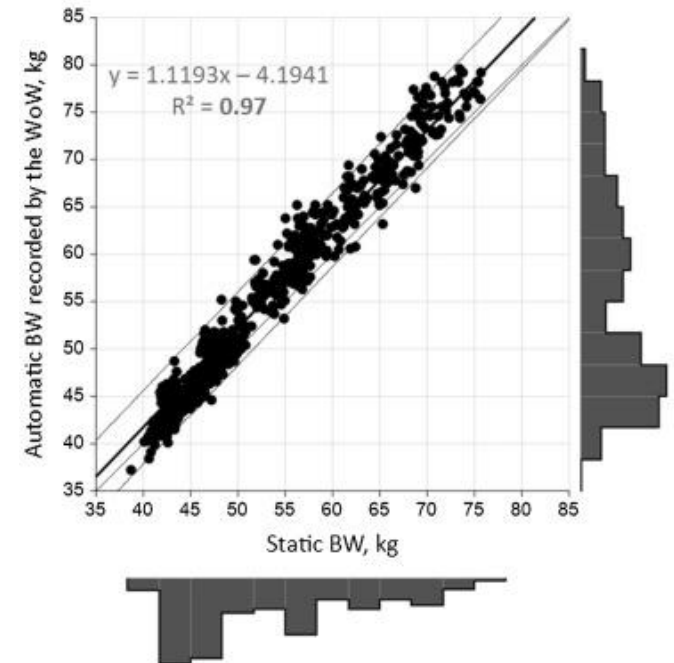


Figure 1. WoW system

Brown et al., 2012; 2014 (Sheep CRC, Australia)



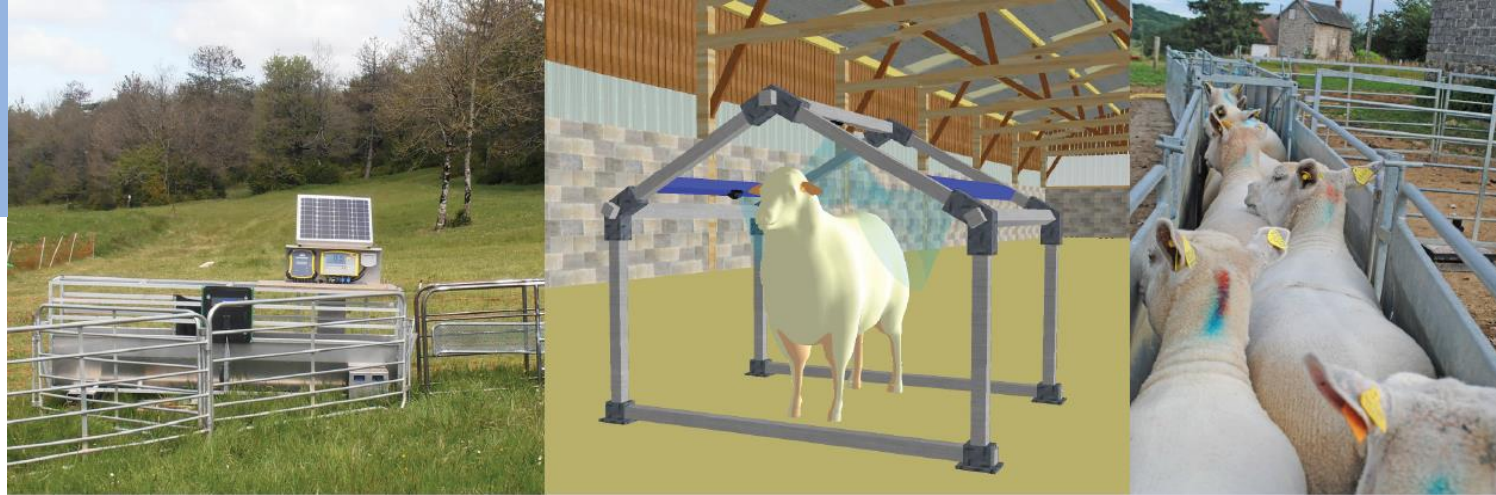
González-García et al, 2018 (INRA, France)



Body Condition, Growth



Gautier et al. 2019 – Institut de l’Elevage, France



Supplementation



Vs.



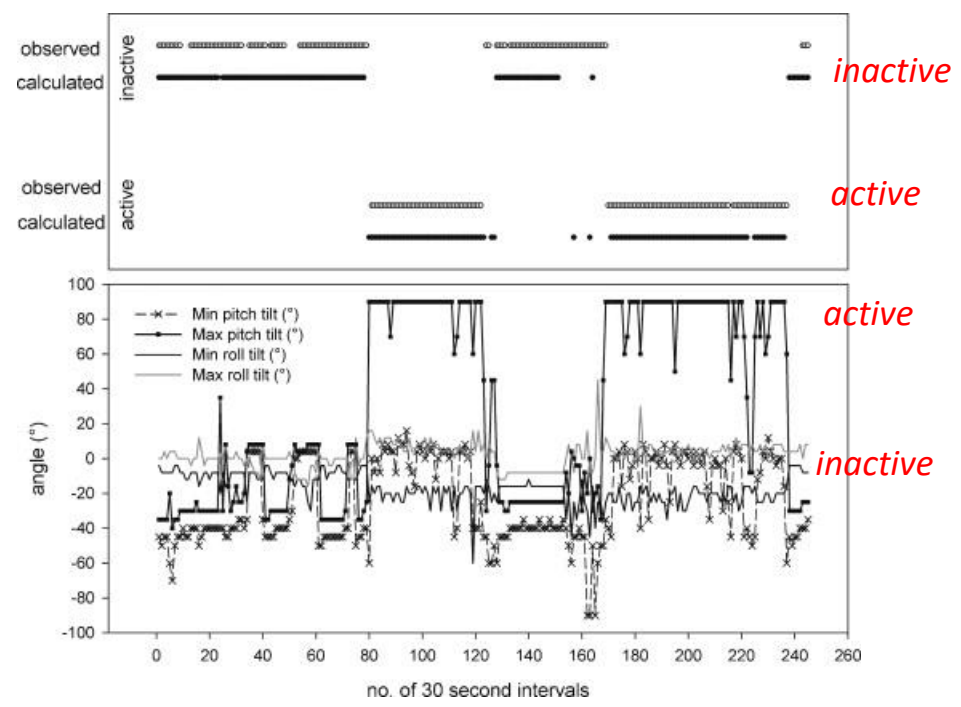
Wishart et al., 2015, SRUC, UK

Potential for PLF applications

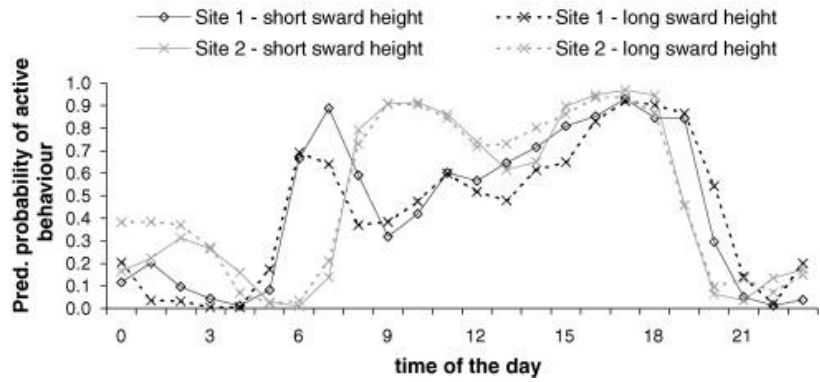
- Feed & water intake, growth
- **Grazing behaviour**
- Fencing
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- Reproduction management
- Social behaviour



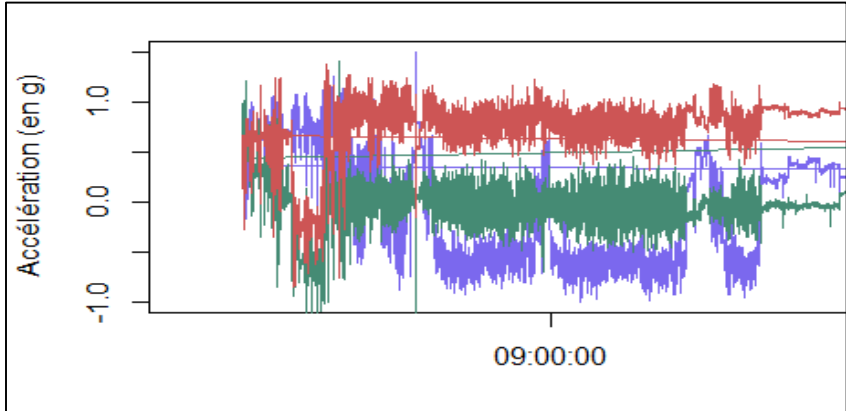
Grazing behaviour – efficient pastoral resource management

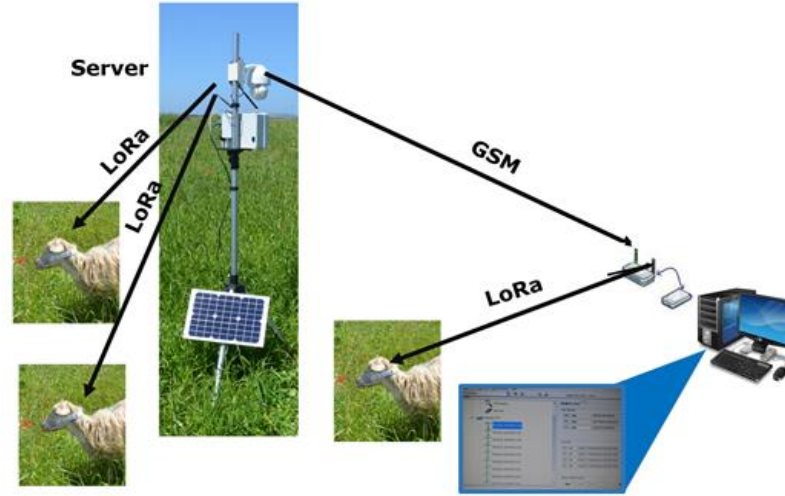


Umstätter et al. 2008, SRUC, UK



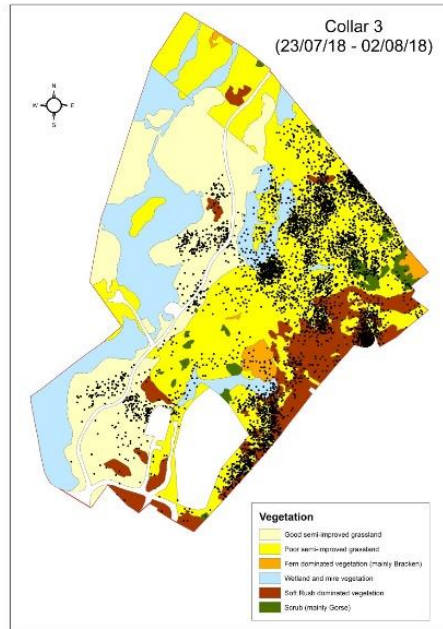
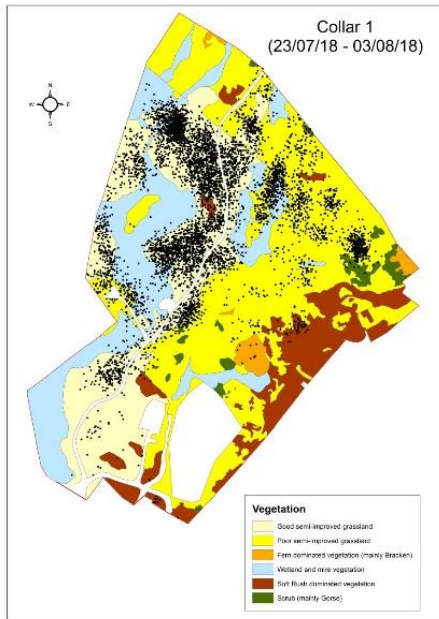
Grisot et al. 2018, Institut de l'Élevage, France



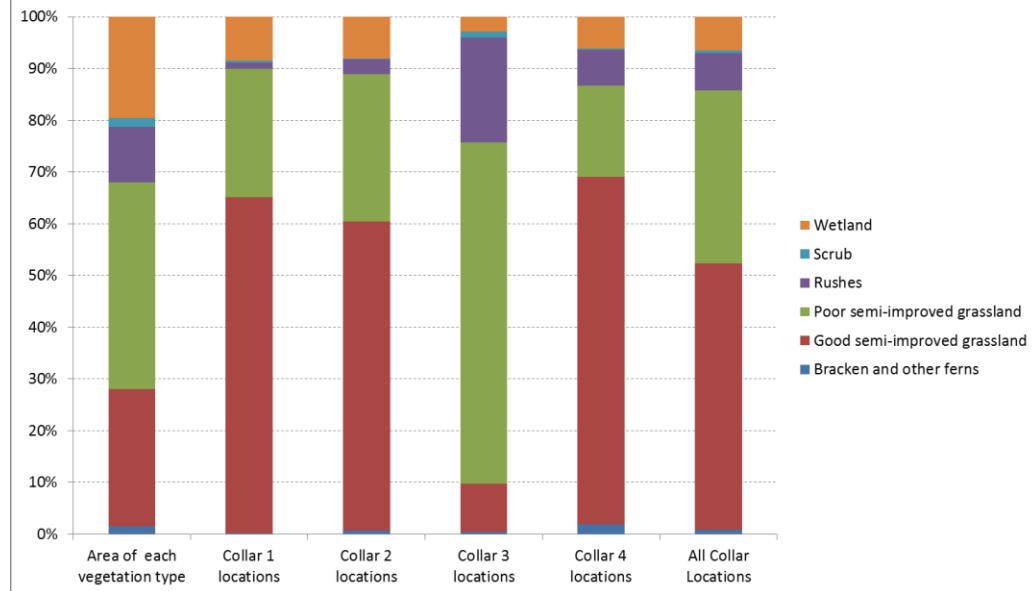


Giovanetti et al. 2017
 Decandia et al. 2018
 Agris Sardegna, Italy

Using GPS collars



The percentage area of each vegetation type compared to the percentage of collar locations in each vegetation type



Holland et al. unpublished data, SRUC, UK

Potential for PLF applications

- Feed & water intake, growth
- Grazing behaviour
- **Fencing**
- Health/disease management
- Reproduction management
- Social behaviour



Virtual fencing

<https://nofence.no/en/>



VigiFence (sensor and phone alert)



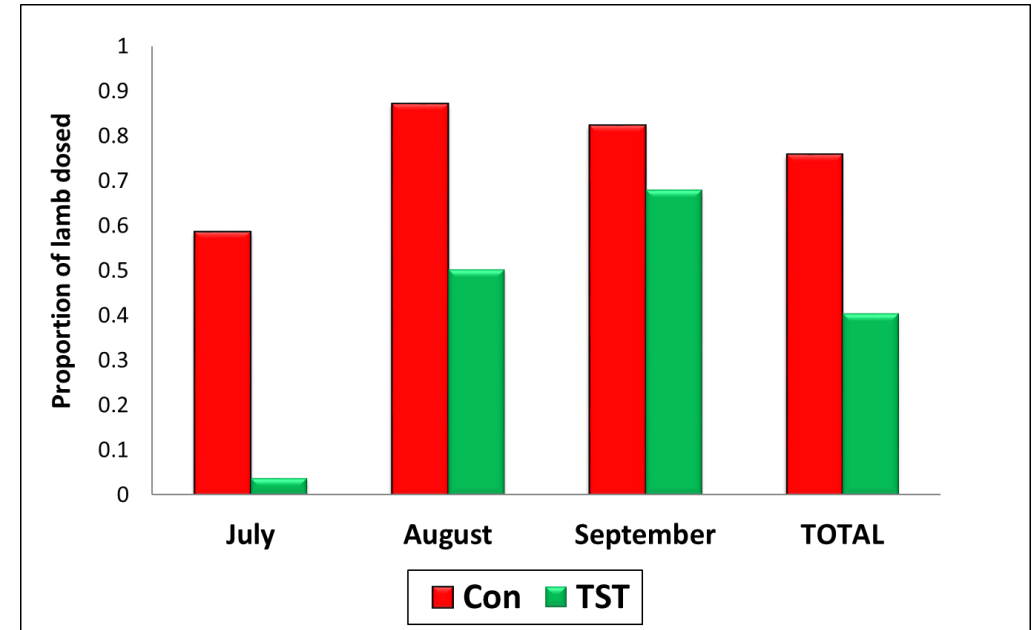
Potential for PLF applications

- Feed & water intake, growth
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- Social behaviour



Disease/Health management

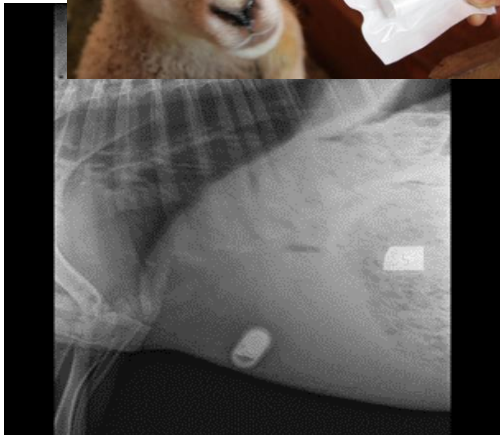
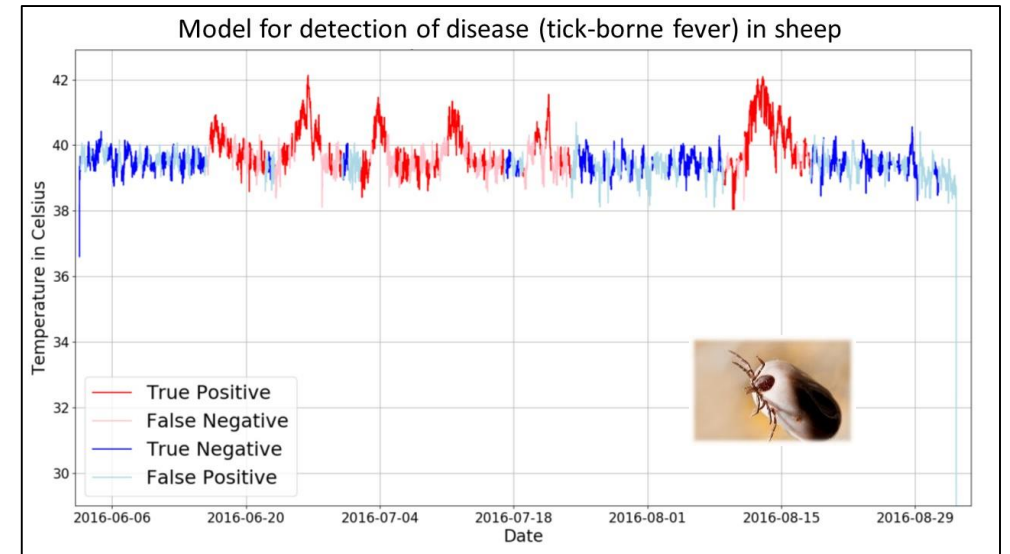
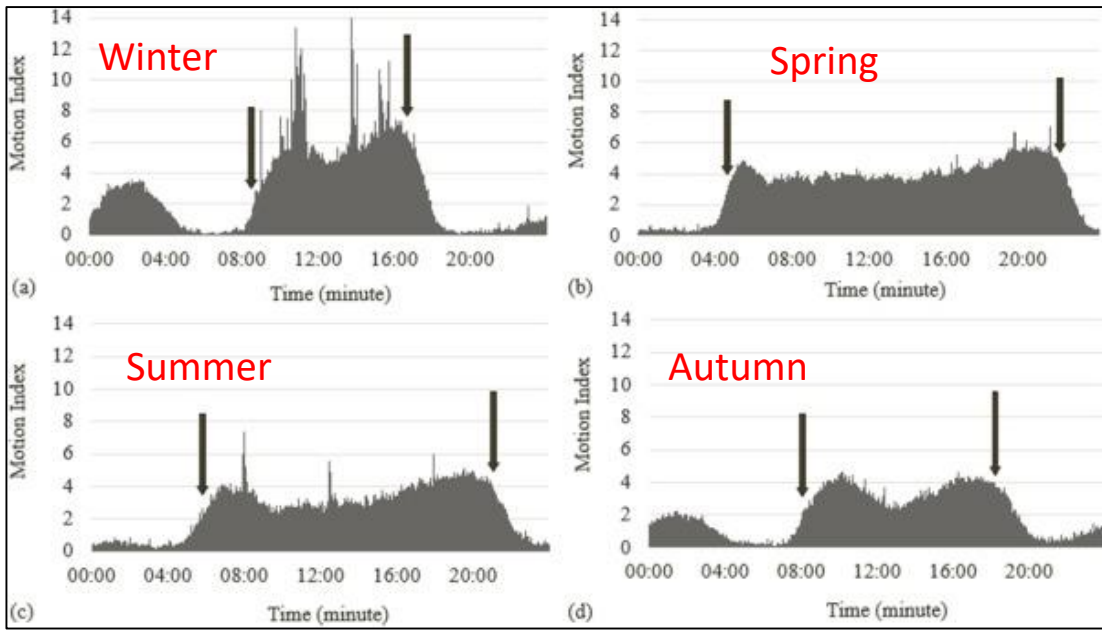
Targeted Selective Treatment - Happy Factor™ algorithm



Morgan-Davies et al., 2018, SRUC, UK
McBean et al., 2016; Greer et al., 2009
Moredun Institute, UK

Circadian rhythms

Sarout et al. 2018, SRUC, UK



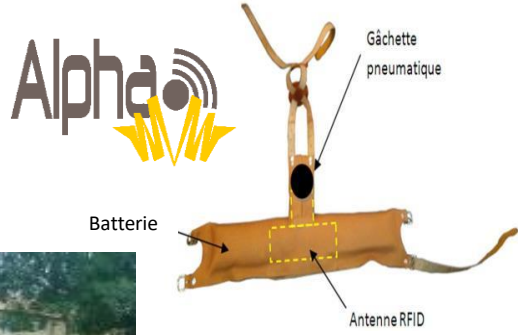
Grøva et al. 2018, NIBIO, Norway

Potential for PLF applications

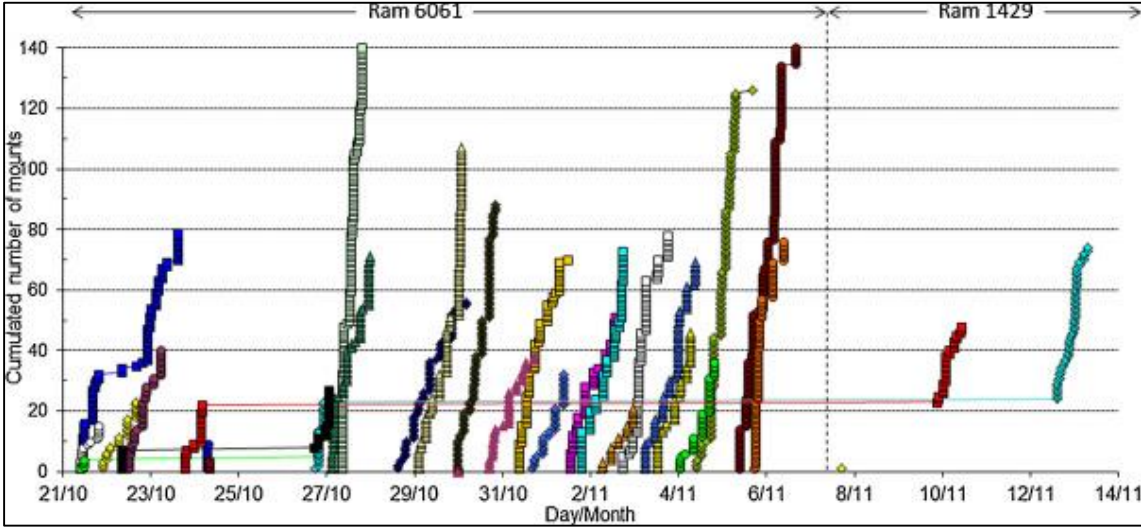
- Feed & water intake, growth
- Grazing behaviour
- Fencing
- Health/disease management
- **Reproduction management**
- Social behaviour



Reproduction management



Alhamada et al. 2016; Bocquier et al. INRA, France



Lambing behaviour

Schmoezl et al. CSIRO, Australia

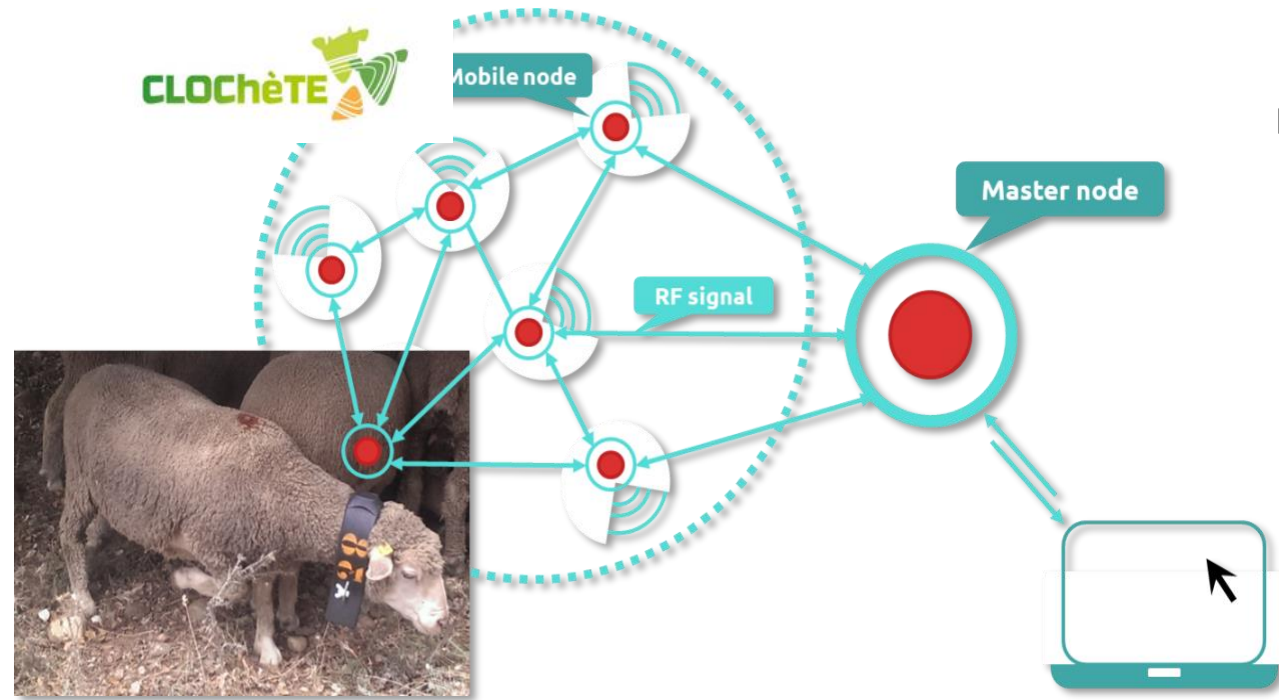


Potential for PLF applications

- Feed & water intake, growth
- Grazing behaviour
- Fencing
- Health/disease management
- Reproduction management
- **Social behaviour**



Social behaviour



Menassol et al. 2018, INRA, France



Pedigree matchmaker

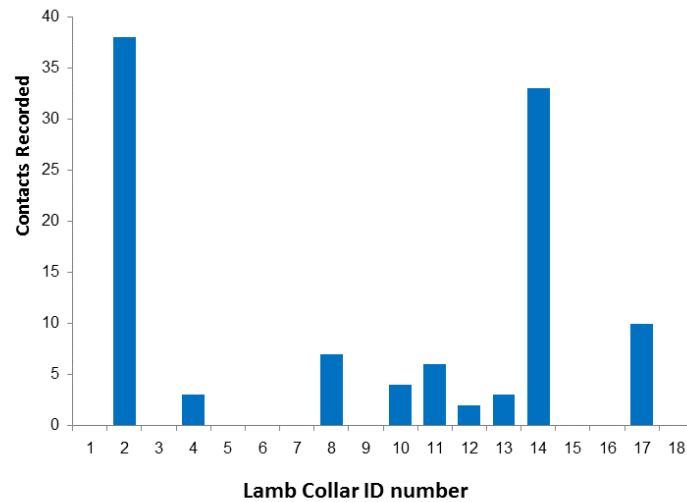
Morris et al. 2012; Kemmis et al. 2016
Sheep CRC, Australia



Pedigree matchmaker – with collars

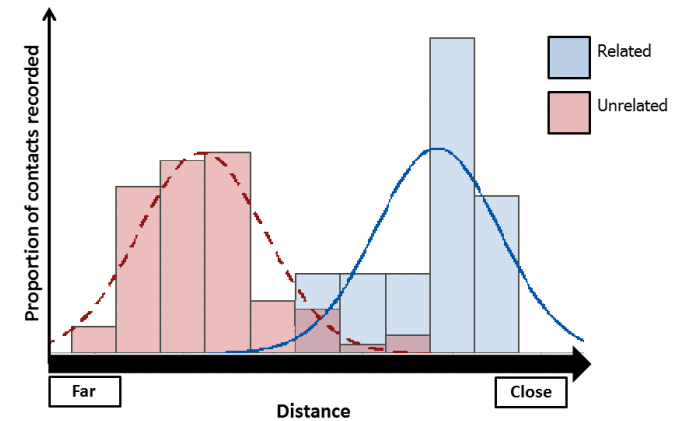
Waterhouse et al., 2019, SRUC, UK

Example – proximity contacts of one ewe with 18 potential offspring



Lamb proximity – RSSI

RSSI – Received signal strength indication



Potential of PLF for small ruminants?

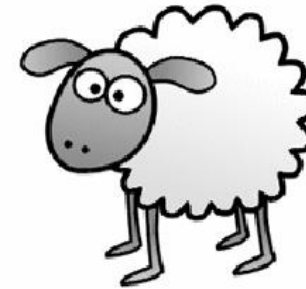
- Range of research/applications exists
- Not exhaustive
- Available on market/research prototype
- Potential for **alert & warning systems**
 - Disease/health
 - Predators
 - Pasture management
 - Animal management



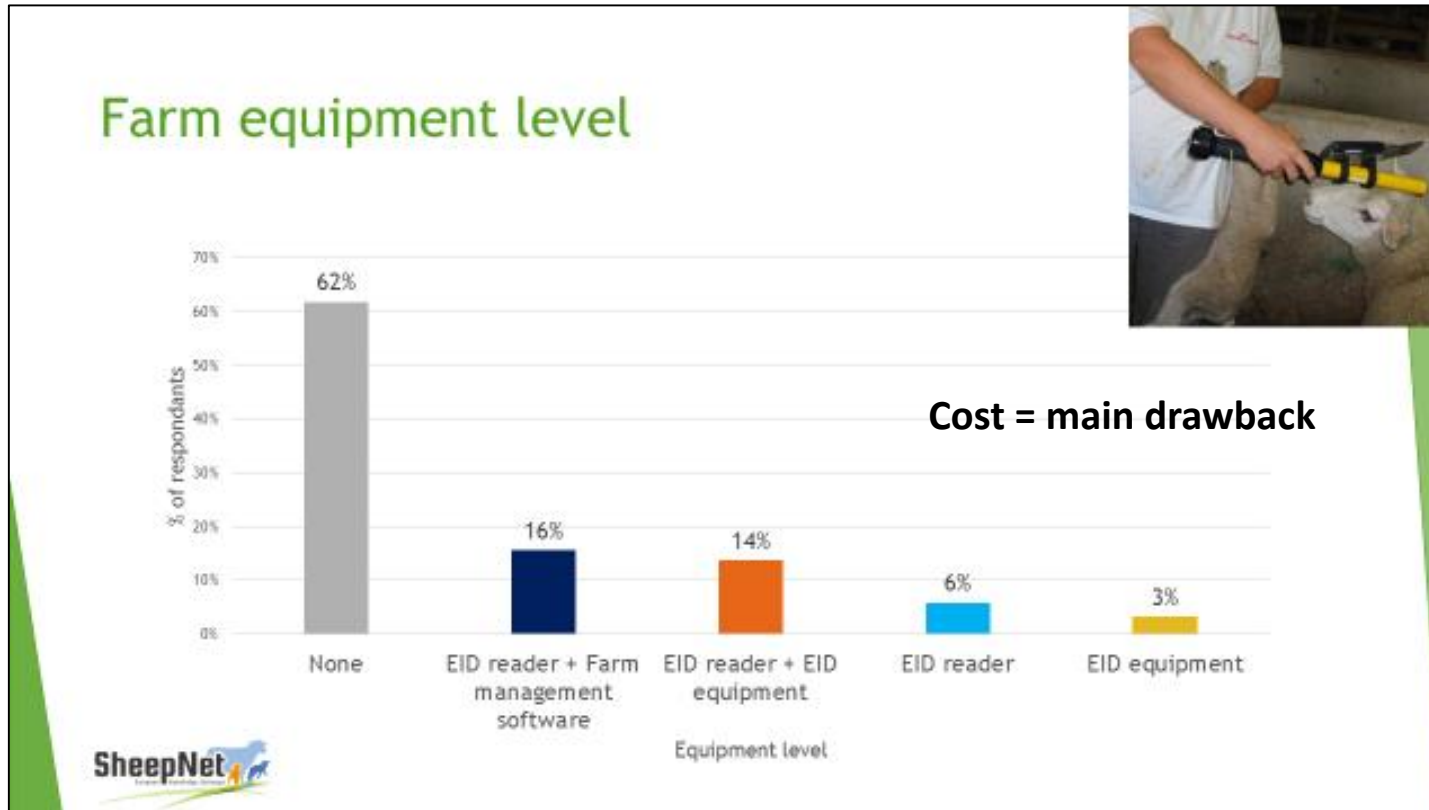
BUT... issues remain that need to be addressed

Issues

- Acceptability (incl. price)
- Affordability for farmers



PLF???



Gautier et al. 2019, SheepNet project

Issues

- Acceptability (incl. price)
- Affordability for farmers
- Funding for research
- Foster collaboration
- Lack of integration
- Data issues
 - Storing/collating
 - Sharing
 - Processing
 - Understanding – warning systems that farmers & technicians can use
- Business models
- SR = model for other species?



PLF???



Conclusions

- There is **potential** for PLF to make a difference in small ruminant systems
- What **needs** to be addressed:
 - Acceptability of technologies
 - Economic relevance/affordability
 - Industry engagement
 - TRL of existing prototypes/technologies (*'cheap and small'*)



Acknowledgments



Agris



NIBIO

NORWEGIAN INSTITUTE OF
BIOECONOMY RESEARCH

UAB

Universitat Autònoma
de Barcelona



EAAP

European Federation of Animal Science



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