TECH CARE

Integrating innovative TECHnologies along the value Chain to improve small ruminant welfARE management

Promising innovations

Walk-over-Weighing – WoW

Eliel González-García (INRAE) *et al.*

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University Foundation - Brussels

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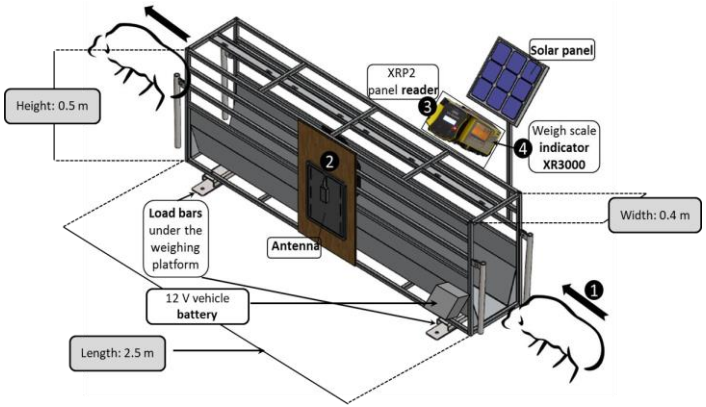
WoW – Walk-over-Weighing –

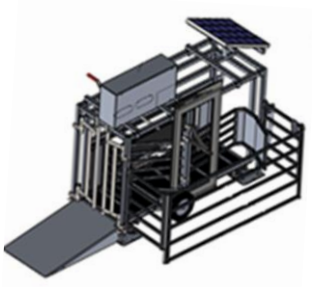
- ✓ Alternative to static scales, **to overcome constraints** for frequent **weighing** the animals (time consuming, labour intensive, stress on both the animals and the operator), and **automatize the process**

Design taking into account:

- ➲ **Energy autonomy** (i.e. equipped with solar panel and a 12 V power vehicle battery),
- ➲ **Light** for easy transportation and mobility and
- ➲ Built with corrosion **resistant materials** (e.g. aluminum frame) to be **resistant to outdoors** conditions



https://www.youtube.com/watch?v=te0mXY3Yum0&t=19s



More than ten trials with the WoW

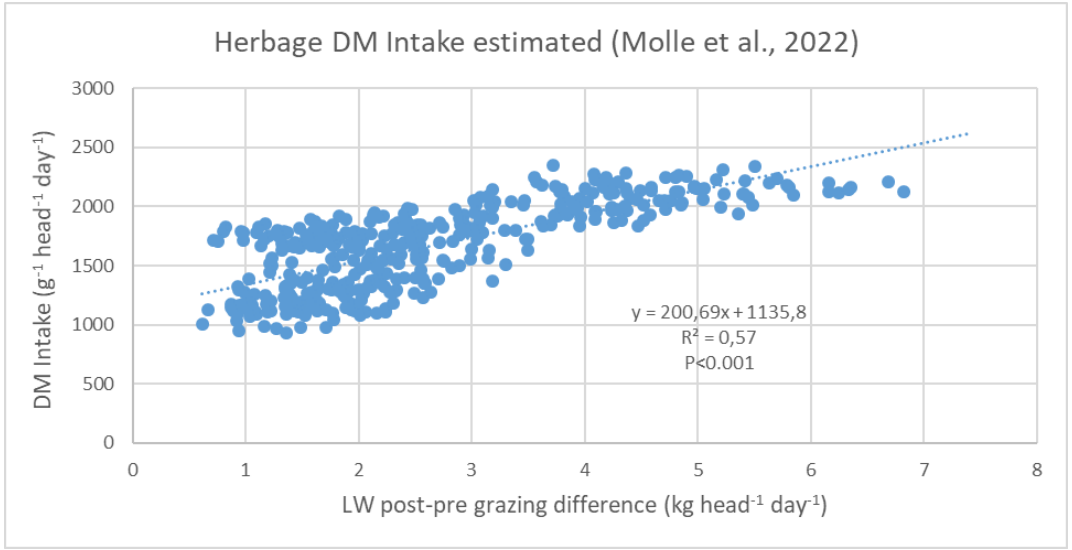
Country	Team	FS conditions	Breed	Animal category (*n*=)	Trial Period	Main objective (addressed AWE issue)
	Agris	Indoor	Sarda	Ewes (36)	2022 (3 d session)	**Precision** and **accuracy** of WoW for **Sarda** sheep. Concordance Correlation Coefficient
		Ind-Out		Ewes (24; two groups 12 each)	7-wk	Responses to **nutritional challenge** (Low vs. High; 70% vs. 140% requirements)
		Outdoor		Ewes (48; two groups 24 each)	2023 & 24 (2 months each) 14/04-> 14/06/2023 26/03->20/05/2024	Early detection of **malnutrition-undernutrition**; changes in LW; different **access time to grassland**. Weighing before and after grazing (**DMIntake assessment**)
	INSTITUT DE L'ELEVAGE idele	Indoor	Ile de France × Romanov	Lambs (weaned); 30, 2 groups of 15 (50%/sex); 26 in 2022	2021 & 2022; 1.5 month	WoW to detect **GIP infection effects** on BW changes
	INRAE science for people, life & earth	Outdoor	Mérinos d'Arles	Ewelambs	Spring 2021 (4 months)	**Growth rate** after weaning at grazing
		Indoor		Fattening lambs	Spring 2022	Decision for **slaughtering**
		Outdoor	Romane	Ewes (full flock)	Three consecutive pregnancies: 2022-23; 2023-24;2024-25	Female **performance during pregnancy**, according to litter size and lamb sex
		All	All	All	Data since 2015 till now	To produce a sound **algorithm for outliers filtering** in raw datasets produced with the WoW: Kfino
		All	All	All	Data since 2015 till now	To construct a **web app to vehicle Kfino** and facilitate adoption and use by end-users: ORIOLE

LW changes and DM intake

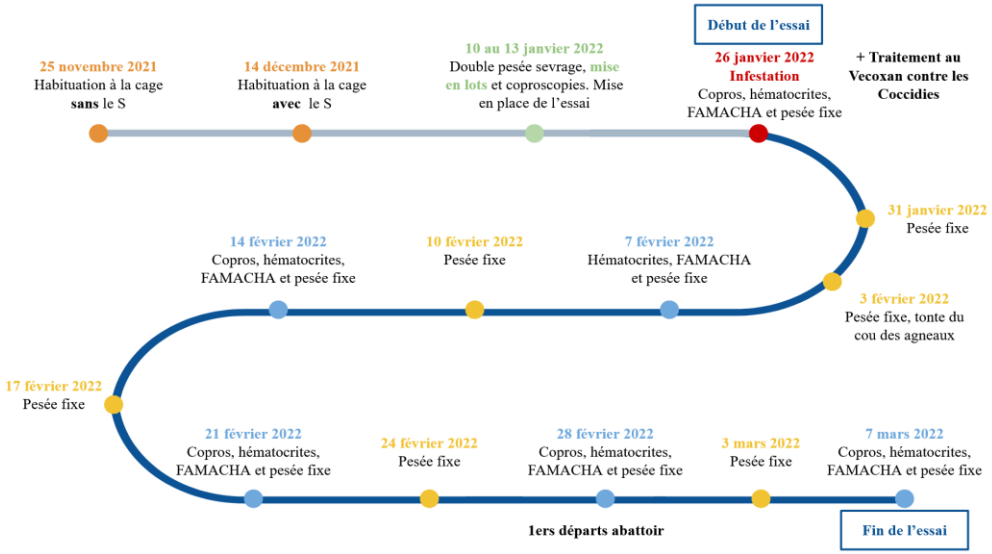
Able to potentially **detect nutrition issues highlighted by LW changes**
Confirmed in grazing condition in late spring 2023 & 2024 with adult lactating Sarda ewes with different **(2 *vs* 6 h) grazing access times (AT)**

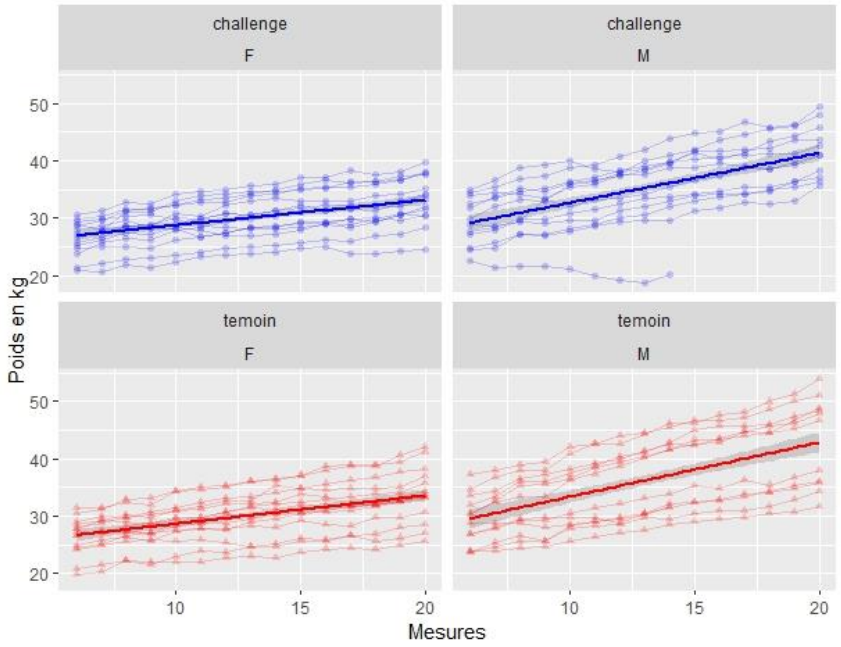
Effect of different AT at pasture on LW measured with WoW before (PRE LW) and after (POST LW) grazing.

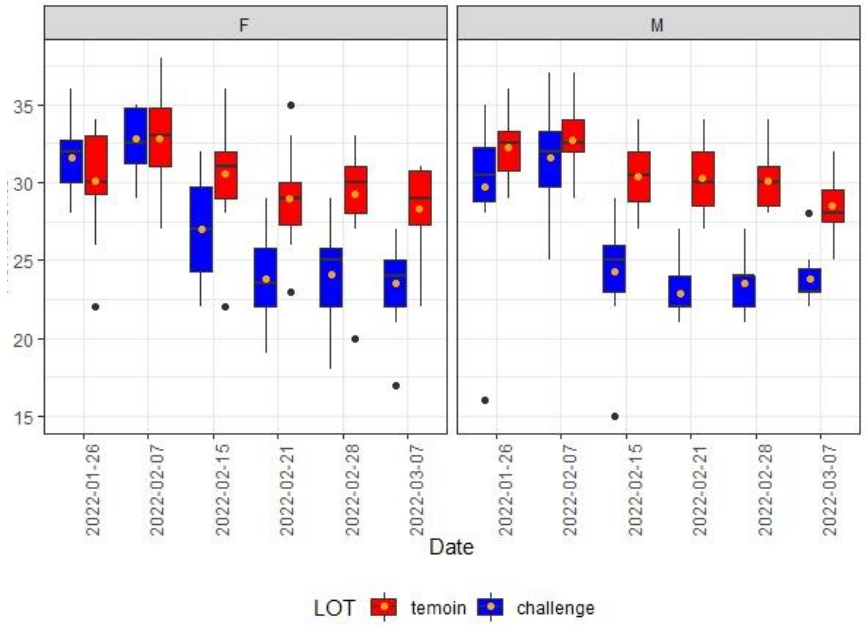
Parameter	AT 6 hrs	AT 2 hrs
PRE LW (kg)	47.8 ± 1.0 a	45.0 ± 1.0 b
POST LW (kg)	50.9 ± 1.0 a	46.8 ± 1.0 b
LW difference (post-pre) (kg)	3.11 ± 0.1 a	1.78 ± 0.1 b



WoW to detect GIP effects on ΔBW

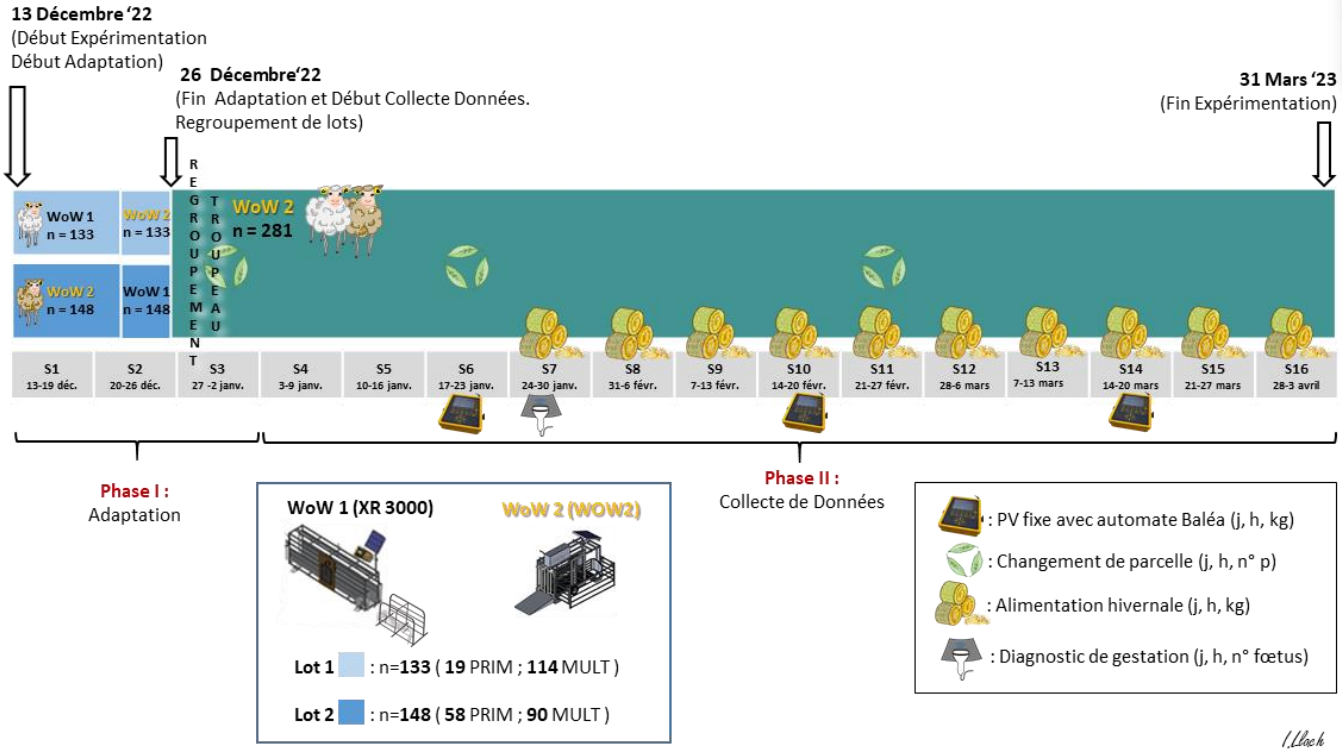


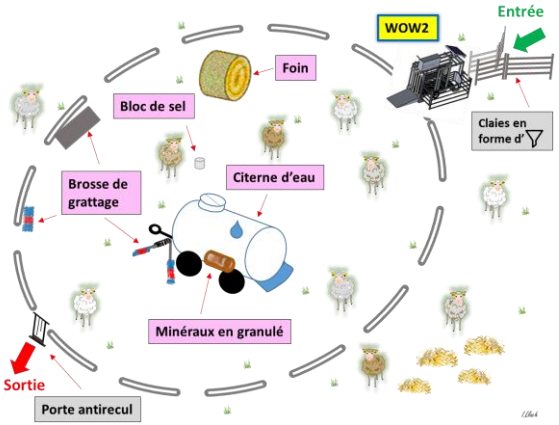




Three consecutive pregnancies outdoor

Three ***F3P*** **full-flock-full-pregnancy trials** (<u>three successive pregnancies</u>; 2022-23; 2023-24 & 2024-25)





An algorithm to filter misbehaviors (Kfino)

- *Mechanistic approach*: the 'normal' expected liveweight path was modelled (with equations)
- Data modelled as slightly noisy (classic) while adding the probability of having fairly outliers (not "simple" sensors errors) (NEW)
- Mathematically,

$$\begin{aligned} X_{t+1} &= a_t X_t + b_t + \epsilon_t \\ Y_{t+1} &= X_t + \epsilon'_t \text{ with proba } p \text{ where } Y_t \sim \mathrm{U}[m, M] \end{aligned}$$

Prediction-> Correction-> Detection-> Removal

Appli repository: https ://forgemia.inra.fr/sk8/sk8-apps/mistea/oriole

Published article **kfino**: Bertrand Cloez, Bénédicte Fontez, Eliel González García, Isabelle Sanchez. Kalman filter with impulse noised outliers : a robust sequential algorithm to filter data with a large number of outliers. *The international journal of biostatistics*, 2024, ⟨10.1515/ijb-2023-0065⟩. ⟨hal-04563781⟩

Article Under review: E. González-García, Sanchez, I., Decandia, M., Giovanetti, V., Llach, I., Cloez, B. 2025. Validating Kfino (Kalman Filter with Impulse Noised Outliers) algorithm for the automatic filtering of individual liveweight outliers from raw datasets produced by the Walk-over-Weighing (WoW) technology in a spectrum of ruminants' systems.

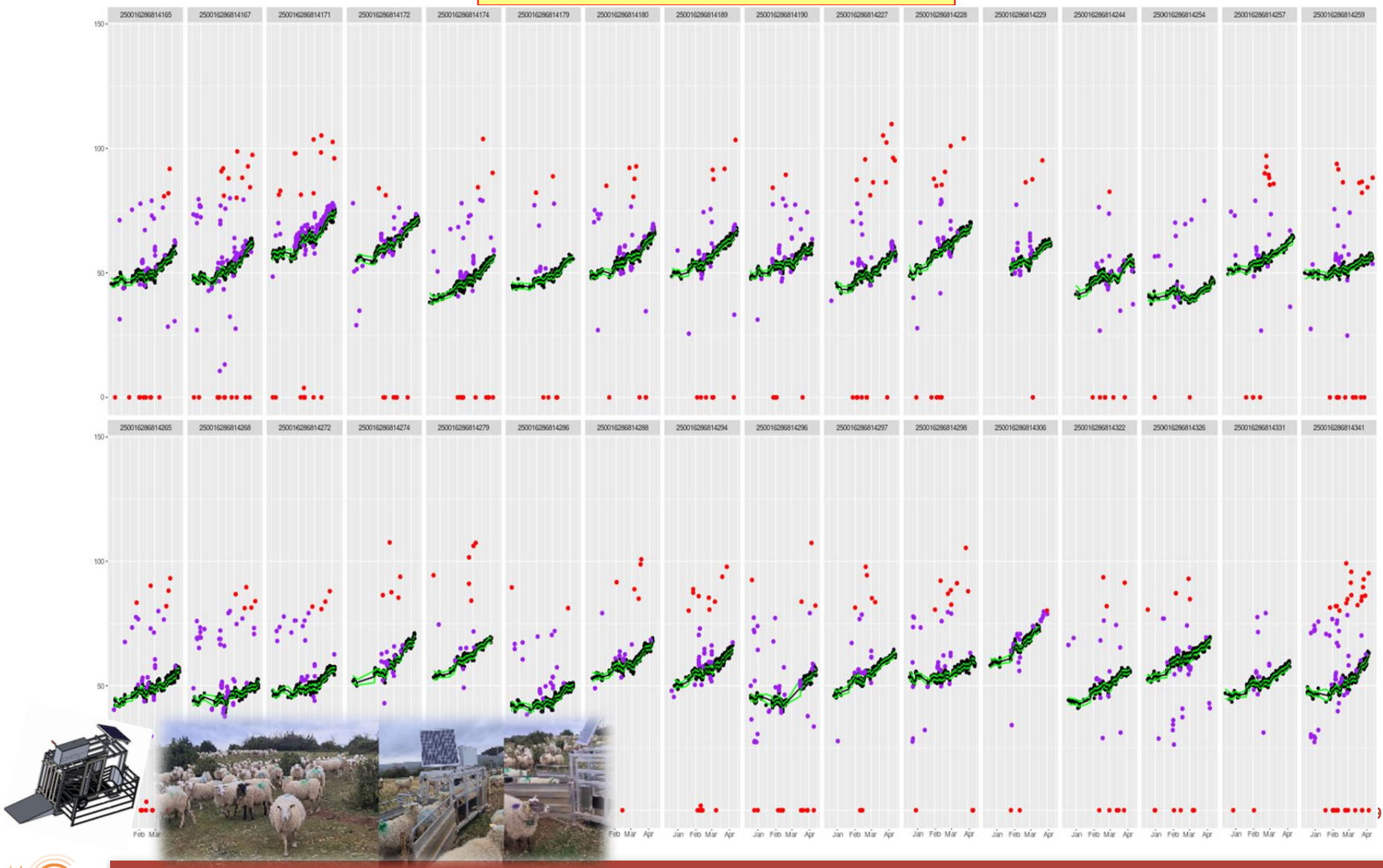
Package R **kfino**: Kalman Filter with Impulsed Noised Outliers: https://CRAN.R-project.org/package=kfino

An end-user friendly web app

Finalized R-Shiny (Automatic filtering outliers from raw database): **ORIOLE**: a web application for the automatic filtering of outliers was built and is online (https://oriole.sk8.inrae.fr/)

With ORIOLE

EWS are now possible



Conclusions

- ✓ **WoW** is a sound **alternative to static scales**, saving time, energy and stress to animals and operators AND -> Providing a huge amount of valuable **daily-individual BW information**
- ✓ Adaptable to **growing and adult animals**, from different breeds
- ✓ **Preferable** designed for **outdoor** conditions
- ✓ Due to important **volumes of outliers** (real-life), a sound **algorithm** for the automatic **filtering of misbehaviors** is required (**Kfino**)
- ✓ As a vehicle of Kfino, end-users **friendly applications** are **helpful** to facilitate WoW tech to be accepted, used in a daily routine; and for the easy of datasets processing and interpretation (**ORIOLE**)
- ✓ Multitude of **research questions** and animal **welfare issues** may be **addressed**, e.g.:
  - ✓ Factors affecting Individual daily growth rates
  - ✓ Assessing DM herbage intake in defined daily grazing time spots
  - ✓ Impacts of parasitism on BW changes
  - ✓ Presence/ absence in the flock (e.g., to address predation)
  - ✓ Full pregnancy females performances
  - ✓ EWS constructions are on-going

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Thank you for your attention!

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WoW for **automatic** daily individual **weighing** of **sheep**