EAAP – Session n°39. Tuesday 29th August 2023

Monitoring water trough attendance in shed: a potential indicator for the detection of sheep health or welfare issues?

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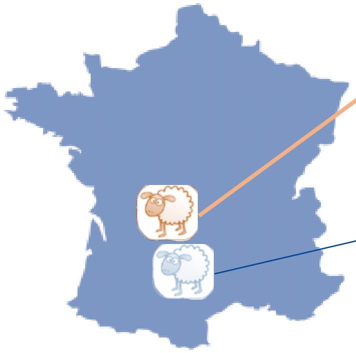
Objectives of the study

- **Test technologies** to:
  - Track individual sheep attendance close to a water trough
  - Monitor water drinking behaviour
- **Identify indicators** that could potentially help in the early detection of sheep welfare and health issues in the shed.

- 3 trials carried out in 2 pilots farms in France:



- Le Mourier (CIIRPO) – meat sheep
  - Trial 1 : 91 lambs (2022)
  - Trial 2 : 60 lambs (2023)
- La Cazotte – dairy sheep
  - Trial 3 : 40 lactating ewes (2022)
  - Trial 3 : 40 lactating ewes (2023)

Focus on our 1st model presented today

Pilot farm experimental set-up

- Animals: **91 fattening lambs**
- Trial period: **48 days** (June 14th to July 31th 2022)

- **3 sensors** with automatic data collection
- **Protocol:** welfare assessment measures + weighing + BCS (6 times during trial period)

Data & methods

Raw data from RFID UHF antennas

- 1 line = 1 animal detected by 1 antenna per second (1 « detection »)
- Total : 4 021 351 lines

Date	Time	Animal ID	Antenna n°	Signal strength (RSSI)
2022-07-05	01:14:03	1912	1	-58
2022-07-05	01:14:05	1912	1	-55
2022-07-05	01:14:38	1912	1	-59
2022-07-05	01:19:00	1912	1	-60
2022-07-05	01:20:10	1912	1	-67

RFID UHF data : from detection to sequence

- Group « detections » corresponding to the same action : **a « sequence » of attendance**
- If the gap between 2 detections (lines) is **> 120 sec**. : creation of a new sequence

Date	Time	Animal	Antenna	Signal strength (RSSI)
2022-07-05	01:14:03	1912	1	-58
2022-07-05	01:14:05	1912	1	-55
2022-07-05	**01:14:38**	1912	1	-59
2022-07-05	**01:19:00**	1912	1	-60
2022-07-05	01:20:10	1912	1	-67

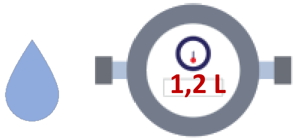
Diff. = 4min22sec.

→ 2 sequences of attendance

- Calculation of several statistical indictors to summarize the **RSSI signal** during the sequence (min., max., med., Q1 ...)

Date	Animal	Start	End	Duration (sec)	Antenna	Min RSSI	Mean RSSI	Max, Median, Q1…
2022-07-05	1912	01:14:03	01:14:38	35	1	-59	-57.3	…
2022-07-05	1912	01:19:00	01:20:10	70	1	-67	-63.5	…

Water meter data



- Cumulative data of water consumption every minute

Video data

- Golden standard for monitoring lamb behaviour around the water trough

Welfare and health data

- **2** of the 91 animals had a serious health event:

  - N°1927 : **severe arthritis** from June 20th (euthanasia on June 29th)
  - N°1924 : **anal prolapse** detected from July 4th (euthanasia on July 11th)

Calculation of indicators

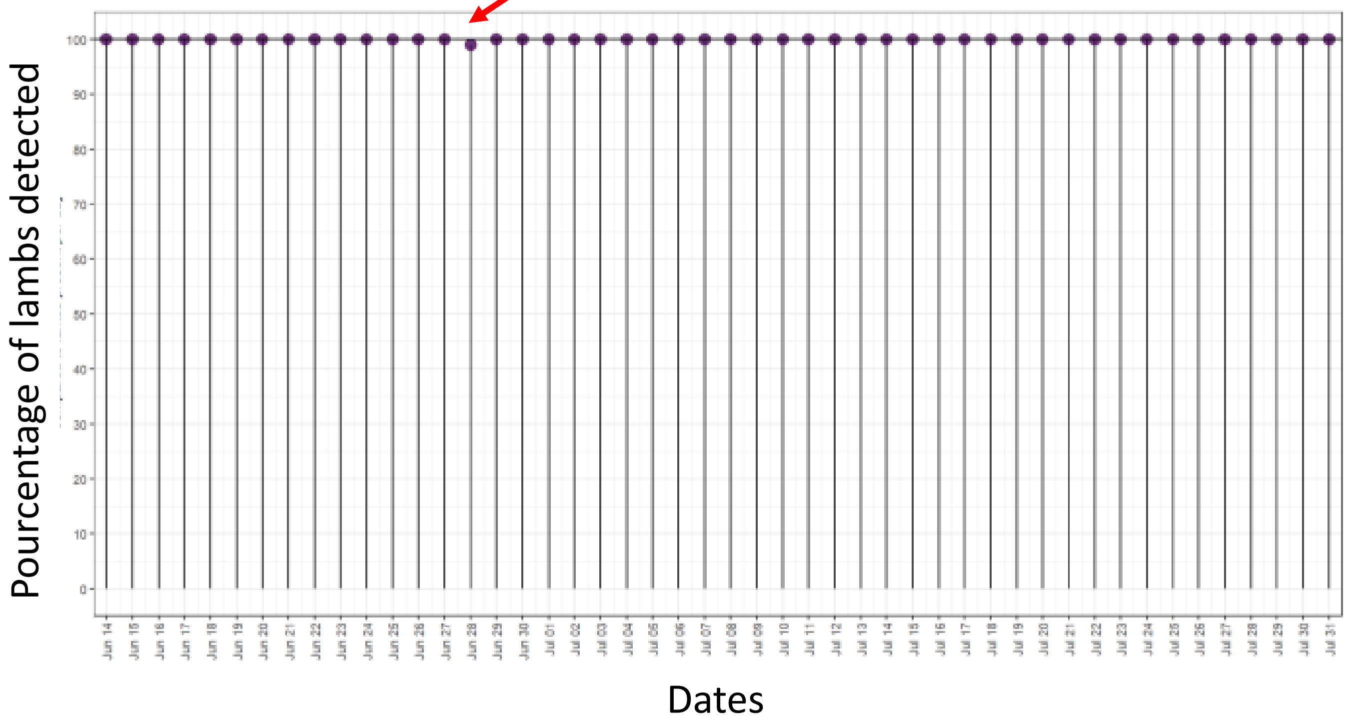
Indicator	Name	Data & Sensors	Filter
1	**« Detection »**	UHF	All the data
1 bis	**« Visit »**	UHF + video	**Duration** of sequences > 8 sec
2	**« Close visit »**	UHF (RSSI) + video	« Visit » + **Classification model (xgboost)** to distinguish close animal from a far one
3	**« Close visit & drinking »**	UHF (RSSI) + video + water meter	« Close visit » + **water consumption** **« drink »** **« potentielly drink »**

Results

First indicator : « Detection »

- Are all animals ID detected around the water trough area every day?

1 animal missing (n°1927) on June 28th



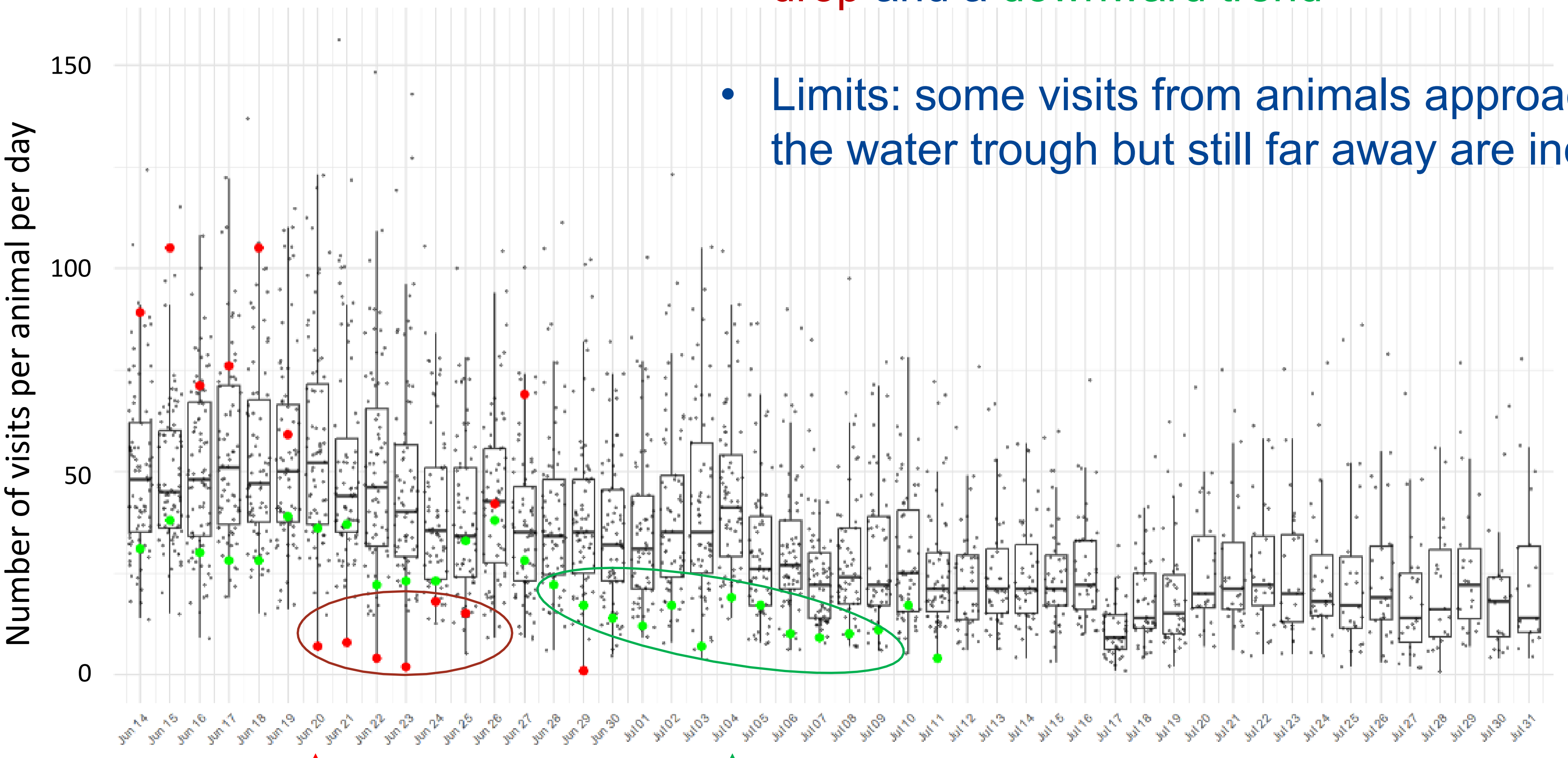
- Advantages: overview of detections and correct operation of the system. Identify “missing”.
- Limits: Not precise on the duration. Animals not necessarily very close to the water trough.

First indicator bis : « Visit »

Red points : N°1927 / arthritis
Green points : N°1924 / prolapse

- Avantages : filter sufficient to see a clear-cut drop and a downward trend

- Limits: some visits from animals approaching the water trough but still far away are included

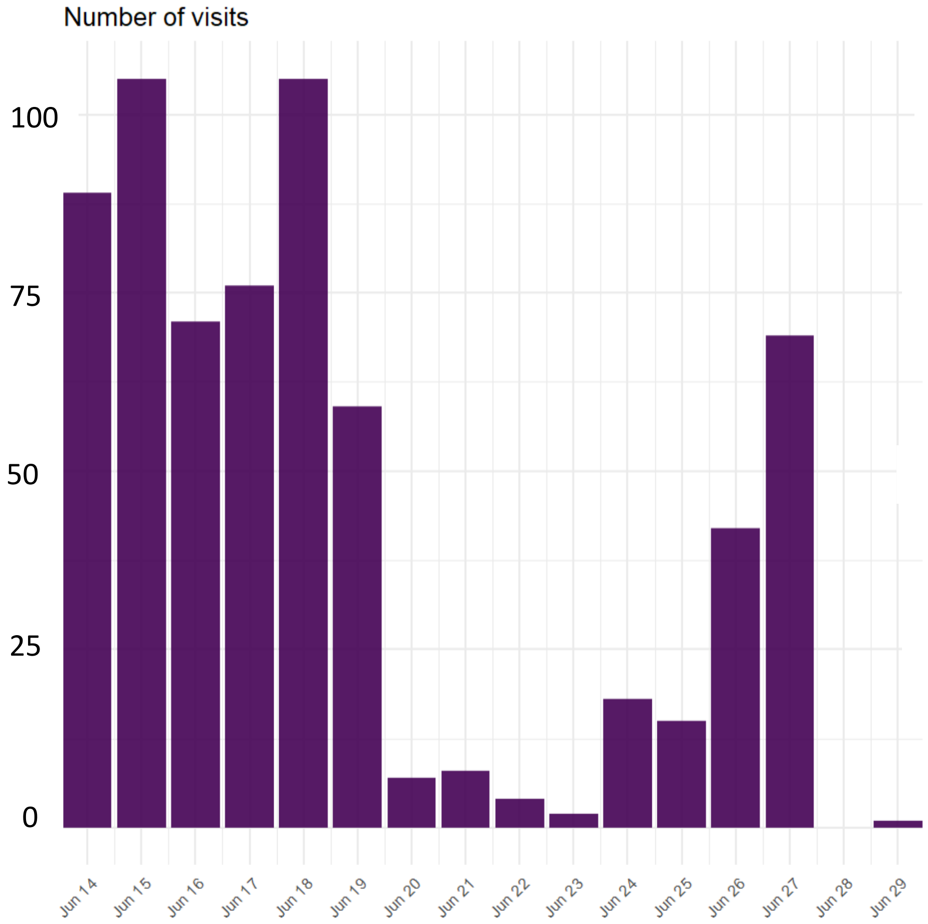


Arthritis reported on June 20

Prolapse reported on July 04

Indicator « Visit » vs. Indicator « close visit »

e.g.: focus on animal 1927 (arthritis)

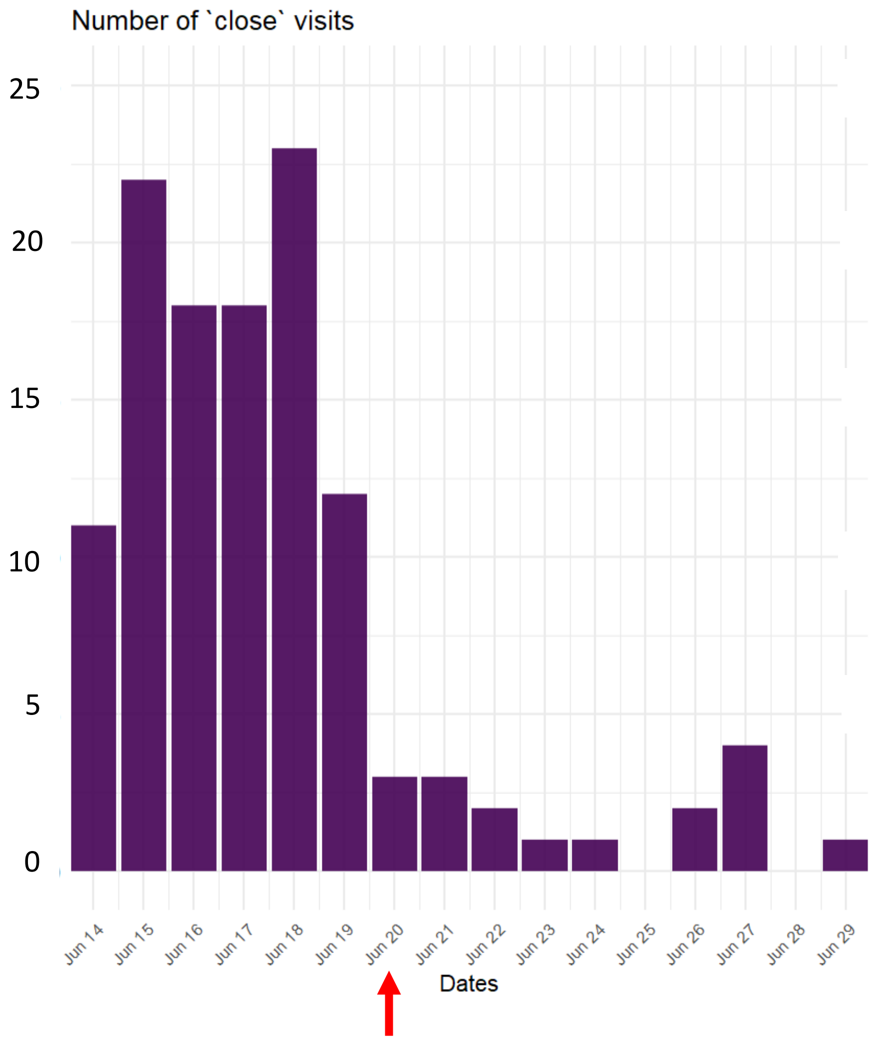


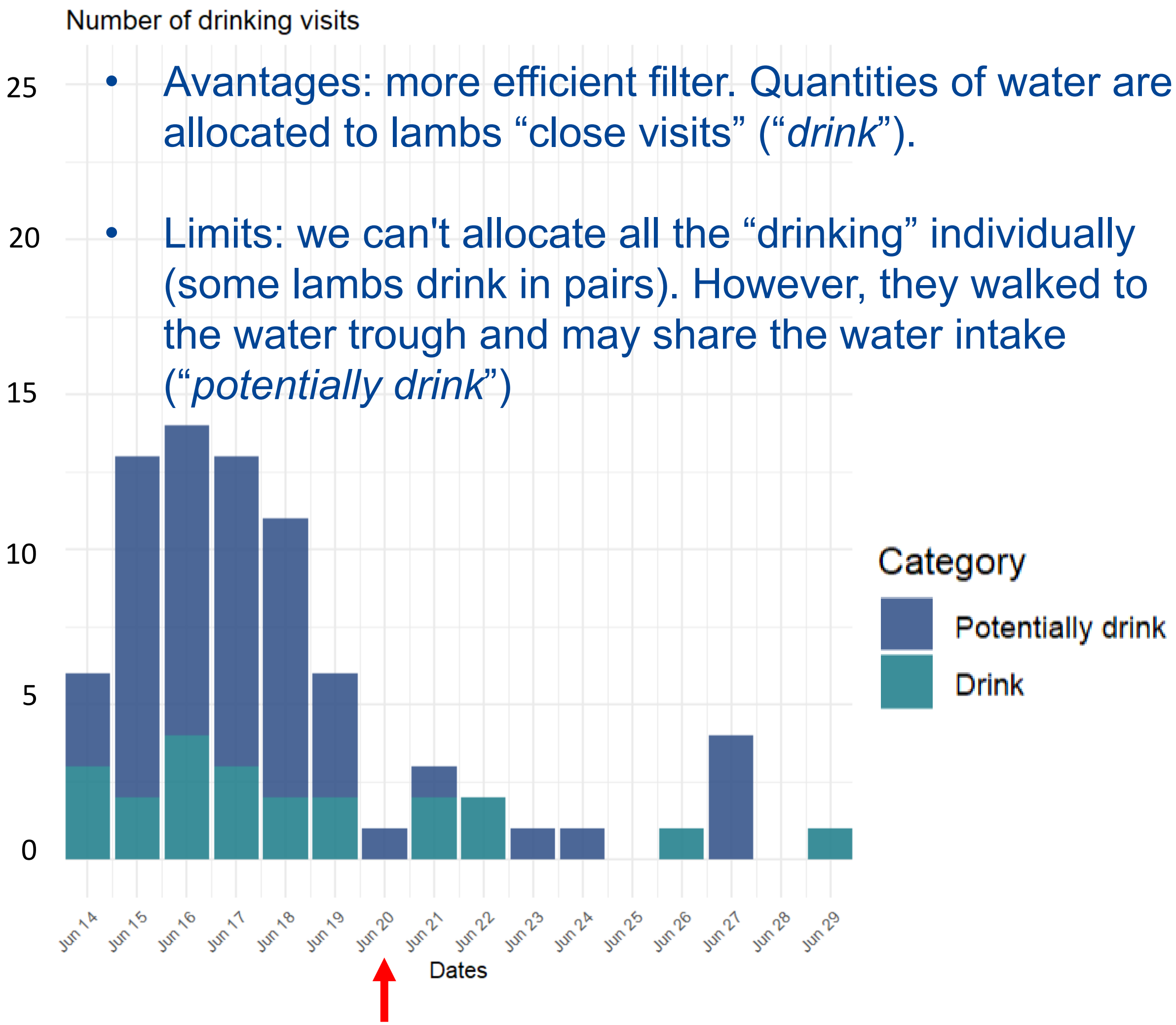
Arthritis reported on June 20

- Avantages: with the RSSI parameter it's possible to distinguish visits very close to the water trough from those further away
- Limits: some visits do not include water consumption

Indicator « close visit » vs. Indicator « close visit & drinking »

e.g.: focus on animal 1927 (arthritis)





- Avantages: more efficient filter. Quantities of water are allocated to lambs "close visits" ("*drink*").

- Limits: we can't allocate all the "drinking" individually (some lambs drink in pairs). However, they walked to the water trough and may share the water intake ("*potentially drink*")

Conclusion

Promising results to :

- **Track sheep attendance next to a water trough with 3 potential indicators**:

« detection » « visit » « close visit »

- **Monitor drinking behavior with 1 potential indicator**:

« close visit & drinking »

- **Detect variations linked to health/welfare issues ?**
  - Only 2 case studies in this 1st batch of lambs, but some interesting trends

Perspectives:

- Include **more data** with sick animals (trial 2023 : 18 health-welfare issues / 60 lambs)
- Tag **more videos** to **robustify the RSSI model** (« close/far »)
- Study “**how early**” this individual detection is in comparison with observations by farm staff.
- Test and adapt the model to a **different type of animal** (lactating ewes)

Thank you for your attention

And a special thanks to all the colleagues who took part in this fisrt study, in particular those working on the pilot farm « Le Mourier – CIIRPO ».

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

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Annexe

Second indicator : Visiting water trough vs stationary behavior around the area

- **Goal** : distinguish animals which visit the water trough compared to animal which stay away from it
- Sample of the study period due to behvaourial observation (8h)
  - Tagged « close » or « far »
- RSSI

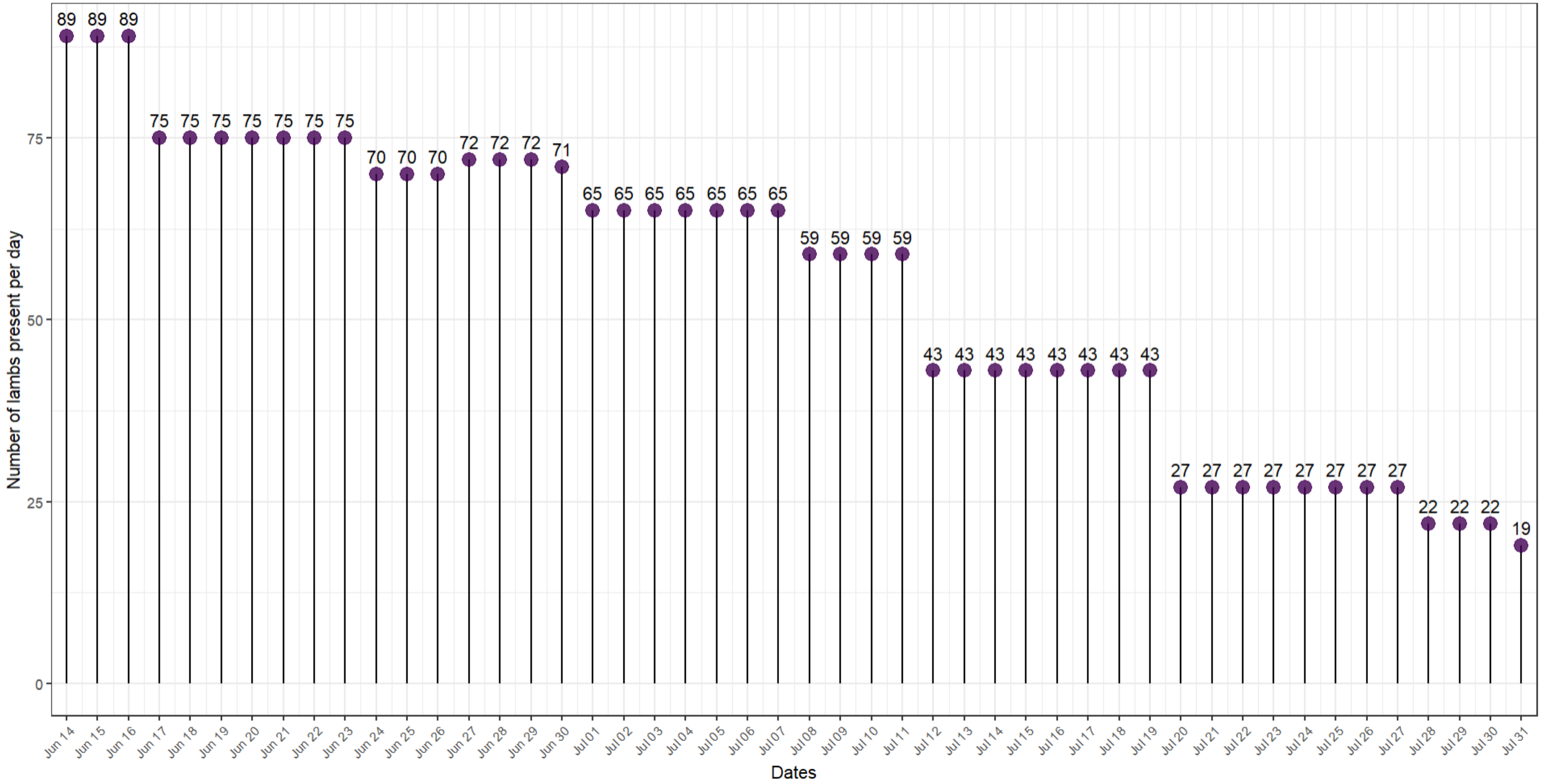
Sequence	Animal	Max RSSI	Mean RSSI	RSSI…	Class
1	1912	-59	-57.3	…	**CLOSE**
2	1928	-67	-63.5	…	**FAR**

Second indicator : Visiting water trough vs stationary behavior around the area

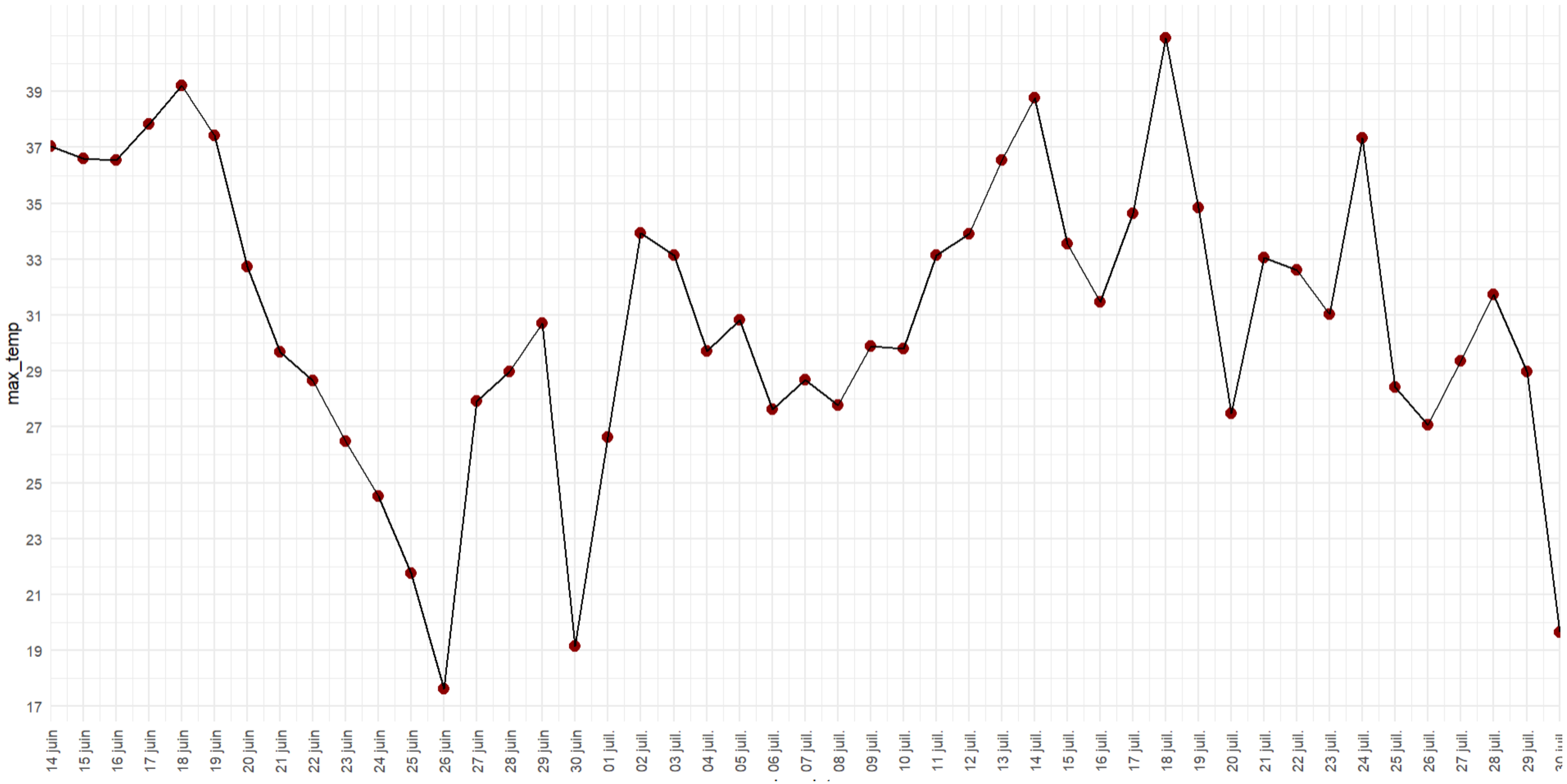
- Classification model (xgboost)
- Nb variables : 10
- Nb class:
    - Close = **91**
    - Far = **30**

- Metric test data: Accuracy = 0.93

Sequence	Animal	Max RSSI	Mean RSSI	RSSI…	Class
1	1912	-59	-57.3	…	**CLOSE**
2	1928	-67	-63.5	…	**FAR**
1	1928	-57	-58.3	…	**CLOSE**


Number of lambs present per day
Dates
0
25
50
75
89 89 89 75 75 75 75 75 75 75 70 70 70 72 72 72 71 65 65 65 65 65 65 65 59 59 59 59 43 43 43 43 43 43 43 43 27 27 27 27 27 27 27 27 22 22 22 19
Jun 14 Jun 15 Jun 16 Jun 17 Jun 18 Jun 19 Jun 20 Jun 21 Jun 22 Jun 23 Jun 24 Jun 25 Jun 26 Jun 27 Jun 28 Jun 29 Jun 30 Jul 01 Jul 02 Jul 03 Jul 04 Jul 05 Jul 06 Jul 07 Jul 08 Jul 09 Jul 10 Jul 11 Jul 12 Jul 13 Jul 14 Jul 15 Jul 16 Jul 17 Jul 18 Jul 19 Jul 20 Jul 21 Jul 22 Jul 23 Jul 24 Jul 25 Jul 26 Jul 27 Jul 28 Jul 29 Jul 30 Jul 31

Temperature (Max) per day



Indicator 1 bis vs Indicator 2

1924 : prolapsus le 4/07