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Monitoring of nest use through RFID tracking in cage-free laying hens

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TESAF

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Università di Padova

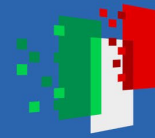
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Use of PLF tools in cage-free hens

Tracking hen activity and location in modern, multi-tiered commercial aviary systems is **challenging**

Among wearable devices, **RFID systems seem promising for tracking hen movement:**

- 1** Low cost (big numbers)
- 2** Low invasiveness
- 3** Low computational capacity

Previous studies:

Hen passing through pop holes and entering individual nest boxes (see *Siegford et al., 2016 for a review*)



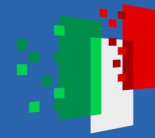
Nests



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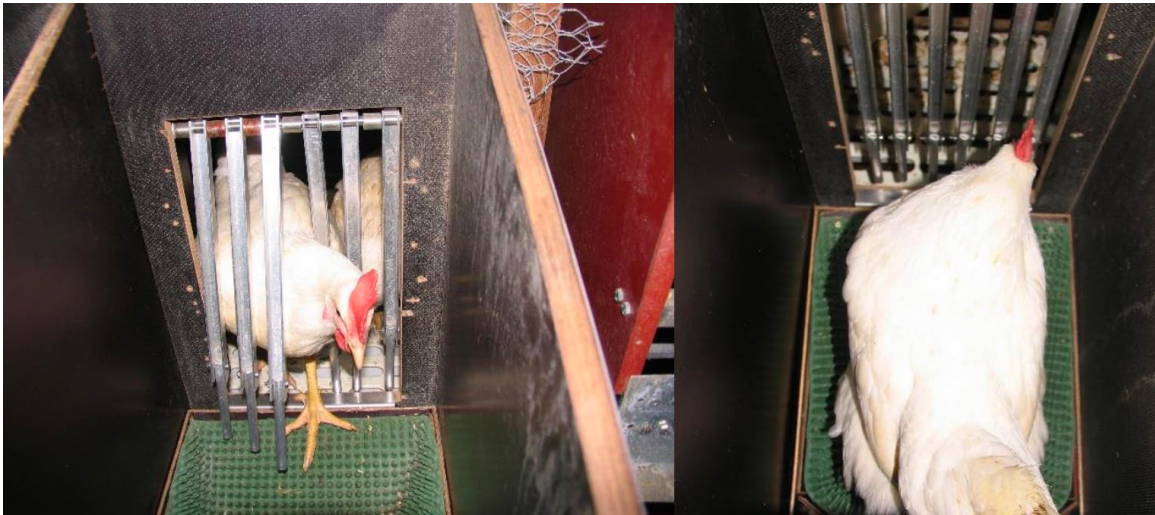
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Use of RFID technology to monitor nesting behaviour

Nesting behaviour in **individual nests**
using funnel nest boxes (Chien et al., 2018; Li et al., 2017)



From Siegford et al., 2016

Promising results in detecting
individual nest occupation
(funnel nest boxes)

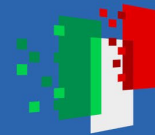
Nesting behaviour in **group nests**
under field/commercial-like designs?



**Challenging,
but needed**

(crowding and smothering,
aggressions, specific
behaviours, time preferences)





Objectives

To evaluate group **nest use** in brown hens housed in an aviary system:

1

Nest use (n. of hens in the nest and duration of nest visits) and **hen behaviours** inside the nests and the effects of:

- week of age (21 and 28 weeks)
- time slots after nest openings (0-2h, 2-4h, 4-6h, and 6-8h)

Video



2

To test the **performance of a RFID system** in detecting the number of hens inside the nest



RFID vs.
Video

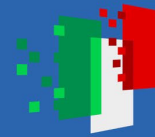




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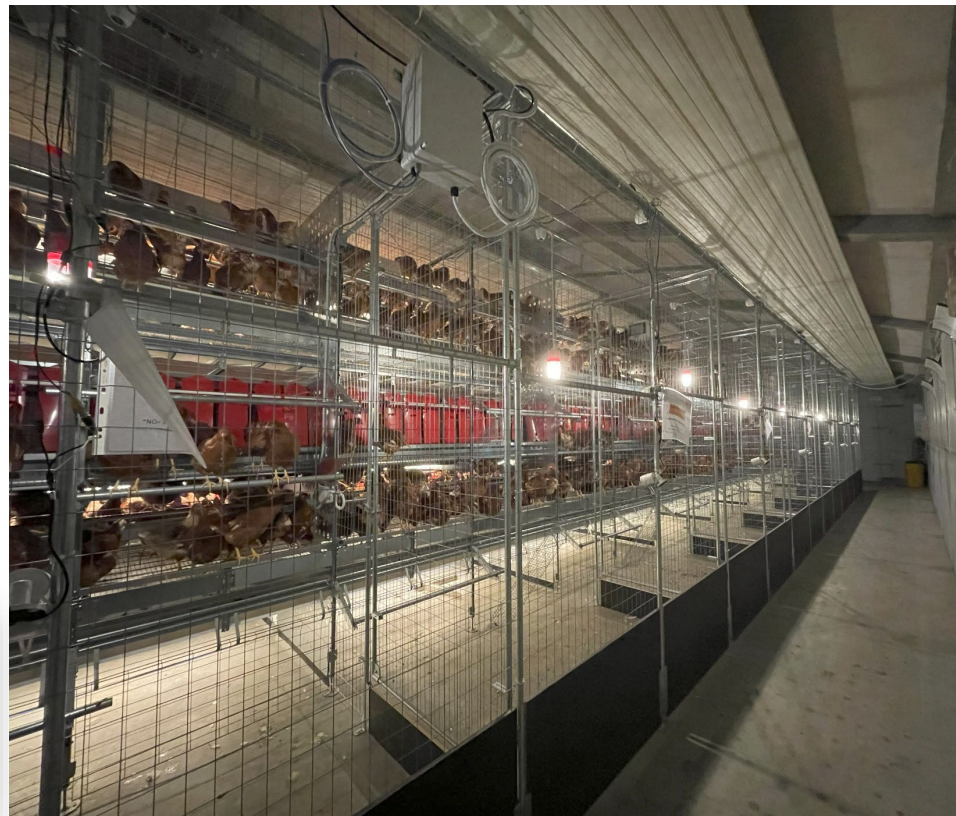


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Experimental trial and aviary

Aviary at the Experimental Farm of the University of Padova (Italy)

- 1800 Hy-Line Brown housed at 17 weeks of age
- 8 pens (225 hens/pen)
- **2 nests (1 pen) used for RFID tracking and video recordings**

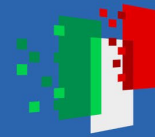




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Video cameras: Recordings of hen entries/exits and behaviour inside the nests

1

Nest occupation

- Number of animals
(to be compared with signals
recorded by the RFID system)
- Duration of nest visits

2

Hen behaviour inside the nest

- Movement (inside the nest
and beak use to explore the nest)
- Preening
- Static behaviour
(pre-laying)



2 Infrared cameras (one per nest): 4 MP mini-dome
with a fixed 3.6 mm lens, 1080p resolution;
Zhejiang Dahua Technology Co., Ltd.; Hangzhou, China)

Video analysis: 10 minutes/hour scanning protocol
(Ciarelli et al., 2023)

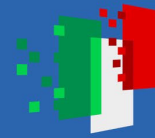




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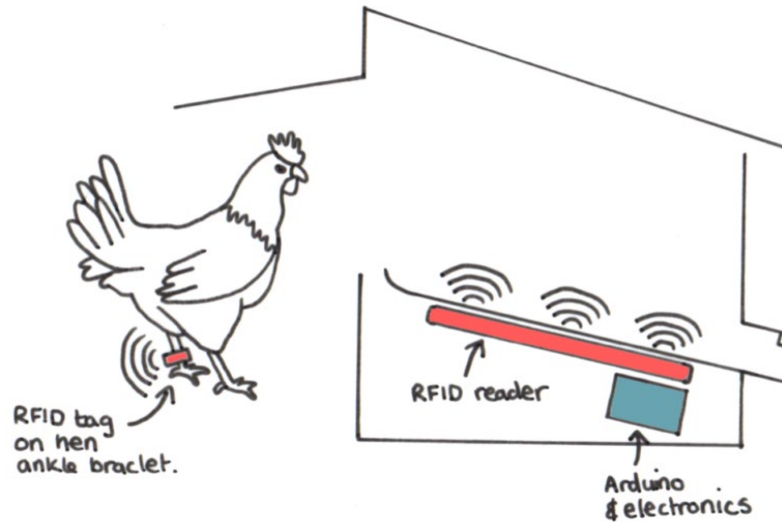


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RFID system

Reader RAIN RFID IDN EL1400

4 antennas (2 per nest) EXT, +30dBm, GPIO: 2 inputs, 2 outputs,
PoE, IP40 (IDNOVA system, Montespertoli, Italy)



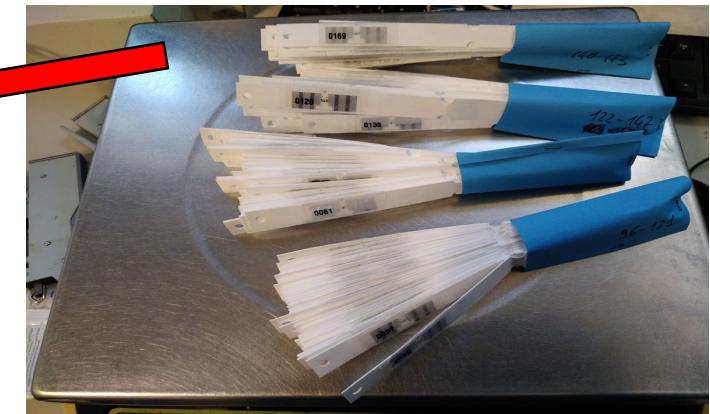
Recordings: hen entries (IN) and exits (OUT)

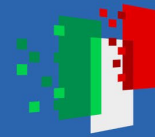
All hens (225 hens) of the first pen were tagged

Powered antennae/reading units

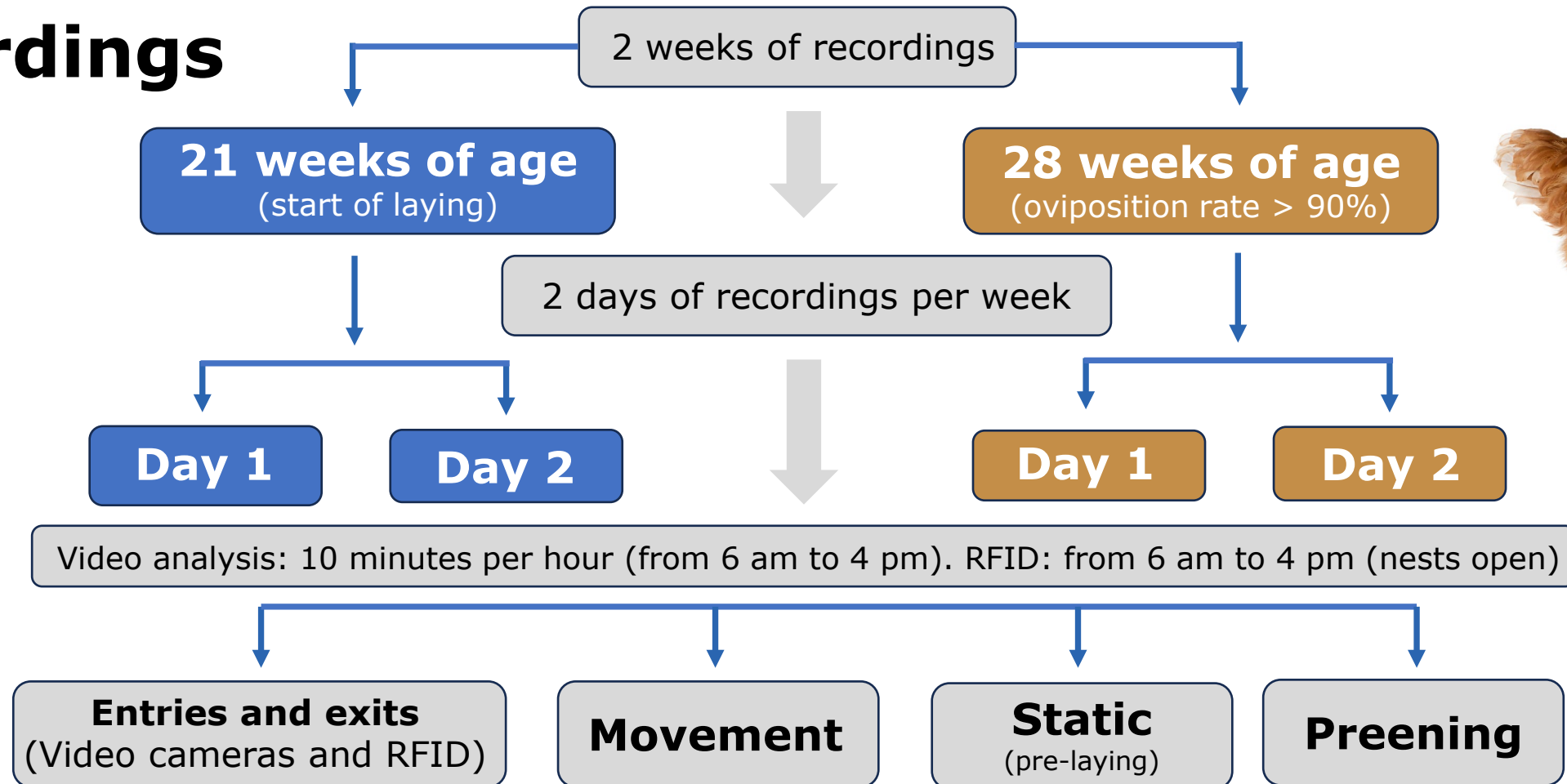


Tags





Recordings

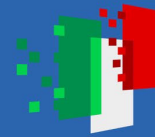




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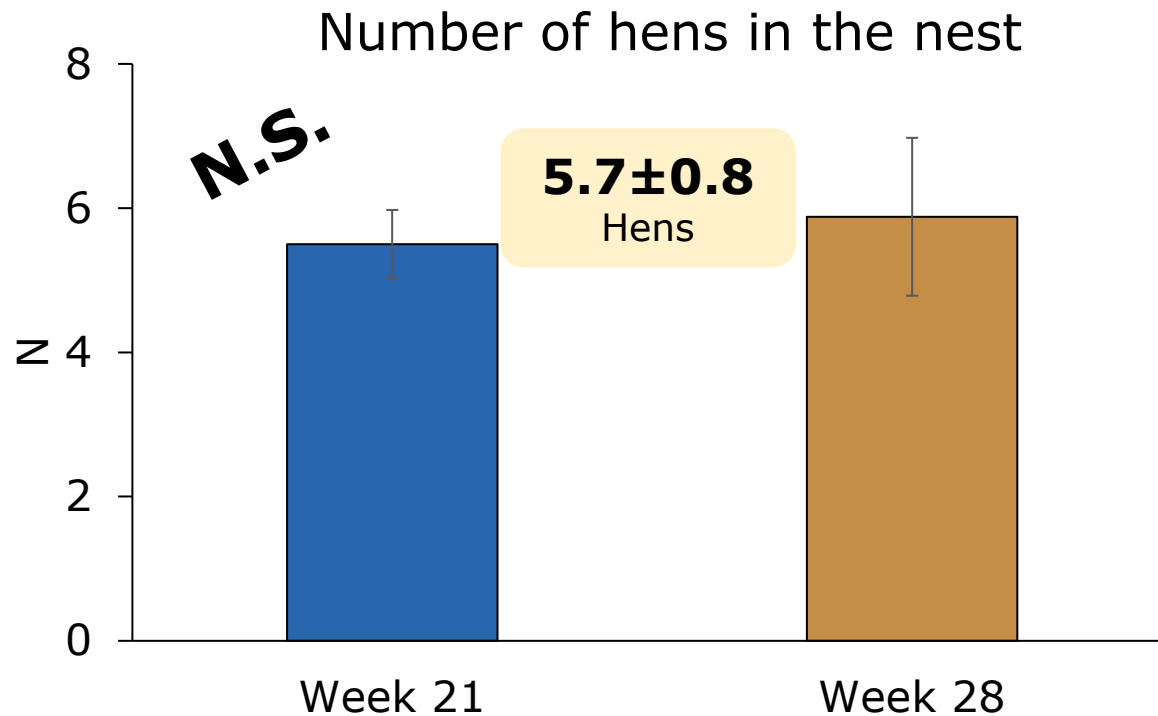
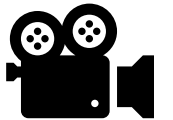


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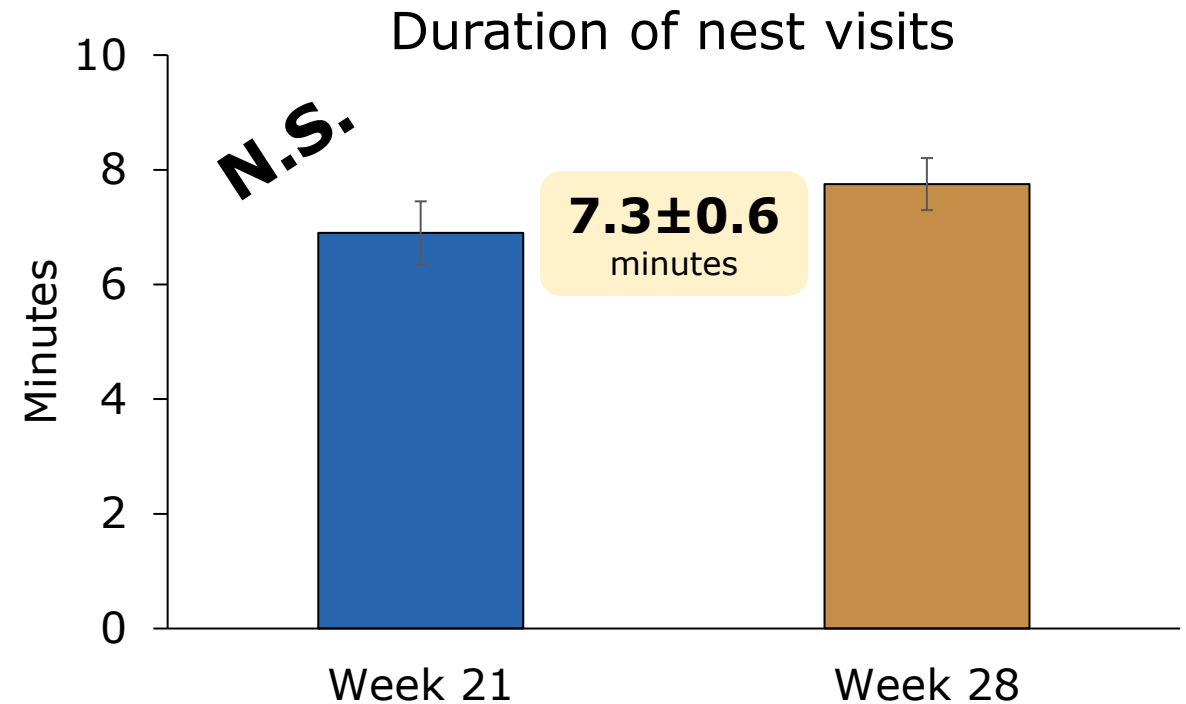


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Effect of the week of age on nest use



≈11 hens/m² of nest



From 4 to 13 minutes

(Turner et al., 2006; Ringgenberg et al. 2014;
Giersberg et al., 2019)

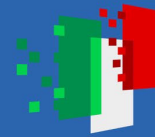
Data are expressed as LS means ± SEM - Generalized linear mixed model with week and time-slot as fixed effects and nest as random effect



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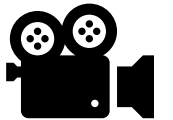


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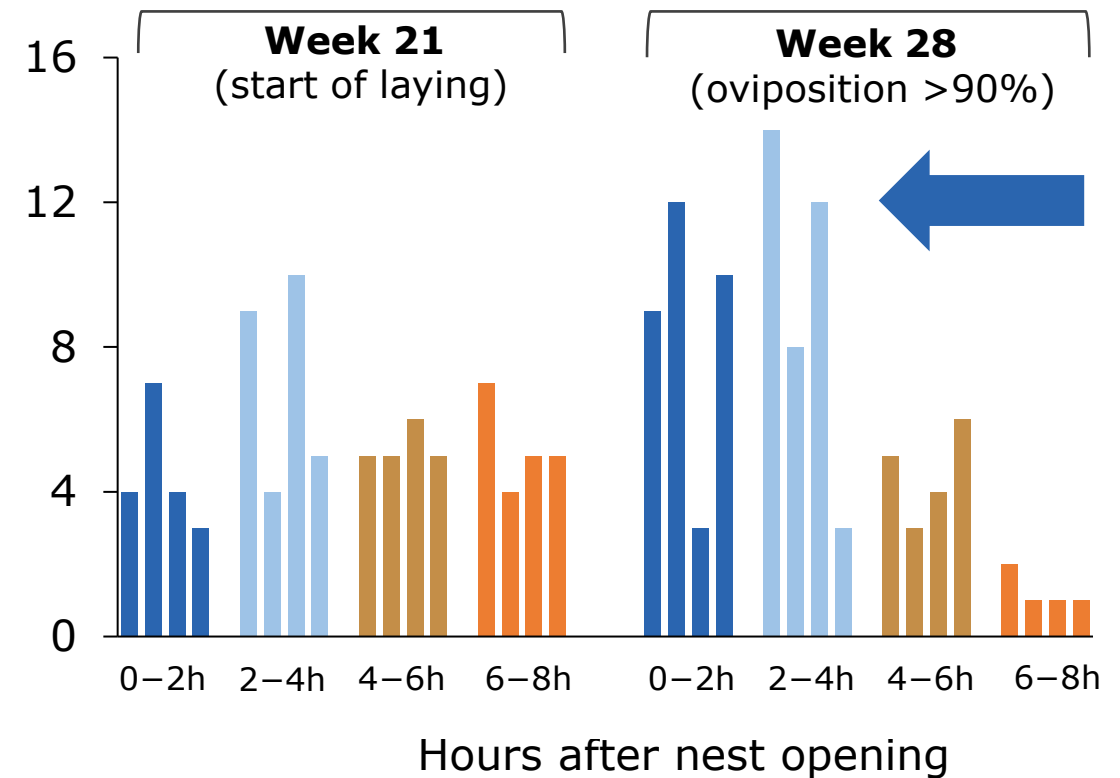
Effect of the time slot after nest opening on nest use



Number of hens in the nest



Number of hens in the nest



Hours after nest opening

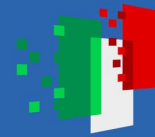
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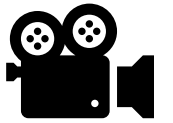


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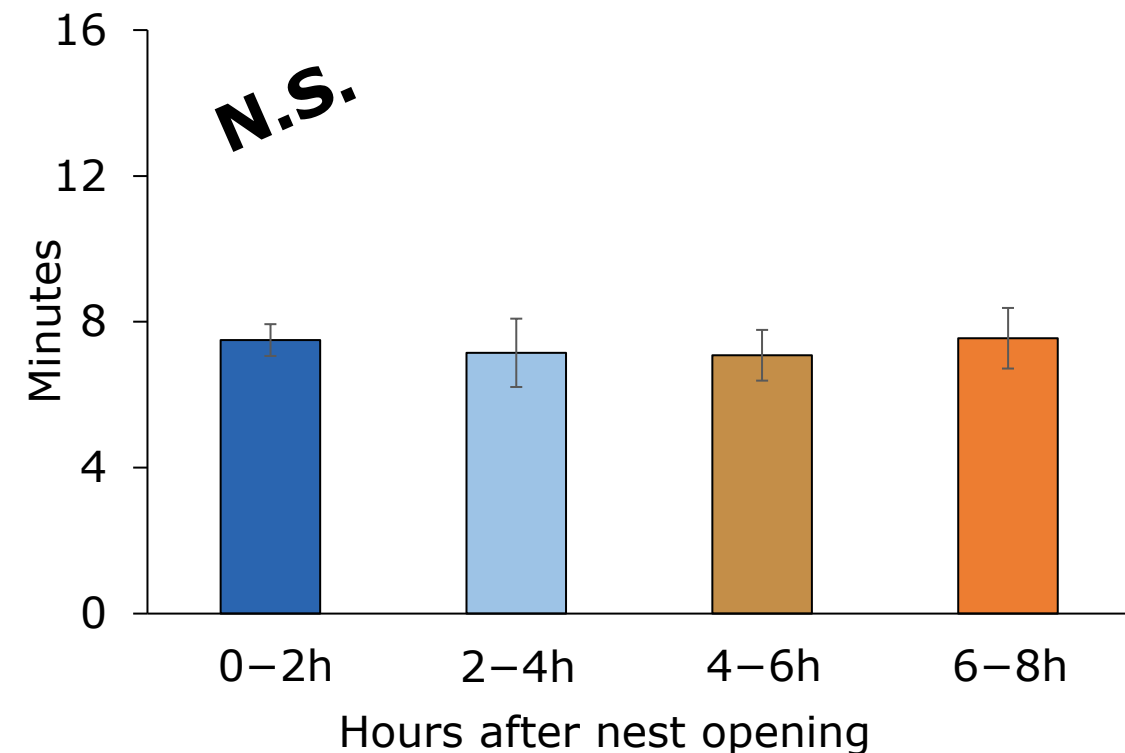
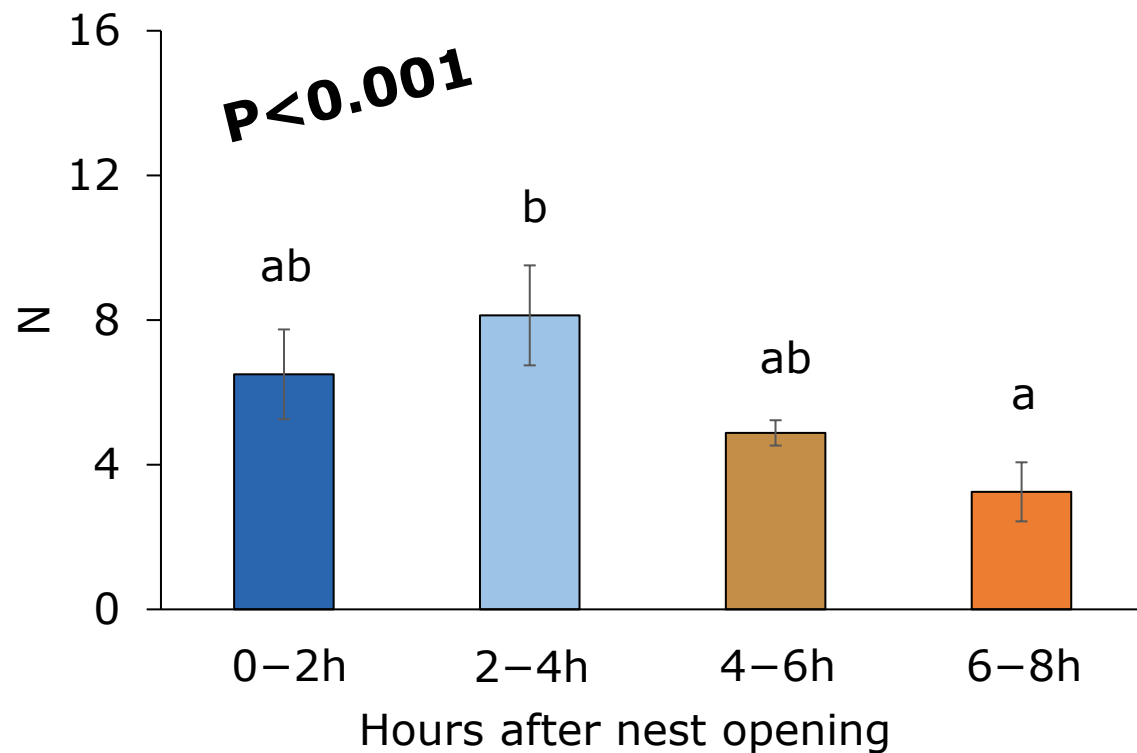
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Effect of the time slot after nest opening on nest use



Number of hens in the nest

Duration of nest visits



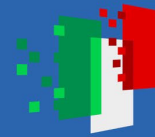
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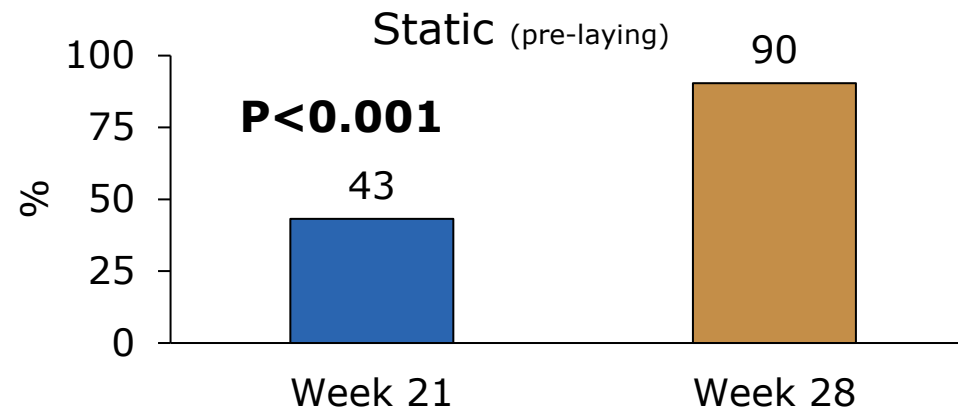
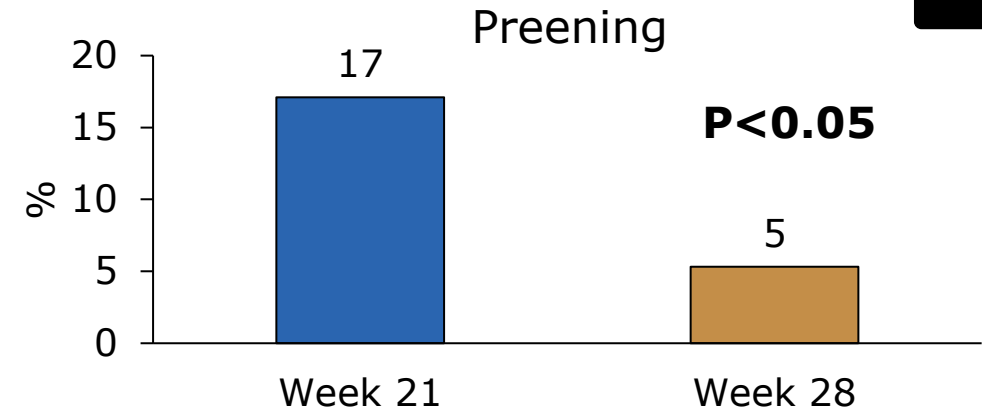
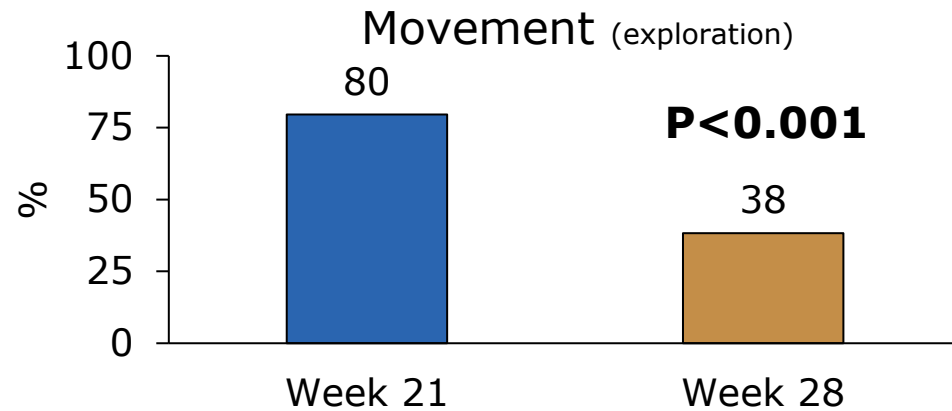
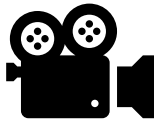


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Effect of the week of age on hen behaviour inside the nest



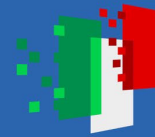
Data expressed as % of total number of behaviours observed. NOTE: More than one behaviour could have been performed by the hen within the observation time
Generalized linear mixed model with week, time-slot as fixed effects and nest as random effect



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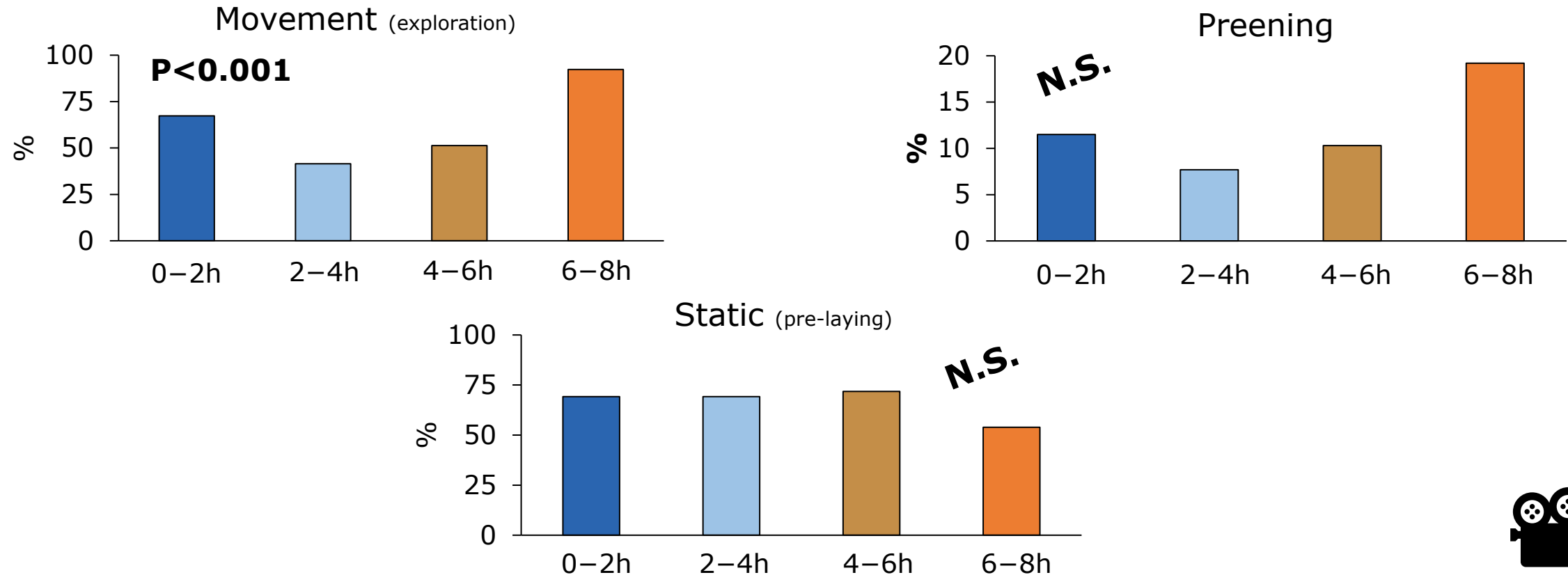


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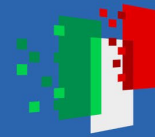


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Effect of the time slot after nest opening on hen behaviours inside the nest

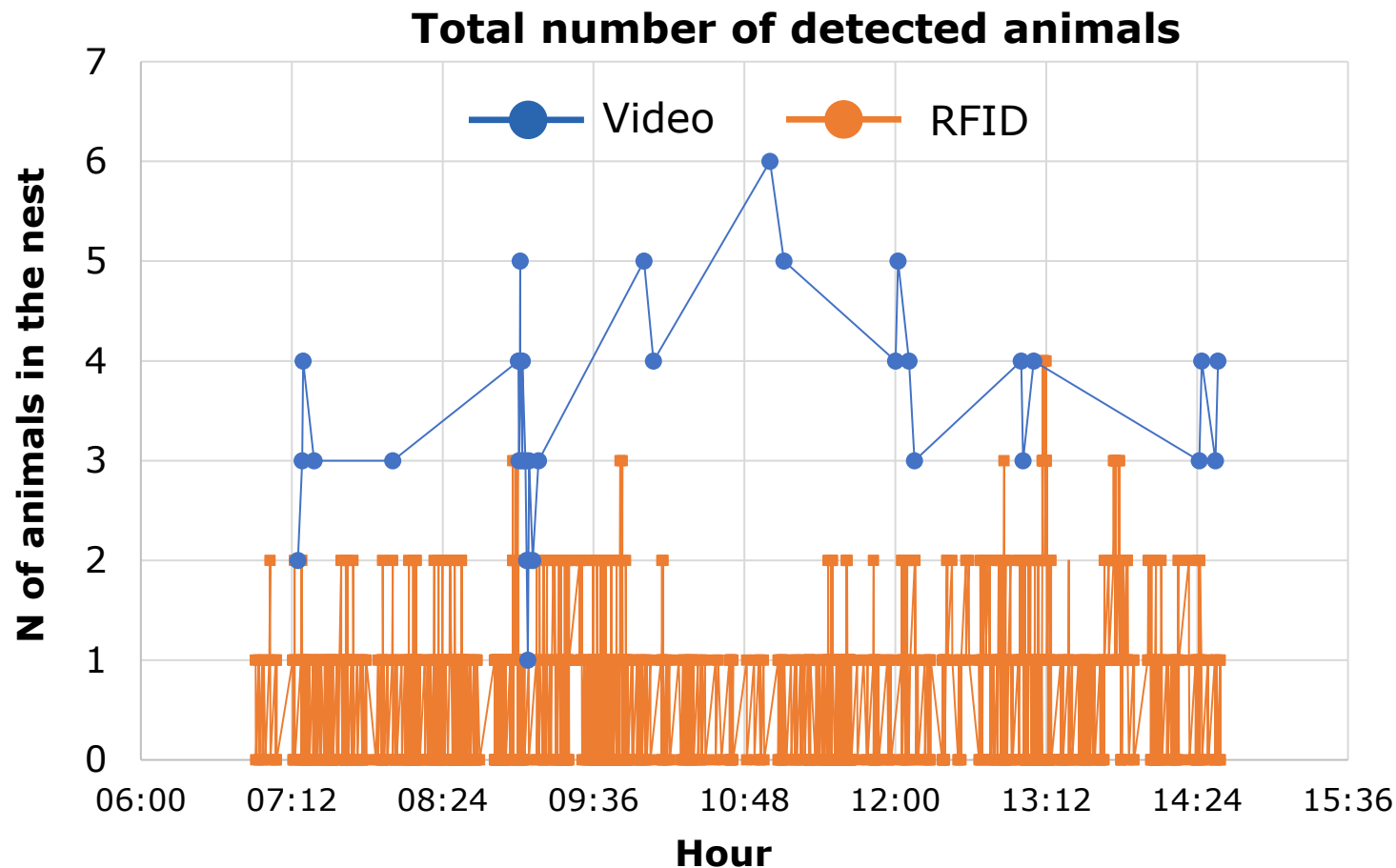


Data expressed as % of total number of behaviours observed. NOTE: More than one behaviour could have been performed by the hen within the observation time
Generalized linear mixed model with week, time-slot as fixed effects and nest as random effect



Performance of an RFID system in detecting nest occupation in group nests

Comparison between data from video and RFID detection



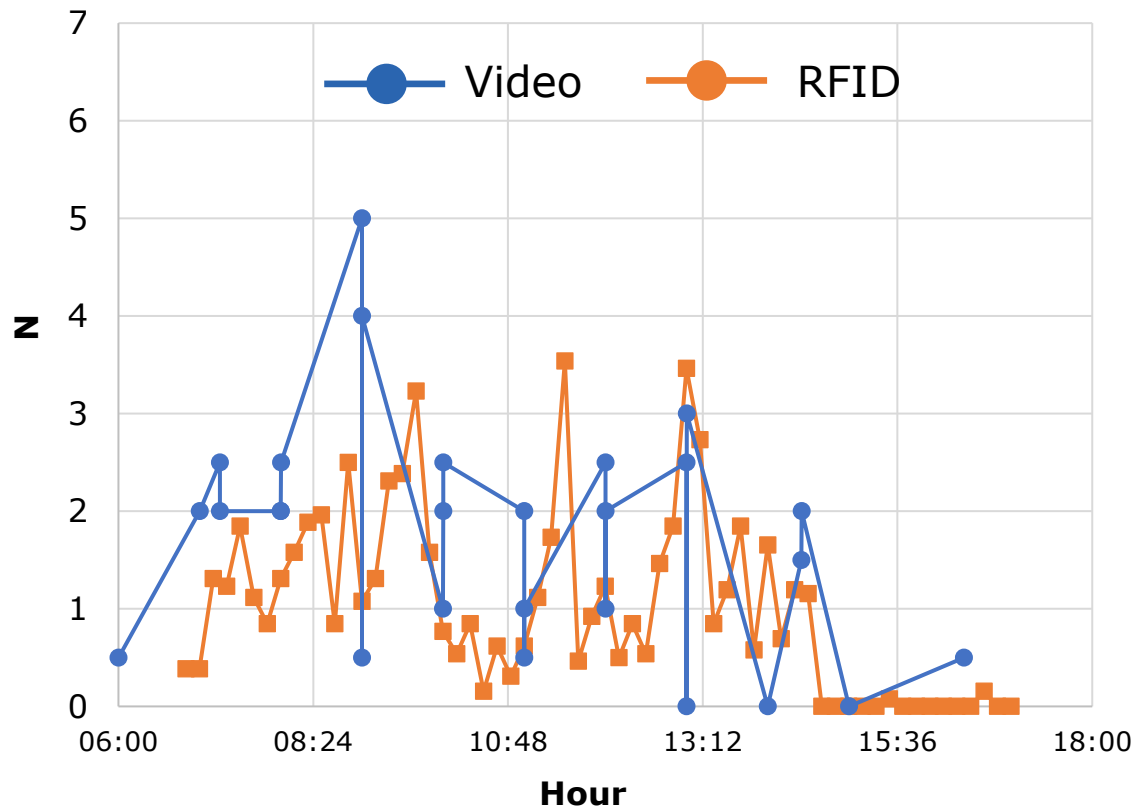
- RFID unable to precisely detect the individual hens inside the nest
- **Loss of signal** once hens remained static in the nest; new signal after movement started again
- Several signals every loss-gain of signal (movement-static transition)
- **RFID could be used to count the frequency of signals**
- **Which give us an idea of hens' activity inside the nest**



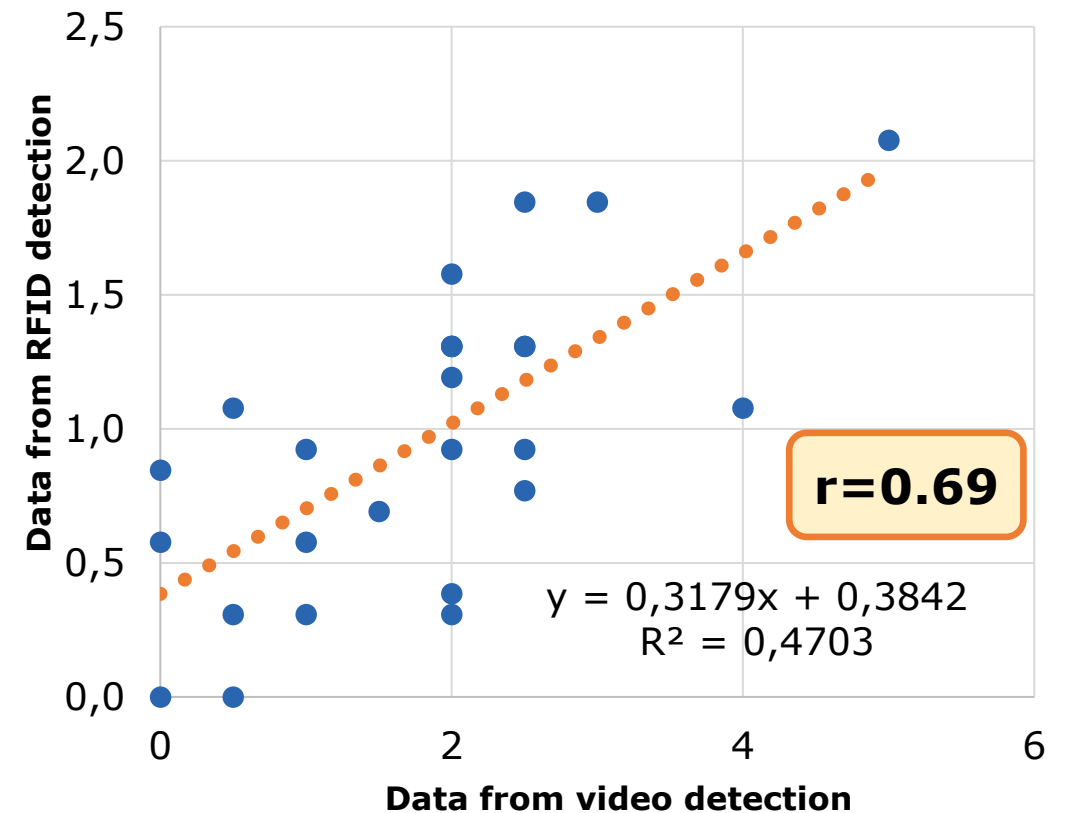
Performance of an RFID system in detecting nest occupation in group nests

Comparison between data from video and RFID detection (movement transitions)

Number of movement transitions (movement to static or vice versa)



Correlation between data from video and RFID

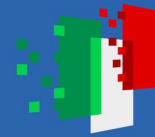




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Conclusions

- Group nests are a challenging environment to track animals and their behaviours
- **Video analysis:**
 - Best tool to precisely evaluate nest use in group nests (n hens, duration of the visits)
 - Provide reference data to evaluate the performance of new PLF tools
 - Difficult to discriminate between static behaviours associated with resting or laying when nests are crowded
 - Analysis of video recording is time consuming
 - Real-time image analysis in the nests?
(challenges related to labelling, lack of background contrast, etc.)



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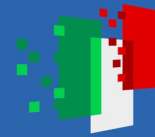
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Conclusions

- **RFID technology** tested in our trial to track hens inside group nests:
 - Unable to effectively track all hens inside the nest (loss of signal with static hens)
 - Lack of adequate power of the tag's antenna, but:

Higher power? → increasing costs
→ increasing size → affect sensor wearability (welfare, bias on natural behaviour,...)
 - Looking for the best trade-off between effectiveness-cost-size-wearability
 - **Effective in monitoring the activity inside the nest:**

↑ Frequency of signals = ↑ Number of hens in the nest?
Overcrowding?
 - Useful for nest monitoring in experimental studies (not yet on farm)



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