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Agroscope

Evaluation of shelter design on equine rhythmicity



Sonia Rey, Hassan-Roland Nasser, Marianne Cockburn

EAAP 2024, Florence



Rhythmicity as a proxy for equine welfare (I)

- Endogenous clock
- Environmental synchronization
- Self-sustained and continuous
- Predicting and responding to environmental changes
- Influence of endogenous and exogenous factors



(Panda et al., 2002)
(Froy, 2011)



Rhythmicity as a proxy for equine welfare (II)



NATIONAL INSTITUTES OF HEALTH
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ORIGINAL RESEARCH
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doi: 10.3389/fanim.2022.839906

001.
Detecting Ultra- and Circadian Activity Rhythms of Dairy Cows in Automatic Milking Systems Using the Degree of Functional Coupling—A Pilot Study

Biological Rhythms

Patricia Fuchs^{1,2*}, Felix Adrion², Abu Z. M. Shafullah³, Rupert M. Bruckmaier⁴ and Christina Umstätter⁵

Metabolic physiology:

Ann B. Hogenesch^{2,3,4}, and

Fish Physiol Biochem (2012) 38:143–152
DOI 10.1007/s10695-011-9523-y

Does feeding time affect fish welfare?

J. F. López-Olmeda · C. Noble ·
F. J. Sánchez-Vázquez



Applied Animal Behaviour Science
Volume 207, October 2018, Pages 26–38



Received: 21 October 2010 / Accepted: 21 October 2010
© Springer Science+Business Media B.V. 2010

Applied Animal Behaviour Science
Volume 64, Issue 1, April 1999, Pages 1–17



Assessment of circadian rhythm of activity combined with random regression model as a novel approach to monitoring sheep in an intensive system

Journal of Dairy Science
Volume 88, Issue 5, May 2005, Pages 1848–1854



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Stress and Circadian Rhythms

Chapter | First Online: 26 April 2021
pp 193–212 | Cite this chapter

K.

Fi

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maintained in large groups

Meng-Juan Sun, Hai-Yan Yin, Xin Cao, Liang Kang, Yu-Shi Hu & Yong Tang

C. Rufener, J. Berezowski, F. Maximiano Sousa, Y. Abreu, L. Asher & M. J. T

Scientific Reports 8, Article number: 12303 (2018) | Cite this article

Diurnal and ultradian rhythms of behaviour in a mare group of Przewalski horse (*Equus ferus przewalskii*), measured through one year under semi-reserve conditions

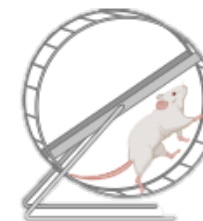
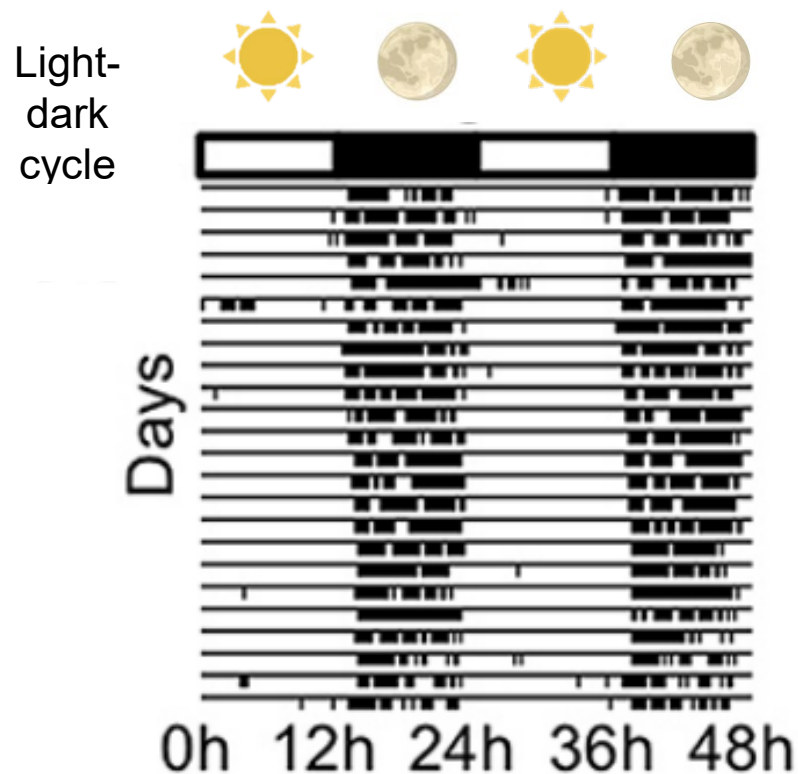
Anne Berger¹, Klaus-M. Scheibe, Knut Eichhorn, Annemarie Scheibe, Jürgen Streich

Within-Day Feeding Behavior of Lactating Dairy Cows Measured Using a Real-Time Control System

Abi¹, M.R. Murphy², U. Moallem³



Representation of rhythmic patterns



(Verwey *et al.*,
2013)



Interpretation of rhythmic patterns

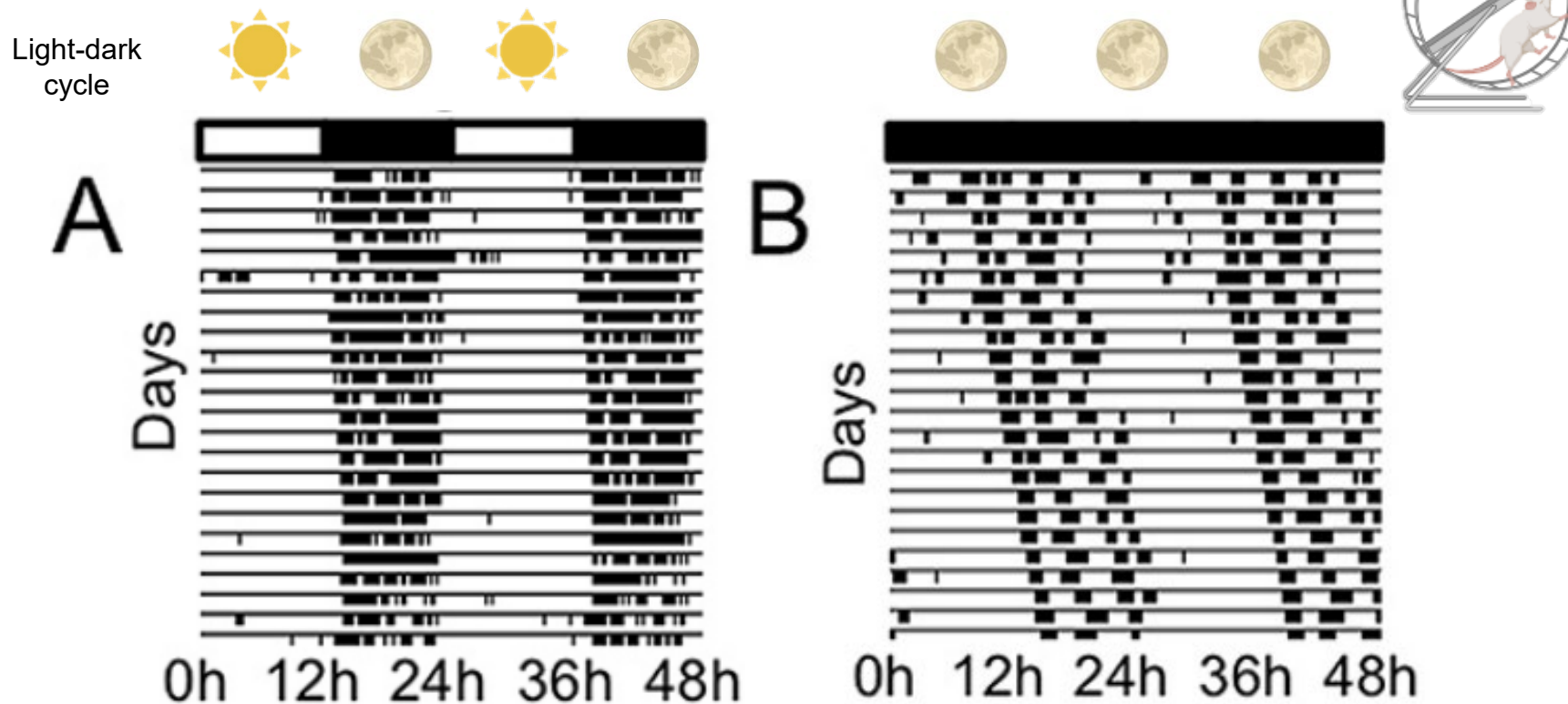
✓ Good state of welfare ✓
➡ same rhythmic patterns

✗ Physiological or psychological stress ✗
⚡➡ disruption of rhythmic patterns
↔ exhaustion, disorientation, higher rate of
disease

(Froy, 2011)



Disruption of rhythmic patterns



(Verwey *et al.*,
2013)



Aim of the study

Does the rhythmicity of domestic horses vary based on their intrinsic motivation to rest ?

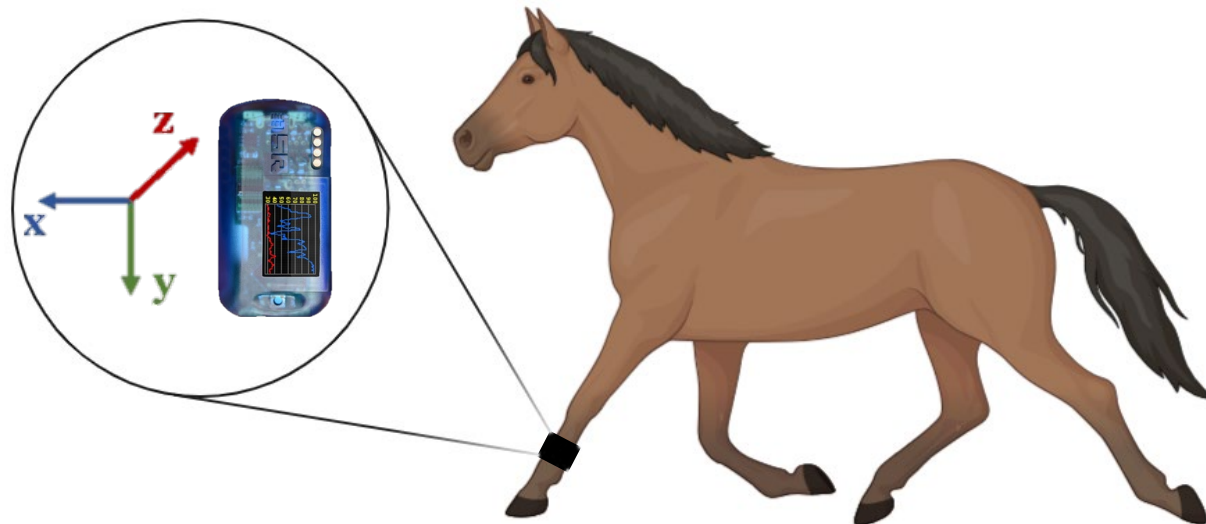
- Comparison to lying behaviour
- Hypothesis
 - Most suitable shelter associated with the highest rhythmicity and the longest lying duration





Material and methods

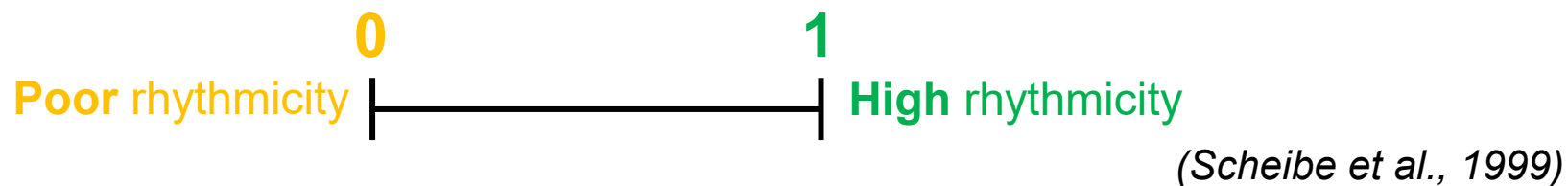
- Locomotor activity assessment
- Accelerometers (MSR145W2D data loggers)
 - X, Y, Z-axis at 1 Hz sampling frequency



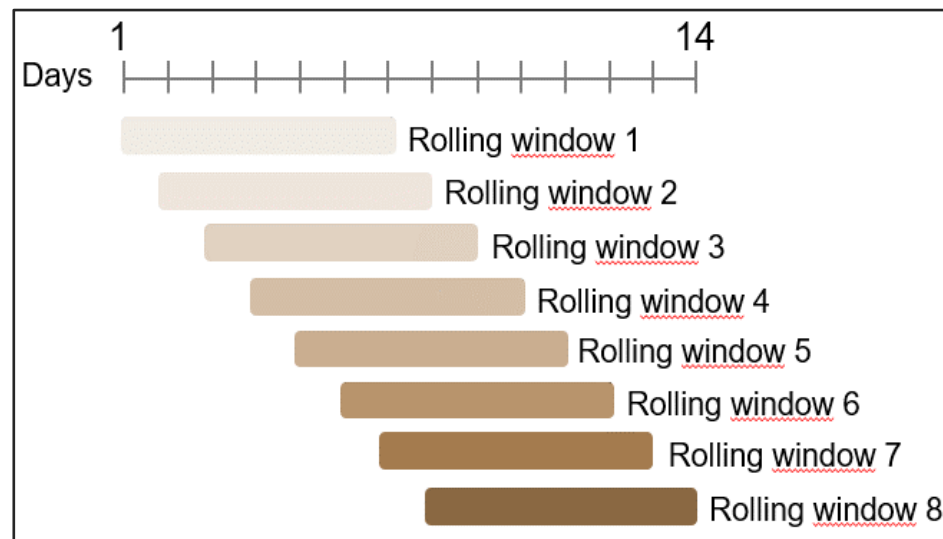


Degree of Functional Coupling (DFC)

- Fourier transformation
- Allows to compute rhythmicity from time-series data
- Reflects synchronization between an organism and environment



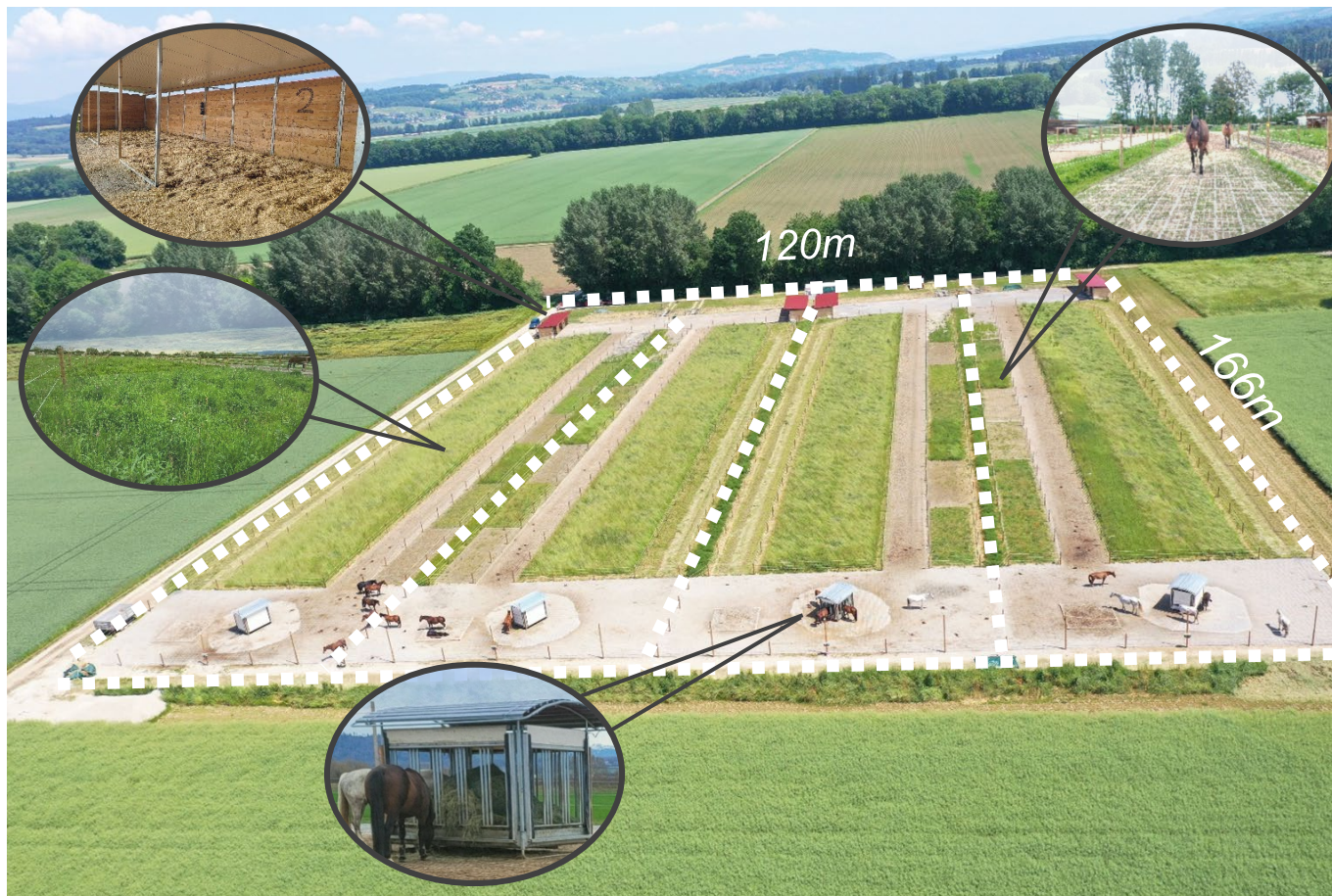
- 7 days of data collection
→ 1 DFC value





Standardized group housing

4 groups of 5 horses each





Phase II: Shelter layouts in randomized design

Small entrances
'small'



Small entrances & sand area
'sand'



Large entrance
'large'



Large entrance & sand area
'both'





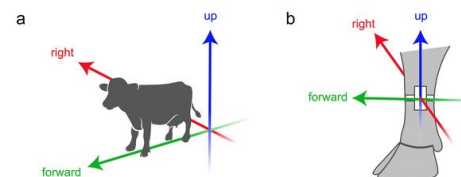
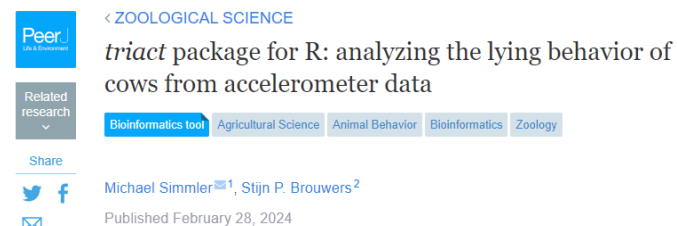
Statistical design



- Variables: DFC, treatment, lying per day, THI, repetition, horse, group, day

- **digiRhythm** and **triact** R libraries

- Linear mixed effect model
- Analysis of the influence of intrinsic motivation to rest using two distinct statistical models
 - Rhythmicity (DFC)
 - Lying behaviour
- Bayesian model selection
- ANOVA

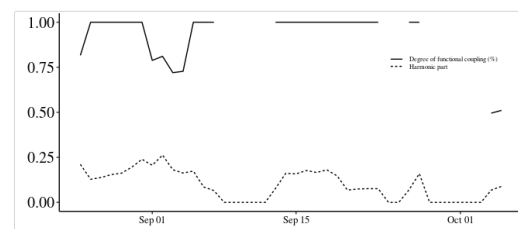


Computing the DFC/HP and manipulating the functions returned objects

Hassan-Roland Nasser and Marie Schneider

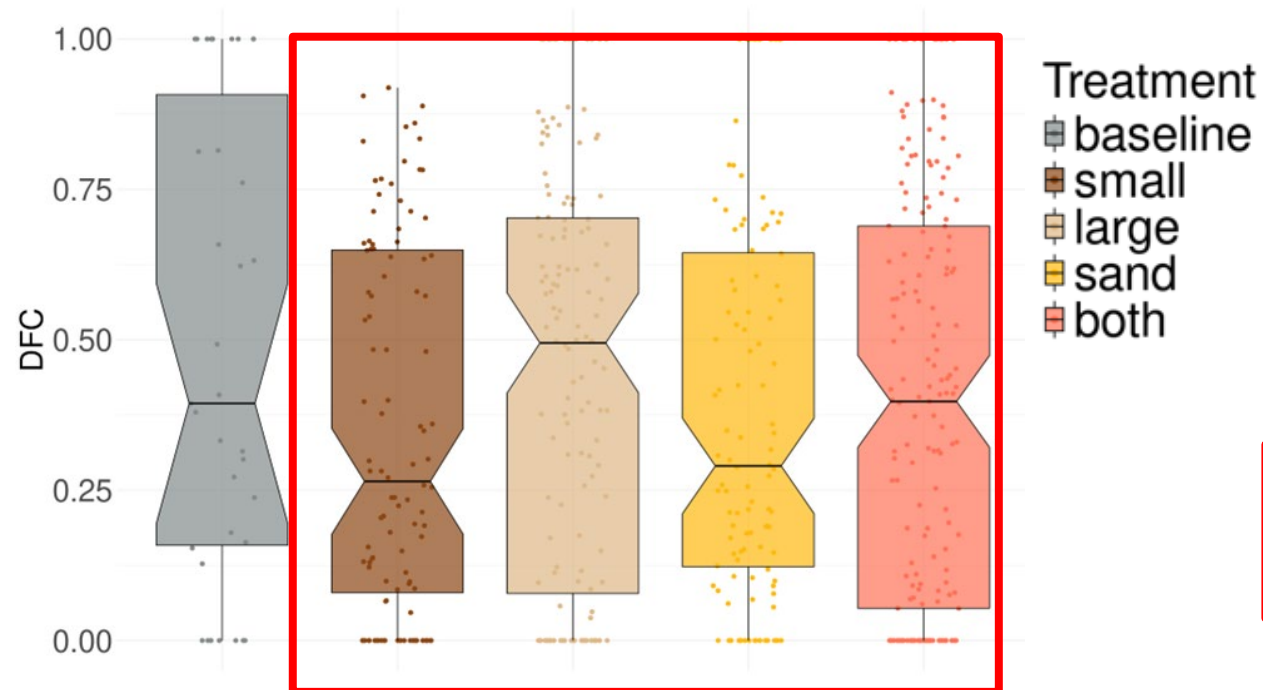
2024-04-04

library(digiRhythm)





Results: Effects of shelters' layout on rhythmicity

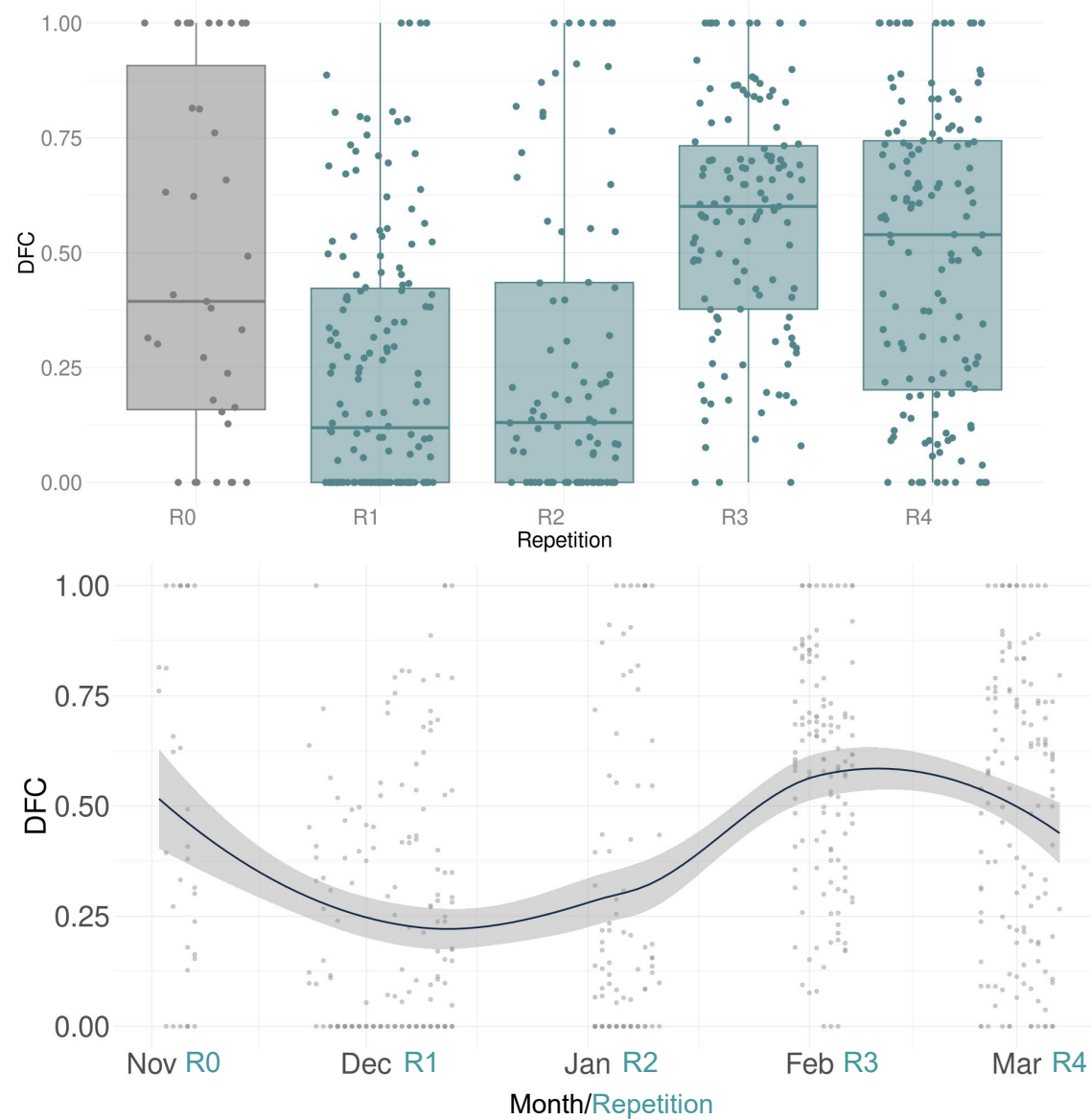


Explanatory variables	Dependent variable		
	DFC	CI 2.5%	CI 97.5%
lying per day	0.003** (0.001)	0.001	0.004
R2	-0.002 (0.042)	-0.084	0.082
R3	0.354** (0.042)	0.272	0.438
R4	0.291** (0.038)	0.216	0.366
large	0.067 (0.035)	-0.003	0.136
sand	0.013 (0.040)	-0.066	0.091
small	0.112** (0.036)	0.041	0.183
lying per day x large	-0.005** (0.001)	-0.007	-0.003
lying per day x sand	-0.003 (0.002)	-0.006	0.001
lying per day x small	-0.011** (0.001)	-0.013	-0.008
constant	0.162* (0.071)	-0.006	0.334

*p<0.05; **p<0.01

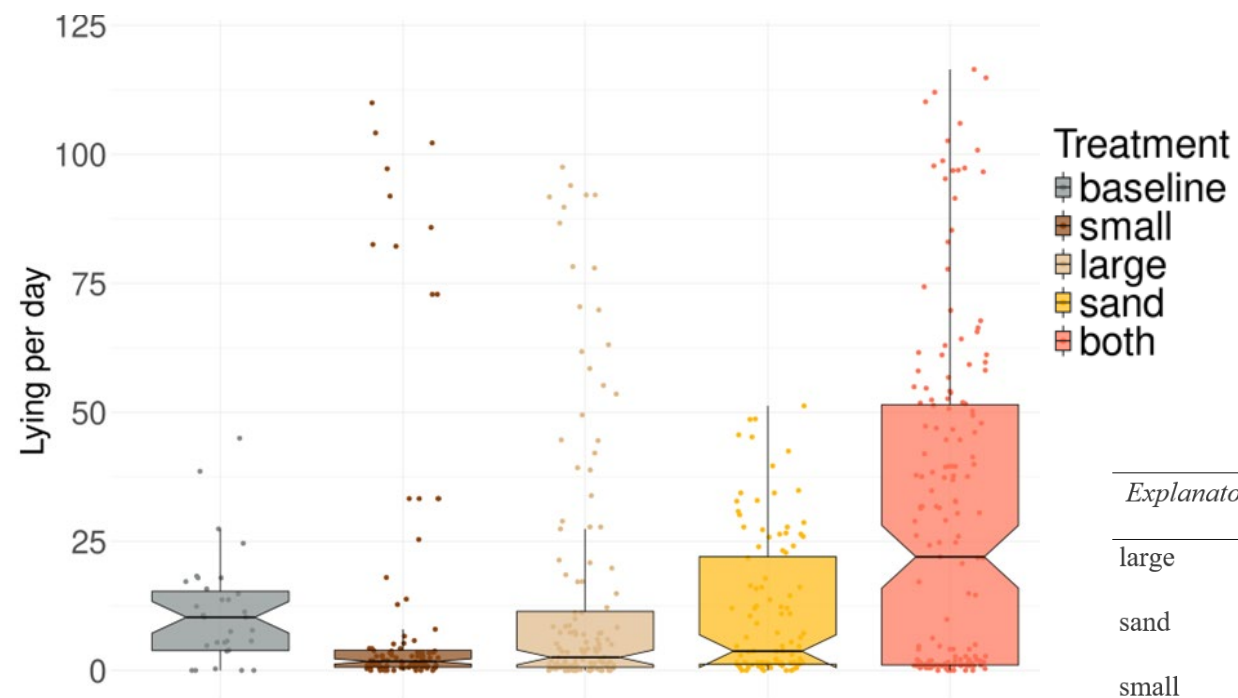


Results: Effect of repetition on DFC





Results: Effects of shelters' layout on lying behaviour



Explanatory variables	Dependent variable		
	lying per day	CI 2.5%	CI 97.5%
large	-15.86** (1.63)	-19.12	-12.59
sand	-14.04** (1.80)	-17.71	-10.47
small	-13.42** (1.79)	-17.01	-9.81
constant	28.34** (5.25)	17.81	38.92

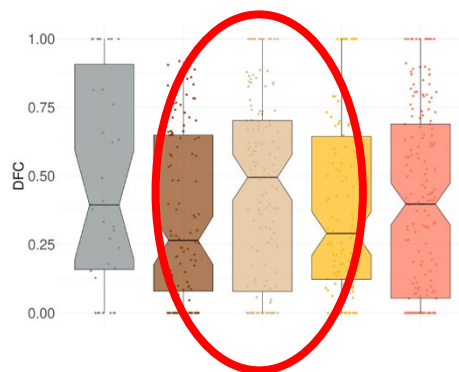
*p<0.05; **p<0.01



Conclusions

- Effect of intrinsic motivation to rest on equine **rhythmicity**
 - Masked by repetition's effect on **rhythmicity** (?)
- Effect of intrinsic motivation to rest on **lying behavior**
- Both indicators differ in determining the best shelter layout

Rhythmicity



*Lying
behaviour*

- Further investigation necessary
- Complementarity of both indicators ?



Thank you for your attention

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www.agroscope.admin.ch



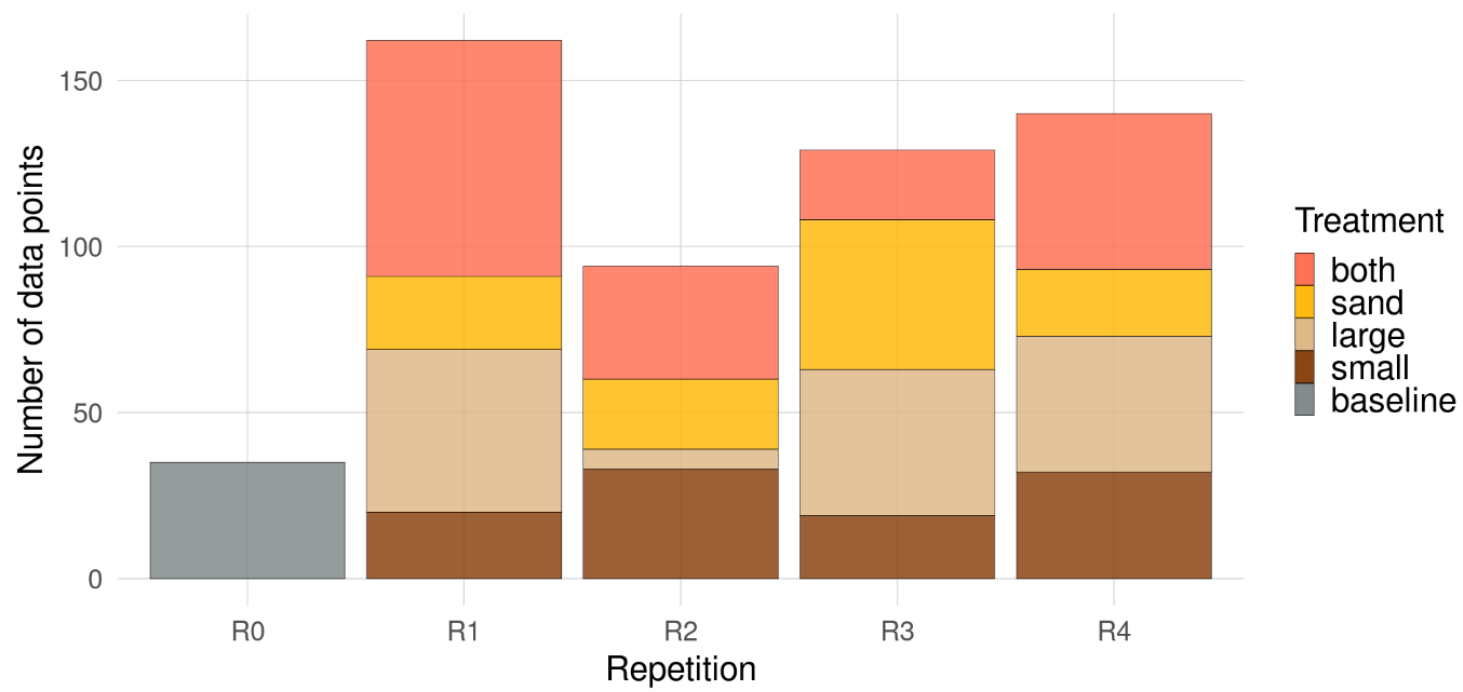
	Baronesse	California	Carinja	Catania	Colea	Comtessa	Cuticula	Esperanza	Ferrara	Fiction	Flamira	Galanta	Heida	Lhasa
adlib	0	16	17	11	1	5	1	4	4	3	4	0	4	13
portion	4	7	0	7	12	17	0	10	10	10	2	3	13	3
tradi	17	3	4	4	7	7	12	2	0	9	0	4	1	11

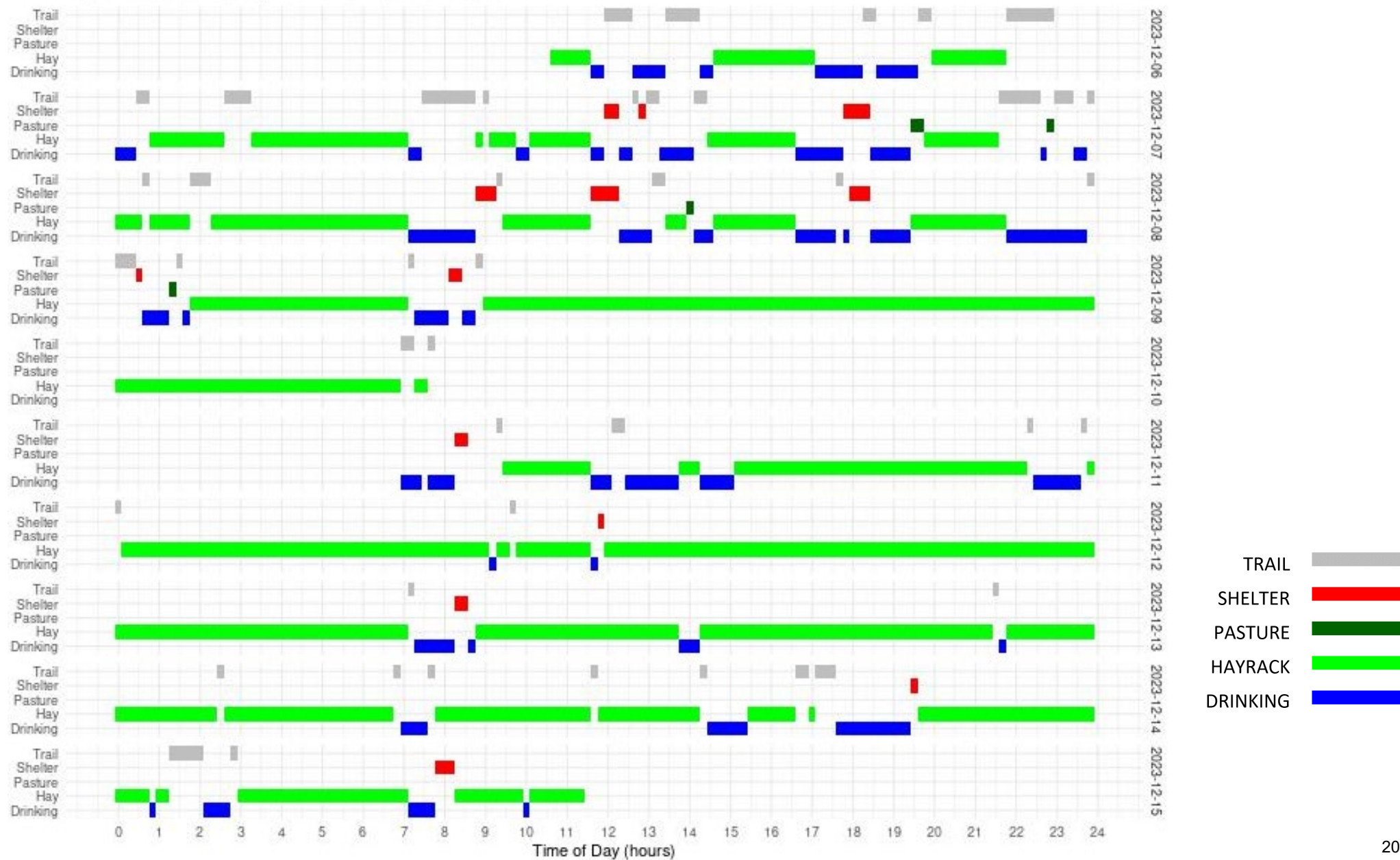
	Lilith	Olana	Retinella	Trouvaille
adlib	17	1	1	3
portion	2	3	4	13
tradi	5	8	17	5

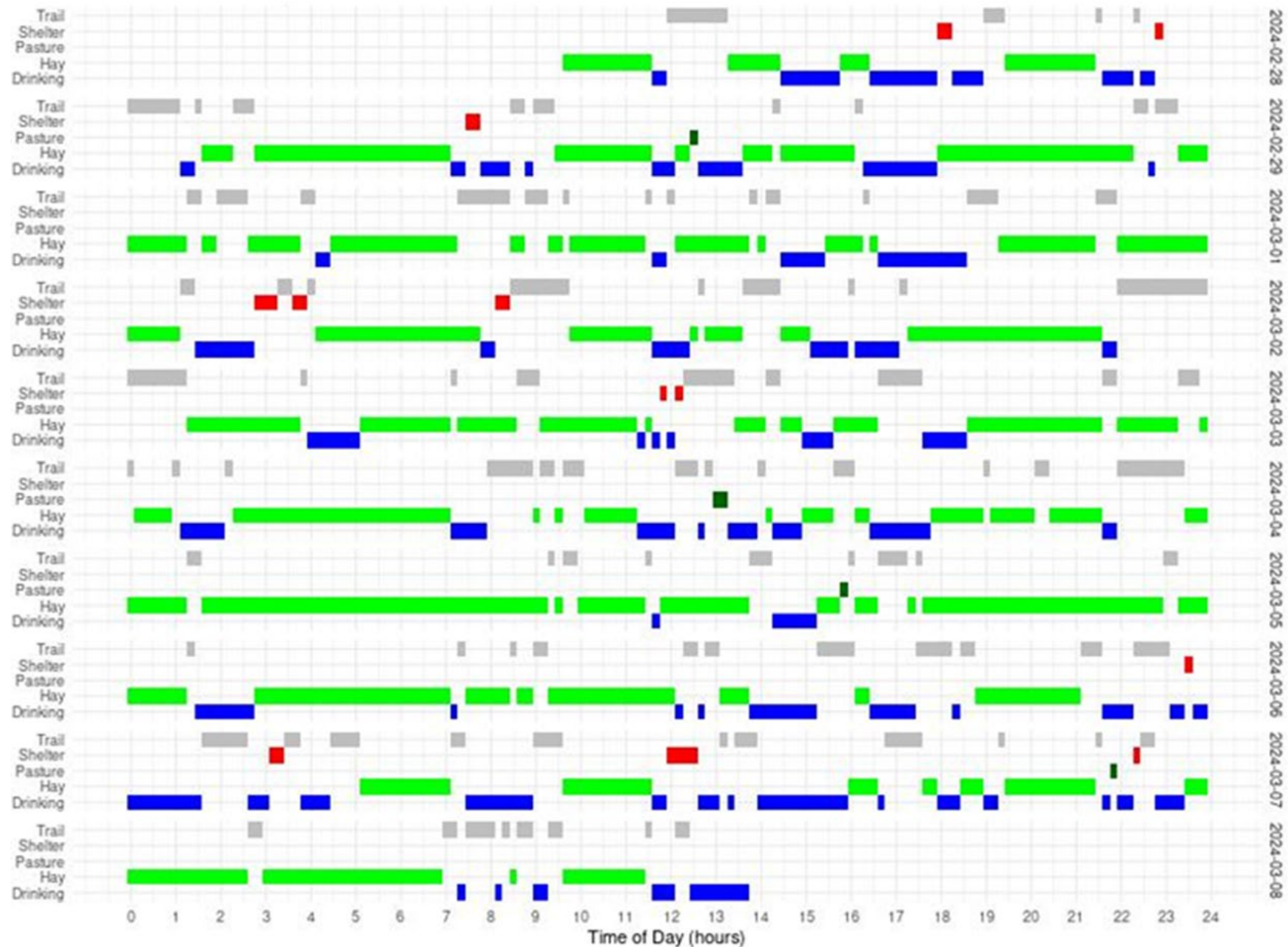
opening hayrack dès le 27.11.23	
Créneau 1	6h - 8h00 =2h
Créneau 2	11h-12h30=1h30
Créneau 3	15h30-17h30=2h
Créneau 4	20h30-22h30=2h
Cloches avec foin en vrac	

$$THI = (0.8 * T) + \left[\frac{r^H}{100} * (T - 14.4) \right] + 46.4$$

Formula 2 Temperature Humidity Index computation. r^H : relative humidity (%), T : temperature (°C)







TRAIL
SHELTER
PASTURE
HAYRACK
DRINKING