INTRA- AND INTER-INDIVIDUAL VARIABILITY IN HAEMATOLOGICAL PARAMETERS IN FEMALE RED DEER

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INTRODUCTION:

Reference Intervals (RI):

- are used to assess the health status of captive and free- ranging wildlife.
- are defined as values encompassing the median 95% of a tested population of apparently healthy animals

In this study we assess the RI of haematological parameters of a captive herd of red deer (*Cervus elaphus*) used for a field experiment to explore the impact of overabundance on deer health.

OBJECTIVES:

- Determine the haematological reference intervals, as well as their intra and inter-individual variability in a herd of 54 female red deer.
- Explore the trend of body condition and selected haematological parameters (HTC, HGB, and WBC) during their adaptation to captivity.

MATERIAL AND METHODS:

A group of 54 free ranging female were captured in July (n=36) and October (n= 18).

Sampling:

July (t0 for the first herd), September (t1 for the first herd), October (t0 for the second herd), December, (t2 for the first herd and t1 for the second).

Reference values:

We determined de novo of reference intervals (RI) and the intra- and inter-individual of a panel or haematology parameters using the initial herd (n=54).

RI = 90% confidence interval, nonparametric method (N > 40).

Statistical analysis:

We explored variation of body condition and some blood parameters (HCT, HGB, and WBC) n=17.

RESULTS AND DISCUSSION:

PARAMETER VARIABILITY:

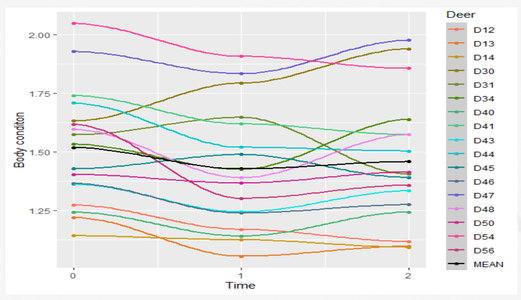

Figure 1. Variation of Body condition in t0, t1 and t2. The black line represents the mean

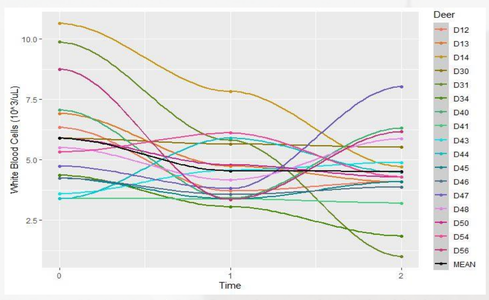

Figure 2. Variation of WBC in t0, t1 and t2. The black line represents the mean

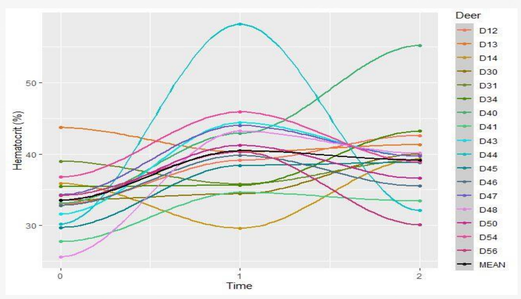

Figure 3. Variation of HCT in t0, t1 and t2. The black line represents the mean

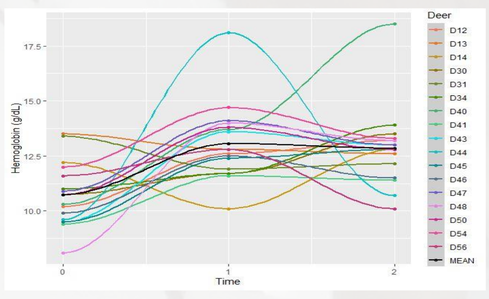

Figure 4. Variation of HGB in t0, t1 and t2. The black line represents the mean

Table 1: Descriptive statistics (*mean*, *standard deviation*, maximum and minimum values) in different times for our response variables (Body condition, HCT, HGB, and WBC).

Parameter	t0	t1	t2
Body condition	*1.51 ± 0.24* 1.14 – 2.04	*1.42 ± 0.26* 1.05 – 1.90	*1.45 ± 0.27* 1.09 – 1.97
White Blood Cells (10^3/uL)	*5.89 ± 2.1* 3.39 – 10.64	*4.54 ± 1.32* 3.06 – 7.83	*4.51 ± 1.64* 1.01 – 8.02
Haematocrit (%)	*33.53 ± 4.2* 25.6 - 43.7	*40.45 ± 6.26* 29.6 – 58.2	*39.15 ± 5.46* 30.1 – 55.2
Haemoglobin (g/dL)	*10.74 ± 1.44* 8.11 – 13.50	*13.06 ± 1.73* 10.10 – 18.1	*12.8 ± 1.78* 10.10 – 18.5

Body condition and WBC decreased over time (Fig 1 and Fig 2) → Adaptative process

HTC and HGB both increased over time (Fig 3 and Fig 4).

All values from t1 to t2 stabilized: Concluding that there was a progressive adaptation.

Table 2: Proportion of explained variability (%) in the GLMM coefficients explained by the fixed (Time of sampling) and random (deer identity) terms.

	Body condition	WBC (10^3/uL)	Haematocrit (%)	Haemoglobin (g/dL)
Time of sampling	2.1	11.9	23.7	14.2
Deer identity	87.3	9.0	0	0

Inter-individual variability accounted for 87.2% of the temporal variation of body condition (Table 2 and Fig. 1).

WBC, HCT and HGB: The effect of time explained higher percentage than inter-individual variability (Table 2 and Fig. 2, 3 and 4).

REFERENCE INTERVALS:

Table 3: Hemogram in a sample of 54 females red deer. Reference intervals (RI), intra- (CVi, in %), and inter-individual variability (CVg in %). Published RI are shown.

Parameter	Units	RI and inter and intra individual variability			
		Published	Sample	CVi	CVg
RBC	(10^6/µL)	6.27 – 9.58 [1]	5.5 – 9.7	19.47	20.02
HGB	(g/dL)	10.1 – 14.2 [1]	8.5 – 13.6	15.6	13.9
HCT	(%)	30.0 – 37.0 [1]	26.4 – 44.4	14.7	13.9
MCV	(ft)	37.0 – 51.1 [1]	39.4 – 57.3	8.88	12.13
MCHC	(g/dL)	31.9 – 37.7 [1]	30.1 – 35.1	7.46	10.87
PLT	(10^3/ µL)	25 – 498 [2]	119.0 – 980.8	63.21	57.89
MPV	(fL)	4.5 – 11.9 [2]	6.6 – 8.4	10.01	13.02
PCT	(%)	0.08 – 0.34 [2]	0.1 – 0.7	67.38	65.64
WBC	(10^3/µL)	2.00 – 5.20 [1]	2.9 – 14.0	27.2	34.2
LYMPH	(10^3/µL)	0.55 – 2.05 [1]	0.6 – 1.9	37.47	43.07
MONO	(10^3/µL)	0.03 – 0.15 [1]	0.3 – 1.2	47.54	44.65
NEUT	(10^3/µL)	1.04 – 3.20 [1]	1.4 – 11.4	51.45	57.25
EO	(10^3/ µL)	0.03 – 0.17 [1]	0.0 – 4.2	83.02	107.56
BASO	(10^3/ µL)	0.00 – 0.05 [1]	0.0 – 0.1	64.64	69.13

1. (Peinado *et al.*, 1999)
2. (Rafaj *et al.*, 2011)

ABBREVIATIONS: red blood cell count (RBC), haemoglobin concentration (HGB), haematocrit (HCT) mean corpuscular volume (MCV), mean corpuscular haemoglobin concentration (MCHC), platelet count (PLT), plateletocrit or thrombocrit (PCT), mean platelet volume (MPV), white blood cell count (WBC), lymphocytes (LYMPH), monocytes (MONO), neutrophiles (NEUT), eosinophiles (EO) and basophiles (BASO).

Pre-analytical, analytical and biological factors of variation should be considered to get RI for hematological parameter. In our study, it was no possible to check health status of the selected individuals assuming that all hinds were healthy, therefore the limits of the reference intervals vary.

On account to the lack of articles of red deer in the same condition than the selected herd, RI of published parameters are slightly different to our results.

About intraindividual and interindividual variability, if the intraindividual variability is considerably high in a specific parameter and is over the interindividual variability, this parameter is not sufficiently sensitive to be used like a reference value.

CONCLUTIONS:

- In free-ranging wild animals it may be difficult to control some preanalytical factors of variation in consequence, reference intervals are broader than in domestic animals.
- Some haematological parameters (e.g., PLT) with high intra-individual variability should not be included in RI panels.
- The measurement of various parameters over time can serve as an indicator of the status of the group of animals.

REFERENCES:

Peinado VI, Celdrán JF, Palomeque J. 1999. Basic hematological values in some wild ruminants in captivity. Comp Biochem Physiol - A Mol Integr Physiol. 124(2):199–203.

Rafaj RB, Tončić J, Vicković I, Šoštarić B. 2011. Haematological and biochemical values of farmed red deer (Cervus elaphus). Vet Arch. 81(4):513–523.