Oikos

WLB-00545

Chassagneux, A., Calenge, C., Siat, V., Mortz, P., Baubet, E. and Saïd, S. 2019. Proximity to the risk and landscape features modulate female red deer movement patterns over several days after drive hunts. – Wildlife Biology 2019: wlb.00545

Appendix 1

Table A1. Hunting effort and number of red deer individuals observed per kilometre in the NHWR of La Petite Pierre during the study period (2004-2018). For each hunting season (Season), we indicated NI, the number of red deer individuals observed per kilometer estimated using spotlight counts data (Garel et al. 2010) and we calculated ND, the number of hunting days, NDriveHunt, the number of drive hunts per hunting day (mean ± SD [range]), HArea, the hunting area per drive hunt (mean ± SD [range]) and the number of shooters (NShoo) and beaters (NBeat) per drive hunt (mean ± SD [range]). The number of dogs is available for three hunting season (2015–2016: 7 ± 2 [4–10], 2016–2017: 5 ± 2 [2–7] and 2017–2018: 8 ± 1 [6–8]).

Season	NI	ND	NDriveHunt	HArea	NShoo	NBeat
2004–2005	0.66 ± 0.48 [0.03-2.06]	9	2.8 ± 0.4 [2-3]	68 ± 26 [25-137]	NA	NA
2005–2006	0.65 ± 0.46 [0.03-2.18]	13	2.4 ± 0.5 [2-3]	58 ± 33 [1-137]	NA	NA
2006–2007	0.74 ± 0.45 [0.06-1.9]	12	2.9 ± 0.3 [2-3]	76 ± 25 [37-137]	27 ± 4 [21-32]	15 ± 1 [13-16]
2007–2008	0.79 ± 0.36 [0.24-1.56]	13	3.0 ± 0 [3-3]	68 ± 24 [35-138]	32 ± 7 [21-40]	NA
2008–2009	0.75 ± 0.61 [0.06-2]	12	1.6 ± 0.7 [1-3]	46 ± 35 [1-96]	29 ± 5 [23-38]	NA
2009–2010	1.13 ± 0.67 [0.17-2.76]	10	2.5 ± 0.5 [2-3]	78 ± 28 [40-127]	28 ± 6 [23-39]	NA
2010–2011	0.86 ± 0.42 [0-1.56]	12	2.3 ± 0.5 [2-3]	80 ± 28 [41-147]	27 ± 5 [17-33]	14 ± 0 [14-14]
2011–2012	0.74 ± 0.67 [0.04-2.41]	20	1.8 ± 0.7 [1-3]	73 ± 35 [19-149]	28 ± 2 [27-33]	13 ± 2 [9-16]
2012–2013	0.73 ± 0.68 [0.08-2.32]	22	1.9 ± 0.8 [1-3]	66 ± 29 [11-138]	29 ± 5 [22-36]	12 ± 2 [10-15]

2013–2014	1.20 ± 0.98 [0.11-2.88]	17	2.2 ± 0.5 [1-3]	74 ± 34 [14-177]	26 ± 5 [20-32]	12 ± 2 [8-14]
2014–2015	1.03 ± 0.85 [0.07-2.66]	12	2.0 ± 0 [2-2]	105 ± 84 [41-480]	27 ± 6 [18-36]	11 ± 2 [8-14]
2015–2016	1.04 ± 0.89 [0.18-3.24]	16	1.8 ± 0.4 [1-2]	95 ± 34 [41-160]	29 ± 2 [26-32]	14 ± 2 [10-16]
2016–2017	0.91 ± 0.76 [0.05-3.06]	13	1.8 ± 0.8 [1-4]	99 ± 47 [18-182]	27 ± 9 [9-43]	12 ± 4 [6-16]
2017–2018	0.99 ± 0.83 [0.11-3.03]	9	1.7 ± 0.5 [1-2]	116 ± 38 [41-182]	37 ± 4 [29-40]	15 ± 2 [12-19]

Appendix 2

Identification of the movement metrics, which best describe the delayed effect of a drive hunt on movement behaviour of animals

Methods

Based on the 26 direct hunting events, we developed and carried out a new factor analysis along the lines of Calenge et al. (2005), in order to identify a major axis of variation describing the changes in movement behaviour after the disturbance.

Let n be the number of animals that have been located within a hunting area at the time of the drive hunt (n = 26 hunting events), and p the number of variables describing movement behaviour of the animals (p = 11). The two tables $\mathbf{X}_1$ and $\mathbf{X}_2$ contain the values of the p variables (columns) calculated over a three-day period respectively before and after the hunting day for the n individuals (rows). To compare the movement metrics before and after hunting on a common basis, we define $\mathbf{X}^*$ as an overall table containing the original variable j (e.g. the 3-day home range size – combining the values before and after the hunt), centred so that its mean is equal to 0, and divided by the standard deviation, over the animals, of the differences for each animal of the value of the variable j after the hunt minus the value before the hunt. The tables $\mathbf{X}_1^*$ and $\mathbf{X}_2^*$ are then obtained as subsets of the overall table $\mathbf{X}^*$.

$$\mathbf{X} = \begin{pmatrix} \mathbf{X}_1 \\ \mathbf{X}_2 \end{pmatrix}$$

Therefore, the i-th animal is characterized by two points in the p-dimensional space: the i-th row of $\mathbf{X}_1^*$, which defines its position prior to the drive hunt, and the i-th row of $\mathbf{X}_2^*$, which defines its position after the drive hunt (Fig. A1 a). These two points define a ‘drive hunt effect vector’ characterizing the effect of a drive hunt on the movement behaviour of an animal over a 3-day period after the disturbance. Then, we re-centred these vectors by calculating the table D = $\mathbf{X}_2^*$ - $\mathbf{X}_1^*$ so that they have a common characteristics before the drive hunt (Fig. A1 b). Finally, we performed a non-centred principal component analysis (PCA) of the table D. The total inertia of this analysis is equal to:

$$\sum_{i=1}^{n} \sum_{j=1}^{p} \left(x_{ij}^{(2)} - x_{ij}^{(1)}\right)^2$$

where $\mathbf{X}_{ij}^{(1)}$ and $\mathbf{X}_{ij}^{(2)}$ are the values at the intersection of the i-th row and j-th column of $\mathbf{X}_1^*$ and $\mathbf{X}_2^*$ respectively. Thus, this non-centred PCA returns the direction that maximizes, globally, the differences between the variables before and after the drive hunt.

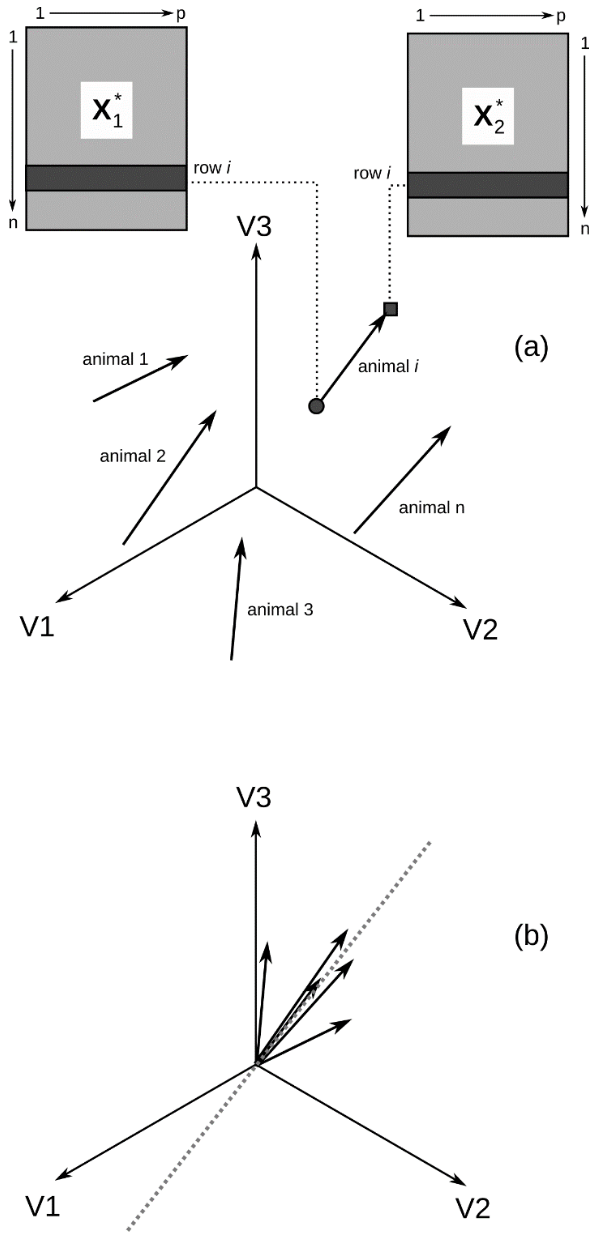

Figure A1. Description of the factor analysis carried out to identify the delayed effect of a drive hunt on the spatial behaviour of female red deer located within the hunting area at the time of the drive hunt. (a) The two tables X_1^* and X_2^* contain the values of the *p* spatial variables respectively before and after the drive hunt for the *n* animals. The figure shows a simplified version of the analysis using $p = 3$ variables. The *i*-th row of the table X_1^* defines the position of animal *i* in this 3-dimensional space before the drive hunt, and the *i*-th row of the table X_2^* defines its position after the drive hunt. For a given animal, these two points delineate a 'drive hunt effect vector' with a length proportional to the effect of the drive hunt and a direction indicating the spatial variables that have changed the most between the two periods. (b) This figure summarizes the different steps of the our analysis, which consists in 1) re-centring the drive hunt effect vectors in order to have a common origin for all of them, and 2) performing a non-centred principal component analysis on this set of re-centred vectors. The grey dotted line represents the first axis of the analysis on which the original vectors can be projected.

Appendix 3

Table A2. Speed calculations, averaged over a 2-h period, for the three following periods: 1) before hunting in red, 2) during hunting in green and 3) after hunting in blue. Each plot represents one of the 26 direct hunting events observed in the NHWR of La Petite Pierre during the study period (2004–2018).