Appendix S1. WinBUGS code for model.

Input data consists of the matrix h_{ij}, the detection/non detection data for site *i*, marking site *j*.

In the code, z_i denotes presence (z_i = 1) or absence z_i = 0) at the level of the sample unit *i*; y_{ij} denotes local presence (y_{ij} = 1) o absence (y_{ij} = 0) on marking site *j*; and h_{ij} denotes detection (h_{ij} = 1) or not (h_{ij} = 0) on marking site *j* of sample unit *i*. Each of these random variables is modeled as a Bernouilli trial, the latter two conditionals on occupancy at sample unit and segment scale:

The model parameter *psi* was given a default value of 1 since surveys were conducted in sample unit *i* (= the territory of the Neowise wolf-pack) where presence of wolves had been previously confirmed by photo trapping.

The other model parameters *theta* and *p* were given uniform prior distributions, U(0,1).

```
model;
{
  for( i in 1 : 5 ) {
    z[i] ~ dbern(psi)
   for( j in 1 : 22 ) {
      y[i , j] ~ dbern(xpsi)
      h[i , j] ~ dbern(p)
    }
  }

      psi ~ dbern(1)
      xpsi ~ dunif(0,1)
      p ~ dunif(0,1)

}
```

Appendix S2. Data.

We repeated the survey at each marking site once per month. The data resulting were treated as detection histories for the sample unit *i* (= Neowise wolf-pack territory). Each detection history corresponding to one survey in the same sample marking site *j* was grafted to the precedent to construct one unique detection history per marking site *j*. Each detection history contained a "0" (no detected scat) or a "1" (detected scat) per marking site *j*. For example, one detection history for marking site *j* may be h_j = 1001. There were no detections of wolf scat on marking sites in surveys 2, and 3, but scats were detected on marking sites at surveys 1 and 4. The following parameters were used in the experimental design: y = Pr(sample unit *i* occupied); q = Pr(wolf scat present on marking site *j* sample êunit *i* occupied by wolf species); *p* = Pr(detection at a marking site *j* êsample unit occupied by wolf species and wolf scat present on marking site *j*).

$$\Pr(h_j = 1001) = y\,\{(qp) \times [q(1-p) + (1-q)] \times [q(1-p) + (1-q)] \times (qp)\}$$

The first term, y, corresponds to the probability that the sample unit *i* is occupied. As scats

were collected at segments 1 and 4, we know that the sample unit is occupied. The first term qp in the brackets corresponds to the probability that the first marking site is occupied. The next marking site is then either occupied with no detection q(1 – p) or not occupied 1 – q.
For the sample unit, occupancy was determined as a Bernouilli trial with probability y. Presence at each marking site of the survey was determined as a Bernouilli trial with probability q and absence with probability (1 – q). Species presence and absence at the remaining marking site were determined similarly, with probability of presence at marking site t being independent of presence at marking site t –1. At each segment where scats were detected, detection was determined as Bern (p).

Detection histories (Dog team)

DATA Outside nursing territory, winter
(22 marking sites, 5 monthly surveys/site during winter season)

h[,1]	h[,2]	h[,3]	h[,4]	h[,5]	h[,6]	h[,7]	h[,8]	h[,9]	h[,10]	h[,11]	h[,12]	
	h[,13]	h[,14]	h[,15]	h[,16]	h[,17]	h[,18]	h[,19]	h[,20]	h[,21]	h[,22]		
0	1	1	0	0	0	0	0	1	0	1	0	0
	1	0	1	0	0	0	1	1	0			
1	1	0	1	1	0	1	0	1	0	0	0	1
	0	1	0	1	1	1	0	1	0			
0	1	1	0	1	0	0	0	0	1	0	0	0
	1	0	0	1	0	1	1	0	0			
1	0	0	0	1	0	1	0	0	0	0	1	0
	1	0	1	0	1	0	0	1	1			
0	1	0	0	0	0	0	0	1	0	0	0	0
	1	0	0	1	1	0	0	0	0			

END

DATA Inside nursing territory, winter
(7 marking sites, 5 monthly surveys/site during winter season)

h[,1]	h[,2]	h[,3]	h[,4]	h[,5]	h[,6]	h[,7]
1	0	0	1	1	0	1
0	1	0	0	1	0	0
0	0	0	0	0	1	0
0	1	0	1	0	1	0
1	0	1	0	0	1	1

END

DATA Outside nursing territory, summer
(22 marking sites, 4 monthly surveys/site during summer season)

h[,1]	h[,2]	h[,3]	h[,4]	h[,5]	h[,6]	h[,7]	h[,8]	h[,9]	h[,10]	h[,11]	h[,12]	
	h[,13]	h[,14]	h[,15]	h[,16]	h[,17]	h[,18]	h[,19]	h[,20]	h[,21]	h[,22]		
0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	1	0			

0	0	0	0	0	0	0	0	1	0	0	0	0
	0	0	0	0	0	0	0	0	1			
0	0	0	1	0	0	0	0	0	0	0	0	0
	1	0	0	0	0	0	0	1	0			
0	1	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	1	0	0	1	0			

END

DATA Inside nursing territory, summer

(7 marking sites, 4monthly surveys/site during summer season)

h[,1]	h[,2]	h[,3]	h[,4]	h[,5]	h[,6]	h[,7]
0	1	1	1	1	1	1
0	1	0	1	1	1	1
1	1	1	1	1	1	1
1	1	1	1	1	1	1

END

Appendix S3. Model of error due to non-target marking by the dog.

Use of the dog on previous studies showed 95-96 % successful detection of wolf scats *vs.* non-target species (Roda et al. 2020, F. Roda & J.N. Philibert, unpublished data). As the marking of non-target species (= false positives) could lead to an over-estimation of wolf scats, we applied a correction factor and checked the results. We simulated data using the true data obtained on field (see Appendix S2 for original data and model description) and applying a correction factor. Four models were tested: Model 1: 5% errors spread throughout the year and across the whole territory; Model 2: 20% errors spread throughout the year and across the whole territory; Model 3: 5% errors spread only during summer and across the whole territory; Model 4: 20% errors spread only during summer and across the whole territory.

Model 1: 5% error

Mean number of wolf scats found inside (n = 1.36) of the nursing territory was greater than outside (n = 0.10; difference statistically significant; t = –4.4182; df = 6.4787; p = 0.003). We calculated that after parturition the per month probability of scat-marking at each marking site decreased threefold outside of the nursing territory (dropping from 36% to 11%) whereas it augmented twofold in the nursing territory (raising from 38% to 80%).

Simulated DATA (taking into account dog detection error): outside nursing territory, winter

(22 marking sites, 5 monthly surveys/site during winter season)

h[,1]	h[,2]	h[,3]	h[,4]	h[,5]	h[,6]	h[,7]	h[,8]	h[,9]	h[,10]	h[,11]	h[,12]	
	h[,13]	h[,14]	h[,15]	h[,16]	h[,17]	h[,18]	h[,19]	h[,20]	h[,21]	h[,22]		
0	1	1	0	0	0	0	0	1	0	1	0	0
	1	0	1	0	0	0	1	1	0			
1	1	0	1	0	0	1	0	1	0	0	0	1
	0	1	0	1	1	1	0	1	0			

0	1	1	0	1	0	0	0	0	1	0	0	0
	1	0	0	1	0	1	1	0	0			
1	0	0	0	1	0	0	0	0	0	0	1	0
	1	0	1	0	1	0	0	1	1			
0	1	0	0	0	0	0	0	1	0	0	0	0
	1	0	0	1	1	0	0	0	0			

END

Simulated DATA (taking into account dog detection error): inside nursing territory, winter

(7 marking sites, 5 monthly surveys/site during winter season)

h[,1]	h[,2]	h[,3]	h[,4]	h[,5]	h[,6]	h[,7]
1	0	0	1	1	0	1
0	1	0	0	1	0	0
0	0	0	0	0	1	0
0	1	0	1	0	1	0
1	0	1	0	0	0	1

END

Simulated DATA (taking into account dog detection error): outside nursing territory, summer

(22 marking sites, 4 monthly surveys/site during summer season)

h[,1]	h[,2]	h[,3]	h[,4]	h[,5]	h[,6]	h[,7]	h[,8]	h[,9]	h[,10]	h[,11]	h[,12]	
	h[,13]	h[,14]	h[,15]	h[,16]	h[,17]	h[,18]	h[,19]	h[,20]	h[,21]	h[,22]		
0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	1	0			
0	0	0	0	0	0	0	0	1	0	0	0	0
	0	0	0	0	0	0	0	0	1			
0	0	0	1	0	0	0	0	0	0	0	0	0
	1	0	0	0	0	0	0	1	0			
0	1	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	1	0	0	1	0			

END

Simulated DATA (taking into account dog detection error): inside nursing territory, summer

(7 marking sites, 4monthly surveys/site during summer season)

h[,1]	h[,2]	h[,3]	h[,4]	h[,5]	h[,6]	h[,7]
0	1	1	1	1	1	1
0	1	0	1	0	1	1
1	1	1	1	0	1	1
1	1	1	1	1	1	1

END

Model 2: 20% error

Mean number of wolf scats found inside (n = 1.04) of the nursing territory was greater than outside (n = 0.10; difference statistically significant; t = –3.6302; df = 6.4464; p = 0.01). We calculated that after parturition the per month probability of scat-marking at each marking site decreased threefold outside of the nursing territory (dropping from 31% to 10%) whereas it augmented twofold in the nursing territory (raising from 35% to 70%).

Simulated DATA (taking into account dog detection error): outside nursing territory, winter

(22 marking sites, 5 monthly surveys/site during winter season)

h[,1]	h[,2]	h[,3]	h[,4]	h[,5]	h[,6]	h[,7]	h[,8]	h[,9]	h[,10]	h[,11]	h[,12]	
	h[,13]	h[,14]	h[,15]	h[,16]	h[,17]	h[,18]	h[,19]	h[,20]	h[,21]	h[,22]		
0	1	1	0	0	0	0	0	1	0	1	0	0
	0	0	1	0	0	0	1	1	0			
1	0	0	1	1	0	1	0	1	0	0	0	0
	0	1	0	1	1	1	0	0	0			
0	1	1	0	1	0	0	0	0	1	0	0	0
	0	0	0	1	0	1	1	0	0			
1	0	0	0	0	0	1	0	0	0	0	1	0
	1	0	1	0	0	0	0	1	1			
0	1	0	0	0	0	0	0	1	0	0	0	0
	0	0	0	1	1	0	0	0	0			

END

Simulated DATA (taking into account dog detection error): inside nursing territory, winter

(7 marking sites, 5 monthly surveys/site during winter season)

h[,1]	h[,2]	h[,3]	h[,4]	h[,5]	h[,6]	h[,7]
1	0	0	1	1	0	1
0	0	0	0	1	0	0
0	0	0	0	0	1	0
0	1	0	1	0	0	0
1	0	1	0	0	1	1

END

Simulated DATA (taking into account dog detection error): outside nursing territory, summer

(22 marking sites, 4 monthly surveys/site during summer season)

h[,1]	h[,2]	h[,3]	h[,4]	h[,5]	h[,6]	h[,7]	h[,8]	h[,9]	h[,10]	h[,11]	h[,12]	
	h[,13]	h[,14]	h[,15]	h[,16]	h[,17]	h[,18]	h[,19]	h[,20]	h[,21]	h[,22]		
0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	1	0			
0	0	0	0	0	0	0	0	1	0	0	0	0
	0	0	0	0	0	0	0	0	1			

0	0	0	1	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	1	0			
0	1	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	1	0	0	1	0			

END

Simulated DATA (taking into account dog detection error): inside nursing territory, summer
(7 marking sites, 4monthly surveys/site during summer season)

h[,1]	h[,2]	h[,3]	h[,4]	h[,5]	h[,6]	h[,7]
0	1	1	1	1	0	1
0	1	0	1	1	0	1
1	1	1	0	1	1	1
1	0	1	1	1	1	0

END

Model 3: 5% error (all errors occurring during summer)
Mean number of wolf scats found inside (n = 1.25) of the nursing territory was greater than outside (n = 0.10; difference statistically significant; t = –4.6143; df = 6.4787; p = 0.003). We calculated that after parturition the per month probability of scat-marking at each marking site decreased fourfold outside of the nursing territory (dropping from 38% to 9%) whereas it augmented less than twofold in the nursing territory (raising from 40% to 73%).

DATA Outside nursing territory, summer
(22 marking sites, 4 monthly surveys/site during summer season)

h[,1]	h[,2]	h[,3]	h[,4]	h[,5]	h[,6]	h[,7]	h[,8]	h[,9]	h[,10]	h[,11]	h[,12]	
	h[,13]	h[,14]	h[,15]	h[,16]	h[,17]	h[,18]	h[,19]	h[,20]	h[,21]	h[,22]		
0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0			
0	0	0	0	0	0	0	0	1	0	0	0	0
	0	0	0	0	0	0	0	0	1			
0	0	0	1	0	0	0	0	0	0	0	0	0
	1	0	0	0	0	0	0	1	0			
0	1	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	1	0			

END

DATA Inside nursing territory, summer
(7 marking sites, 4monthly surveys/site during summer season)

h[,1]	h[,2]	h[,3]	h[,4]	h[,5]	h[,6]	h[,7]
0	0	1	1	1	1	1
0	1	0	0	1	1	1
1	1	1	0	1	1	1
1	1	1	1	0	1	1

END

Model 4: 20% error (all errors occurring during summer)

Mean number of wolf scats found inside (n = 0.75) of the nursing territory was greater than outside (n = 0.08; difference statistically significant; t = –4.8242; df = 7.006; p = 0.002). We calculated that after parturition the per month probability of scat-marking at each marking site decreased threefold outside of the nursing territory (dropping from 38% to 7%) whereas it augmented in the nursing territory (raising from 40% to 50%).

DATA Outside nursing territory, summer

(22 marking sites, 4 monthly surveys/site during summer season)

h[,1]	h[,2]	h[,3]	h[,4]	h[,5]	h[,6]	h[,7]	h[,8]	h[,9]	h[,10]	h[,11]	h[,12]	
	h[,13]	h[,14]	h[,15]	h[,16]	h[,17]	h[,18]	h[,19]	h[,20]	h[,21]	h[,22]		
0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0			
0	0	0	0	0	0	0	0	1	0	0	0	0
	0	0	0	0	0	0	0	0	0			
0	0	0	1	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	1	0			
0	1	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	1	0			

END

DATA Inside nursing territory, summer

(7 marking sites, 4monthly surveys/site during summer season)

h[,1]	h[,2]	h[,3]	h[,4]	h[,5]	h[,6]	h[,7]
0	1	0	1	0	1	0
0	1	0	0	1	0	1
1	0	1	0	1	0	1
1	0	1	0	1	0	1

END

Literature

Roda F., Sentilles J., Molins C. et al. 2020: Wolf scat detection dog improves wolf genetic monitoring in new French colonized areas. *J. Vertebr. Biol. 69: 20102.*