# Appendices

# Appendix 1 – Habitat selection by caribou and predation risk by wolves using Resources selection Functions (RSFs)

*Methods*

We tested the effect of the use of highly selected habitats by caribou (*Rangifer tarandus*) and predation risk by gray wolves (*Canis lupus*) on survival of eastern migratory caribou of the Rivière-aux-Feuilles (RFH) and Rivière-George herds (RGH). We based the value of these variables on habitat selection analyses of caribou and wolves during summer and winter. Assuming that characteristics selected at the population level should represent attributes affecting fitness (Gaillard et al. 2010; McLoughlin et al. 2006), we conducted habitat-selection analyses at the population level for both species and each of the two herds separately. We used the relative probability of caribou occurrence predicted from Resources Selection Functions (RSFs; Manly et al. 2002) to assess patterns of habitat use within each herd. Similarly, we defined predation risk by wolves using the relative probability of wolf occurrence in summer and winter caribou ranges.

We conducted RSF analyses using 168 female caribou of the RFH (summer=166, winter=96) and 166 females of the RGH (summer= 146, winter= 123). We captured caribou by net-gunning from a helicopter and equipped them with GPS collars programmed to record locations every 1 to 13 h (Vectronic GPS Iridium and Globalstar). Between 2011 and 2016, we also captured 28 wolves on the RFH range (summe r = 26 wolves-seasons, winter= 16 wolves-seasons) and 14 wolves on the RGH range (summer = 12 wolves-seasons, winter= 8 wolves seasons). We also captured wolves using a net-gun fired from a helicopter and immobilized them physically or chemically (Telazol, 10 mg/kg). We equipped them with GPS collars recording one location every 1, 2, 4 or 5 hours (Telonics GPS-Iridium and Lotek GPS-Iridium). We restricted our analysis to wolves spatially and temporally overlapping with caribou, thus potentially interacting with them. Many wolves on the RFH range displayed large seasonal movements during spring and fall to reach the summer range of caribou. Some wolves, however, remained at lower latitudes year-round and may have displayed different habitat selection behaviors because they did not have access to caribou during summer. We thus only included wolves for which the seasonal 100% Minimum Convex Polygon (MCP) overlapped the seasonal range of caribou. Wolves on the RGH range did not display such migratory behavior, but we also restricted our analysis to wolves for which the seasonal 100% MCP overlapped the RGH seasonal ranges.

For both caribou and wolves, we compared the habitat characteristics at used locations to those at an equal number of available (random) locations. For caribou, available locations were drawn within seasonal ranges of herds, whereas for wolves, they were drawn within individual seasonal 100% MCP. To temporally identify summer and winter seasons, and to spatially delineate caribou seasonal ranges, we identified the start and end dates of summer and winter seasons based on temporal variations in caribou movements (Le Corre et al. 2014). We used the same seasons for wolves. We then delineated caribou seasonal ranges using all caribou locations for a given season across years using Minimum Convex Polygons (MCPs) toconsider inter-annual variability and thus, include all the areas that could potentially be used by caribou or wolves. Thus, we analyzed selection by wolves using multi-year wolf MCPs to define availability, but used the caribou MCPs to predict the probability of occurrence of wolves on caribou ranges.

We tested the effect of the same covariates on the habitat selection of caribou and wolves, including vegetation cover type, Normalized Difference Vegetation Index (NDVI), which served as an index of vegetation productivity (Pettorelli 2013) and was thus only included in summer analyses, elevation and proximity to water (main rivers and lakes). To describe vegetation cover types, we used a landcover map of 19 vegetation cover types (MODIS 250 x 250 m-resolution; Natural Resources Canada) that we merged into 4 to 6 cover types (Table 1). We merged vegetation cover types according to season-specific availability in vegetation cover types. For example, boreal and taiga forests were two distinct categories during winter because of the high availability of forested areas on winter ranges, whereas we merged them during summer because low availability on summer ranges. We characterized each caribou and available locations with a time-matching value of NDVI provided by a 16-days composite image (230 x 230 m-resolution; NASA 2016). Spatiotemporal variation in NDVI can be a good proxy of spatial temporal variation and change in forage biomass relevant to caribou because shrubs and herbaceous/graminoids constitute the most important food resources during summer and the amount of coniferous vegetation is limited in the summer ranges of both caribou herds (see study area description). We evaluated the effect of elevation on habitat selection using a digital elevation model (100 x 100 m-resolution). We also tested the effect of proximity to water because it could influence caribou habitat selection by altering movement patterns (reluctance to cross large water bodies; Leblond et al. 2016) or by modulating hunting and predation risk (Newton et al. 2017; Plante et al. 2017). We evaluated caribou selection for proximity to water bodies by measuring the Euclidian distance (km) to the nearest river or lake. To account for a possible reduction of the effect of water as distance increases, we also included a quadratic term of the distance to the nearest river or lake in the models. For wolves, water availability may not be a limiting factor in northern Québec and Labrador due to the high abundance of rivers and lakes, but it may alter movement and range use (Klaczek et al. 2015; Newton et al. 2017). Habitat selection by wolves is also likely to be influenced by caribou occurrence (Klaczek et al. 2015). We avoided, however, including indices of caribou use in habitat selection models for wolves because we aimed to identify habitat characteristics that are associated with higher wolf occurrence independently of caribou use.

We modelled habitat selection of both species using a RSF equation of the form:

$$w\left(x\right)=exp⁡\left(β\_{0}+β\_{1}x\_{1}+…+β\_{k}x\_{k}+γ\_{0i}+γ\_{0j}\right)$$

where *w*(**x**) represented the relative probability of caribou or wolf occurrence, $β\_{0}$ represented the intercept for the population, $β\_{k}$ was the selection coefficient for the *kth* habitat characteristic, and $γ\_{0i}$ and $γ\_{0j}$ were the random intercepts for the *ith* year and the *jth* individual (Gillies et al. 2006). We only tested the most complete model which included all covariates described above. A preliminary analysis suggested that, for both caribou and wolves, the most parsimonious model was the most complete model (tested models also included vegetation covariates, elevation and proximity to water taken seperatly; AIC; Burnham and Anderson 2002). We checked for multicollinearity among covariates using a Variance Inflator (VIF) test. To reduce multicollinearity, we standardized continuous variables. We assessed the predictive performance of the best model using a 4-fold cross-validation (Boyce et al. 2002). We used the model prediction for the available locations of 75% of individuals to create 10 validation bins and then classified the prediction for the locations used by the remaining 25% of individuals in the 10 bins. We measured the rank correlation (Rspearman) between fold rank and frequency of used locations in each fold. We repeated the validation procedure 10 times and used the mean Rspearman as an index of model performance. All models had a good predictive performance (Rspeaman>0.70) and could be used to predict habitat selection and predation risk on seasonal caribou ranges. We calculated the relative probabilities of caribou and wolf occurrence on each pixel of 250 x 250 m of the summer and winter ranges. We calculated relative occurrence probability on an annual basis between 2009 and 2016 to account for annual variations in vegetation productivity and fire occurrences. We used the mean value of vegetation productivity during each summer-year to make the seasonal prediction of caribou relative probability of occurrence.

**Results**

RSF models for caribou and wolves had a good predictive power (Table 1). Patterns of habitat selection by migratory caribou and gray wolves varied greatly across herds and seasons (Tables 3 and 4).

Table 1. Spearman’s rank correlations calculated from the k-fold cross validation to assess the predictive performance of RSF models for migratory caribou of the Rivière-aux-Feuilles (RFH) and Rivière-George (RGH) herds and associated gray wolves, in northern Québec and Labrador, Canada.

|  |  |  |  |
| --- | --- | --- | --- |
| Species | Herd | Season | Rspearman |
| Caribou | RFH | Summer | 0.92 |
| Winter | 0.97 |
| RGH | Summer | 0.99 |
| Winter | 0.97 |
| Wolves | RFH | Summer | 0.86 |
| Winter | 0.87 |
| RGH | Summer | 0.91 |
| Winter | 0.99 |

Table 2. Vegetation cover types used to describe habitat selection by migratory caribou of the Rivière-aux-Feuilles (RFH) and Rivière-George (RGH) herds, and gray wolves on both caribou herd ranges in northern Québec and Labrador, Canada, 2009-2016. The original number (Original no.) and names correspond to the vegetation cover types originally described by Latifovic and Pouliot (2005).

|  |  |  |  |
| --- | --- | --- | --- |
| Vegetation cover type | Original no. | Original name | Description |
| Boreal forest | 1 | Temperate or sub-polar needleleaf forest | Forest generally taller than 3 m composing >20% of total vegetation with >75% of forest cover composed of needleleaf trees |
| 5 | Temperate or sub-polar broadleaf deciduous forest | Forest generally taller than 3 m composing >20% of total vegetation with >75% of forest cover composed of deciduous trees |
| 6 | Mixed forest | Forest generally taller than 3 m composing >20% of total vegetation with <75% covered by broadleaf or needleleaf forest, groups are co-dominant |
| Taiga forest | 2 | Sub-polar taiga needleleaf forest | Forest generally taller than 3 m, >75% of needleleaf forest and >5% of cover with shrub and lichens |
| Forest | 1, 2, 5, 6 | N/A | See descriptions above |
| Shrubland | 8 | Temperate or sub-polar shrubland | Areas dominated by shrubs (<3 m) with cover >20% |
| 11 | Sub-polar or polar shrubland-lichen-moss | Areas dominated with dwarf shrubs with lichen and moss covering at least 20% of total vegetation cover |
| Forest and shrubland | 1, 2, 8, 11 | N/A | See descriptions above |
| Grassland | 10 | Temperate or sub-polar grassland | Areas dominated by graminoid or herbaceous vegetation covering >80% of total cover |
| 12 | Sub-polar or polar grassland-lichen-moss | Areas dominated by grassland with lichen and moss covering at least 20% of vegetation cover |
| Open areas | 13 | Sub-polar or polar barren-lichen-moss | Areas dominated by a mixture of bare areas with lichens and moss for at least 20% of the cover |
| 14 | Wetland | Area dominated with perennial herbaceous and woody wetland vegetation (marches, swamps, bogs) |
| 16 | Barren lands | Areas characterized by bare rock, gravel, sand, silt, clay and other earthen material with <10% of green vegetation |
| 32 | N/A | Fires (from the Canadian National Fire Database) |
| Lichen-moss | 13 | N/A | See descriptions above |
| Barren-lichen-moss | 13, 16 | N/A | See descriptions above |
| Barren and wetlands | 14, 16 | N/A | See descriptions above |
| Water | 0, 18 | Water | Water (with <25% of non-water cover types) |

Table 3. Summary of the Resource Selection models used to describe habitat selection by caribou of the Rivière-aux-Feuilles (RFH) and Rivière-George (RGH) herds, northern Québec and Labrador, Canada (2009-2006). For each model, we provide selection coefficient (β), standard error (SE), 95% confidence intervals (L and U CI) and the variance inflator factors (VIF). The (\*) identifies the reference vegetation cover type to which selection of other vegetation cover types are compared. The (-) identifies a vegetation cover type (barren-lichen-moss) that was too rare to be included in the RSF. This vegetation class was removed from the analysis for the RGH.

|  |  |  |  |
| --- | --- | --- | --- |
|   |   | RFH | RGH |
| Season | Variable | β | SE | L CI | U CI | VIF | β | SE | L CI | U CI | VIF |
| Winter | Water | -1.19 | 0.02 | -1.23 | -1.15 | 1.19 | -1.18 | 0.02 | -1.22 | -1.13 | 1.31 |
| Boreal forest | \* | \* | \* | \* | \* | -0.44 | 0.02 | -0.47 | -0.41 | 1.43 |
| Taiga forest | 0.05 | 0.02 | 0.02 | 0.08 | 1.35 | 0.41 | 0.02 | 0.38 | 0.45 | 1.77 |
| Shrubland | -0.07 | 0.02 | -0.10 | -0.04 | 1.35 | \* | \* | \* | \* | \* |
| Grassland | -1.23 | 0.02 | -1.27 | -1.19 | 1.16 | 0.16 | 0.02 | 0.13 | 0.19 | 1.94 |
| Open areas | -2.47 | 0.08 | -2.63 | -2.32 | 1.01 | -1.20 | 0.04 | -1.27 | -1.13 | 1.15 |
| Elevation | -0.45 | 0.01 | -0.47 | -0.44 | 1.17 | 0.19 | 0.01 | 0.18 | 0.20 | 1.92 |
| Distance to river | -0.08 | 0.01 | -0.09 | -0.06 | 2.13 | 0.16 | 0.01 | 0.15 | 0.17 | 1.93 |
| Distance to river2 | -0.01 | 0.003 | -0.01 | 0.00 | 2.06 | 0.07 | 0.005 | 0.06 | 0.08 | 1.91 |
| Distance to lake | 0.39 | 0.01 | 0.38 | 0.41 | 1.65 | 0.49 | 0.01 | 0.48 | 0.51 | 1.97 |
| Distance to lake2 | 0.22 | 0.01 | 0.20 | 0.22 | 1.55 | -0.21 | 0.004 | -0.22 | -0.20 | 1.82 |
| Summer | Water | -0.95 | 0.03 | -1.00 | -0.90 | 1.54 | -0.67 | 0.03 | -0.72 | -0.62 | 1.35 |
| Forest | -0.94 | 0.03 | -1.01 | -0.88 | 1.43 | -0.38 | 0.02 | -0.41 | -0.34 | 1.65 |
| Shrubland | -0.45 | 0.03 | -0.5 | -0.40 | 1.73 | \* | \* | \* | \* | \* |
| Grassland | 0.40 | 0.02 | 0.36 | 0.43 | 2.50 | 0.46 | 0.02 | 0.43 | 0.49 | 1.99 |
| Barren-lichen-moss | \* | \* | \* | \* | \* | - | - | - | - | - |
| Open areas | 0.20 | 0.06 | 0.09 | 0.32 | 1.06 | -0.32 | 0.03 | -0.38 | -0.26 | 1.42 |
| Elevation | 0.11 | 0.01 | 0.10 | 0.12 | 1.17 | 0.25 | 0.01 | 0.24 | 0.26 | 1.14 |
| NDVI | -0.31 | 0.05 | -0.41 | -0.22 | 1.44 | 1.34 | 0.04 | 1.26 | 1.42 | 1.23 |
| Distance to river | -0.15 | 0.01 | -0.17 | -0.14 | 1.86 | -0.04 | 0.01 | -0.05 | -0.02 | 1.57 |
| Distance to river2 | -0.05 | 0.005 | -0.06 | -0.04 | 1.81 | -0.18 | 0.005 | -0.19 | -0.17 | 1.55 |
| Distance to lake | -0.04 | 0.01 | -0.05 | -0.02 | 1.91 | -0.02 | 0.006 | -0.03 | -0.01 | 1.11 |
| Distance to lake2 | 0.08 | 0.004 | -0.07 | 0.09 | 2.22 | -0.36 | 0.005 | -0.37 | -0.34 | 1.11 |

Table 4. Summary of the Resource Selection models used to describe habitat selection by gray wolves on the Rivière-aux-Feuilles (RFH) and Rivière-George (RGH) herds’ ranges in northern Québec and Labrador, Canada (2009-2006). For each model, we provide selection coefficient (β), standard error (SE), 95% confidence intervals (L and U CI) and the variance inflator factors (VIF). The (\*) identify the reference vegetation classes to which selection of other vegetation classes are compared.

|  |  |  |  |
| --- | --- | --- | --- |
|   |   | RFH | RGH |
| Season | Variable | β | SE | L CI | U CI | VIF | β | SE | L CI | U CI | VIF |
| Winter | Water | \* | \* | \* | \* | \* | -0.19 | 0.07 | -0.32 | -0.06 | 1.49 |
| Forest | 0.39 | 0.04 | 0.30 | 0.46 | 2.26 | 0.45 | 0.06 | 0.33 | 0.56 | 1.81 |
| Shrubland | 0.32 | 0.05 | 0.22 | 0.41 | 1.78 | \* | \* | \* | \* | \* |
| Grassland | -0.38 | 0.04 | -0.46 | -0.29 | 1.98 | -0.67 | 0.05 | -0.77 | -0.57 | 1.80 |
| Open areas | 0.61 | 0.10 | 0.42 | 0.80 | 1.13 | -0.62 | 0.10 | -0.81 | -0.42 | 1.39 |
| Elevation | 0.05 | 0.02 | 0.02 | 0.08 | 1.21 | -0.75 | 0.03 | -0.80 | -0.70 | 1.47 |
| Distance to river | 0.09 | 0.02 | 0.05 | 0.13 | 2.13 | 0.70 | 0.02 | 0.65 | 0.75 | 1.50 |
| Distance to river2 | -0.03 | 0.01 | -0.05 | -0.01 | 1.73 | 0.11 | 0.02 | 0.07 | 0.15 | 1.39 |
| Distance to lake | 0.18 | 0.02 | 0.14 | 0.22 | 2.14 | 0.01 | 0.03 | -0.05 | 0.07 | 1.67 |
| Distance to lake2 | 0.23 | 0.02 | 0.20 | 0.26 | 1.79 | 0.37 | 0.02 | 0.33 | 0.4 | 1.39 |
| Summer | Water | -0.86 | 0.08 | -1.02 | -0.72 | 1.92 | 0.22 | 0.09 | 0.05 | 0.40 | 1.48 |
| Forest | -0.12 | 0.08 | -0.29 | 0.04 | 2.59 | \* | \* | \* | \* | \* |
| Shrubland | \* | \* | \* | \* | \* | -0.26 | 0.08 | -0.42 | -0.10 | 1.39 |
| Grassland | 0.27 | 0.06 | 0.15 | 0.40 | 3.78 | 0.90 | 0.07 | 0.76 | 1.03 | 2.02 |
| Open areas | 0.50 | 0.09 | 0.33 | 0.67 | 2.45 | 1.27 | 0.14 | 0.99 | 1.55 | 1.39 |
| NDVI | 1.48 | 0.17 | 1.15 | 1.81 | 1.41 | -0.46 | 0.21 | -0.86 | -0.05 | 1.54 |
| Elevation | -0.07 | 0.02 | -0.11 | -0.03 | 1.26 | -1.21 | 0.04 | -1.28 | 1.14 | 1.37 |
| Distance to river | 0.25 | 0.02 | 0.21 | 0.30 | 2.04 | 0.70 | 0.03 | 0.64 | 0.76 | 1.17 |
| Distance to river2 | -0.03 | 0.02 | -0.06 | 0.00 | 1.61 | 0.36 | 0.03 | 0.29 | 0.42 | 1.15 |
| Distance to lake | -0.03 | 0.02 | -0.07 | 0.02 | 2.20 | -0.57 | 0.04 | -0.64 | -0.50 | 1.75 |
| Distance to lake2 | 0.07 | 0.01 | 0.05 | 0.09 | 2.03 | -0.06 | 0.02 | -0.09 | -0.02 | 1.58 |

**Appendix 2. Correlations among variables tested to explain variations in caribou survival**

Table 1. Correlation matrix (RPearson) among the variables tested to explain variation in caribou survival of the Rivière-aux-Feuilles (RFH) and Rivière-George (RGH) herds in northern Québec and Labrador, Canada (2009-2016). The matrix also included the correlation coefficients between tested variables and latitude. Values above and under the diagonal respectively correspond to correlation coefficients during summer and winter. We assumed no correlation when RPearson < 0.50.

|  |  |  |  |
| --- | --- | --- | --- |
| Herd |   |  | Summer (above diagonal) |
|   |   |   | Use of highly selected habitats | Distance to nearest disturbance (all types) | Distance to nearest industrial disturbance | Distance to nearest non-industrial disturbance | Predation | Temperature | Precipitation | Latitude |
| RFH | Winter (under diagonal) | Use of highly selected habitats | - | 0.03 | 0.00 | 0.03 | 0.13 | 0.03 | 0.01 | -0.01 |
| Distance to nearest disturbance (all types) | 0.15 | - | 0.61 | 0.96 | 0.07 | -0.03 | 0.06 | -0.74 |
| Distance to nearest industrial disturbance | 0.18 | 0.45 | - | 0.54 | 0.12 | -0.17 | 0.06 | -0.57 |
| Distance to nearest non-industrial disturbance | 0.15 | 0.99 | 0.44 | - | 0.05 | -0.08 | -0.06 | -0.79 |
| Predation | 0.82 | 0.46 | 0.29 | 0.46 | - | -0.08 | 0.02 | -0.06 |
| Temperature | -0.03 | -0.19 | -0.04 | -0.18 | -0.09 | - | -0.02 | 0.22 |
| Precipitation | -0.05 | -0.12 | -0.05 | -0.12 | -0.08 | 0.34 | - | -0.08 |
| Latitude | 0.23 | 0.73 | 0.58 | 0.72 | 0.35 | -0.24 | -0.13 | - |
|  |  |  |  |  |  |  |  |  |  |  |
| RGH | Winter (under diagonal) | Use of highly selected habitats | - | -0.08 | -0.19 | 0.17 | -0.30 | -0.02 | 0.02 | 0.09 |
| Distance to nearest disturbance (all types) | 0.26 | - | 0.80 | 0.46 | 0.17 | 0.04 | -0.03 | 0.52 |
| Distance to nearest industrial disturbance | -0.23 | -0.14 | - | 0.54 | 0.00 | 0.09 | -0.02 | 0.19 |
| Distance to nearest non-industrial disturbance | 0.2 | 0.92 | -0.30 | - | 0.29 | -0.01 | -0.01 | 0.62 |
| Predation | 0.01 | -0.11 | -0.08 | -0.18 | - | -0.20 | -0.10 | -0.36 |
| Temperature | 0.00 | -0.08 | 0.19 | -0.07 | -0.07 | - | 0.08 | -0.09 |
| Precipitation | -0.02 | -0.03 | 0.05 | -0.03 | 0.00 | 0.36 | - | -0.02 |
| Latitude | 0.19 | 0.38 | -0.76 | 0.47 | 0.10 | -0.19 | -0.06 | - |

**Appendix 3. Identifying the most important factors for migratory caribou mortality risk using model selection**

Table 1. Relative support for the hypotheses (H1 to H6) and candidate models used to explain individual variation in early-life mortality risk in the Rivière-aux-Feuilles (RFH) and Rivière-George (RGH) herds in northern Québec and Labrador, Canada (2009-2016). For each model, we provide the Akaike Information Criterion (AIC), AIC difference with best model (ΔAIC) and Akaike weight (AIC ω). Models retained for interpretation (most parsimonious and non-nested models) are indicated in bold. Details for competing hypotheses H1 to H6 are given in the main text.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Hypothesis/Model | RFH | RGH |
| AIC | Delta AIC | AIC weight | AIC | Delta AIC | AIC weight |
| H1 | Use of highly selected habitats | 122.4 | 6.1 | 0.01 | 156.1 | 5.4 | 0.04 |
| H2 | Human disturbances | 124.5 | 8.2 | 0.00 | *Non-proportional risks* |
| H3 | Predation | **116.9** | **0.6** | **0.21** | **150.7** | **0.0** | **0.55** |
| H4 | Temperature | *Non-proportional risks* | *Non-proportional risks* |
| H4 | Precipitations | **116.3** | **0.0** | **0.28** | 156.8 | 6.1 | 0.03 |
| H5 | Habitat use + Human disturbances | 123.7 | 7.4 | 0.01 | 157.4 | 6.7 | 0.02 |
| H5 | Habitat use + Predation | 118.1 | 1.8 | 0.12 | 152.7 | 2.0 | 0.20 |
| H5 | Habitat use + Temperature | 123.6 | 7.3 | 0.01 | 157.3 | 6.6 | 0.02 |
| H5 | Habitat use + Precipitations | 116.3 | 0.0 | 0.28 | 156.9 | 6.2 | 0.02 |
| H5 | All (additive) | 119.3 | 3.0 | 0.06 | *Non-proportional risks* |
| H6 | Maladaptive (habitat use \* disturbances) | 123.5 | 7.2 | 0.01 | *Non-proportional risks* |
| H6 | Maladaptive (habitat use \* predation) | *Non-proportional risks* | 154.9 | 4.2 | 0.07 |
| H0 | Null | 124.7 | 8.4 | 0.00 | 155.37 | 4.7 | 0.05 |

Table 2. Relative support of the candidate models used to explain variations in seasonal and daily mortality risk for migratory caribou of the Rivière-aux-Feuilles (RFH) and Rivière-George (RGH) herds in northern Québec and Labrador, Canada (2009-2016). For each model, we provide the Akaike Information Criterion (AIC), difference in AIC with the most parsimonious model (ΔAIC) and Akaike’s weight (AIC ω). Models retained for interpretation (most parsimonious and non-nested models) are indicated in bold. (--) indicates that the at least one variable in the model was correlated with the % of locations in highly selected habitat, and that the model was not tested.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Scale | Herd | Model | Winter | Summer |
| AIC | Delta AIC | AIC weight | AIC | Delta AIC | AIC weight |
| Seasonal mortality risk | RFH | Habitat use | **126.6** | **0.0** | **0.35** | 151.3 | 24.7 | 0.00 |
| Human disturbances | 141.7 | 15.1 | 0.00 | 152.2 | 25.6 | 0.00 |
| Predation | -- | -- | -- | 150.9 | 24.3 | 0.00 |
| Temperature | 142.4 | 15.8 | 0.00 | **126.6** | **0.0** | **0.62** |
| Precipitations | 141.7 | 15.1 | 0.00 | 152.2 | 25.6 | 0.00 |
| Habitat use + Human disturbances | 128.2 | 1.6 | 0.16 | 153.4 | 26.8 | 0.00 |
| Habitat use + Predation | -- | -- | -- | 152.8 | 26.2 | 0.00 |
| Habitat use + Temperature | 128.0 | 1.4 | 0.18 | 128.6 | 2.0 | 0.22 |
| Habitat use + Precipitations | 128.7 | 2.1 | 0.13 | 153.4 | 26.8 | 0.00 |
| Maladaptive (habitat use \* disturbance) | 127.9 | 1.3 | 0.18 | 129.3 | 2.7 | 0.16 |
| Maladaptive (habitat use \* predation) | -- | -- | -- | 143.6 | 17.0 | 0.00 |
| Null | 140.4 | 13.8 | 0.00 | 150.2 | 23.6 | 0.00 |
| RGH | Habitat use | 194.6 | 2.0 | 0.08 | 193.9 | 6.5 | 0.02 |
| Human disturbances | 194.1 | 1.5 | 0.10 | **189.0** | **1.6** | **0.23** |
| Predation | 194.3 | 1.7 | 0.09 | 196.5 | 9.1 | 0.01 |
| Temperature | 193.9 | 1.3 | 0.11 | 196.7 | 9.3 | 0.00 |
| Precipitations | 195.7 | 3.1 | 0.05 | 196.5 | 9.1 | 0.01 |
| Habitat use + Human disturbances | 195.4 | 2.8 | 0.05 | 189.8 | 2.4 | 0.15 |
| Habitat use + Predation | 195.9 | 3.3 | 0.04 | 195.8 | 8.4 | 0.01 |
| Habitat use + Temperature | 194.1 | 1.5 | 0.10 | 195.4 | 8.0 | 0.01 |
| Habitat use + Precipitations | 196.7 | 4.1 | 0.03 | 195.8 | 8.4 | 0.01 |
| Maladaptive (habitat use \* disturbance) | 192.6 | 0.0 | 0.21 | 187.4 | 0.0 | 0.53 |
| Maladaptive (habitat use \* predation) | 198.1 | 5.5 | 0.01 | 194.1 | 6.7 | 0.02 |
| Null | **193.6** | **1.0** | **0.13** | 194.8 | 7.4 | 0.01 |
| Daily mortality risk | RFH | Habitat use | 91.3 | 8.9 | 0.01 | 100.4 | 53.6 | 0.00 |
| Human disturbances | 89.6 | 7.2 | 0.01 | 77.5 | 30.7 | 0.00 |
| Predation | -- | -- | -- | 100.6 | 53.8 | 0.00 |
| Temperature | **82.4** | **0.0** | **0.51** | 97.3 | 50.5 | 0.00 |
| Precipitations | 89.9 | 7.5 | 0.01 | 97.4 | 50.6 | 0.00 |
| Habitat use + Human disturbances | 91.6 | 9.2 | 0.01 | 79.4 | 32.6 | 0.00 |
| Habitat use + Predation | -- | -- | -- | 102.3 | 55.5 | 0.00 |
| Habitat use + Temperature | 84.4 | 2.0 | 0.19 | 99.3 | 52.5 | 0.00 |
| Habitat use + Precipitations | 91.7 | 9.3 | 0.00 | 99.1 | 52.3 | 0.00 |
| Maladaptive (habitat use \* disturbance) | 92.9 | 10.5 | 0.00 | 72.4 | 25.6 | 0.00 |
| Maladaptive (habitat use \* predation) | -- | -- | -- | 90.9 | 44.1 | 0.00 |
| Null | **83.9** | **1.5** | **0.25** | **46.8** | **0.0** | **1.00** |
| RGH | Habitat use | **155.7** | **0.4** | **0.17** | 124.2 | 74.5 | 0.00 |
| Human disturbances | 163.5 | 8.2 | 0.00 | 116.0 | 66.3 | 0.00 |
| Predation | 161.8 | 6.5 | 0.01 | -- | -- | -- |
| Temperature | 163.8 | 8.5 | 0.00 | 119.7 | 70.0 | 0.00 |
| Precipitations | 159.1 | 3.8 | 0.03 | 121.4 | 71.7 | 0.00 |
| Habitat use + Human disturbances | 155.8 | 0.5 | 0.15 | 115.8 | 66.1 | 0.00 |
| Habitat use + Predation | 155.3 | 0.0 | 0.20 | -- | -- | -- |
| Habitat use + Temperature | 158.8 | 3.5 | 0.10 | 121.7 | 72.0 | 0.00 |
| Habitat use + Precipitations | 155.4 | 0.1 | 0.19 | 122.4 | 72.7 | 0.00 |
| Maladaptive (habitat use \* disturbance) | 157.9 | 2.6 | 0.06 | 107.0 | 57.3 | 0.00 |
| Maladaptive (habitat use \* predation) | 156.8 | 1.5 | 0.10 | -- | -- | -- |
| Null | 164.3 | 9.0 | 0.00 | **49.7** | **0.0** | **1.00** |