

The Effect of Traffic Levels on the Distribution and Behavior of Calving Caribou in an Arctic Oilfield

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SUPPLEMENTARY TABLES

TABLE S1. Top-five performing logistic regression models for the probability of caribou exhibiting moderate or strong reactions during road surveys of the Tarn and Meltwater Roads during 2001–03, AICc scores, and the probability (Akaike weight) that each model was the best in the candidate set.

| Model | AICc | Akaike weight |
|---|--------|---------------|
| Area + Period + Dist_class + Calf + Distance*Area | 1159.9 | 0.464 |
| Area + Period + Dist_class + Calf + Distance*Area + Period*Area | 1160.5 | 0.341 |
| Area + Period + Dist_class + Calf | 1162.9 | 0.104 |
| Area + Period + Dist_class + Calf + Period*Area | 1163.2 | 0.087 |
| Area + Period + Dist_class + Calf + Distance*Area + Distance*Period | 1170.1 | 0.003 |

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TABLE S2. Top three performing RSF models for all groups, AICc scores, and the probability (Akaike weight) that each model was the best model in the candidate set for caribou observed during aerial surveys of the Tarn and Meltwater survey areas during different time periods, Kuparuk oilfield, northern Alaska, 2001–03.

| Year | Period | RSF model | AICc | Akaike weight |
|---------|-------------|---|-----------|---------------|
| 2001 | Precalving | IDW + Ruggedness | 150.56 | 0.207 |
| | | IDW | 150.91 | 0.173 |
| | | IDW + Elevation + Ruggedness | 152.36 | 0.084 |
| | Calving | Elevation + Dist. Coast + IDW + Ruggedness + Dist. Roads | 1682.18 | 0.897 |
| | | Elevation + Dist. Coast + Ruggedness + Dist. Roads | 1688.59 | 0.036 |
| | | Elevation + Landcover + Dist. Coast + IDW + Ruggedness + Dist. Roads | 1689.55 | 0.022 |
| | Postcalving | Landcover + Dist. Coast + IDW + Dist. Roads | 3765.54 | 0.128 |
| | | Landcover + Dist. Coast + IDW + Ruggedness + Dist. Roads | 3765.94 | 0.105 |
| | | Elevation + Landcover + Dist. Coast + IDW + Dist. Roads | 3766.10 | 0.097 |
| 2002 | Precalving | Landcover + Dist. Coast + IDW | 1880.88 | 0.217 |
| | | Landcover + IDW | 1881.83 | 0.135 |
| | | Elevation + Landcover + Dist. Coast + IDW | 1882.54 | 0.095 |
| | Calving | Elevation + Landcover + Dist. Coast + IDW | 6269.95 | 0.204 |
| | | Elevation + Dist. Coast + IDW | 6270.20 | 0.180 |
| | | Elevation + Landcover + Dist. Coast + IDW + Ruggedness | 6270.66 | 0.143 |
| | Postcalving | Landcover + Dist. Roads | 5654.66 | 0.159 |
| | | Landcover + IDW + Dist. Roads | 5655.30 | 0.115 |
| | | Elevation + Landcover + Dist. Roads | 5655.42 | 0.109 |
| 2003 | Precalving | Dist. Platform + Ruggedness | 684.56 | 0.110 |
| | | Ruggedness | 684.75 | 0.100 |
| | | Ruggedness + Dist. Roads | 685.75 | 0.060 |
| | Calving | Elevation + Landcover + Dist. Coast + IDW + Dist. Roads | 3514.67 | 0.539 |
| | | Elevation + Landcover + Dist. Coast + IDW + Ruggedness + Dist. Roads | 3515.86 | 0.298 |
| | | Dist. Platform + Elevation + Landcover + Dist. Coast + IDW + Ruggedness + Dist. Roads | 3518.24 | 0.090 |
| | Postcalving | Elevation + Dist. Coast + IDW + Ruggedness + Dist. Roads | 6848.69 | 0.660 |
| | | Dist. Platform + Elevation + Dist. Coast + IDW + Ruggedness + Dist. Roads | 6851.26 | 0.183 |
| | | Dist. Coast + IDW + Ruggedness + Dist. Roads | 6854.09 | 0.044 |
| 2001–03 | Precalving | Landcover + Dist. Coast + IDW + Ruggedness | 2750.82 | 0.250 |
| | | Elevation + Landcover + IDW + Ruggedness | 2751.73 | 0.159 |
| | | Landcover + IDW + Ruggedness | 2751.83 | 0.151 |
| | Calving | Elevation + Landcover + Dist. Coast + IDW + Ruggedness + Dist. Roads | 11 478.89 | 0.861 |
| | | Elevation + Landcover + Dist. Coast + IDW + Dist. Roads | 11 483.04 | 0.108 |
| | | Elevation + Dist. Coast + IDW + Ruggedness + Dist. Roads | 11 485.91 | 0.026 |
| | Postcalving | Landcover + IDW + Ruggedness + Dist. Roads | 16 309.16 | 0.455 |
| | | Landcover + Dist. Coast + IDW + Ruggedness + Dist. Roads | 16 311.02 | 0.179 |
| | | Elevation + Landcover + IDW + Ruggedness + Dist. Roads | 16 311.14 | 0.169 |

TABLE S3. Top three performing RSF models for groups containing calves, AICc scores, and the probability (Akaike weight) that each model was the best model in the candidate set for caribou observed during aerial surveys of the Tarn and Meltwater survey areas, 2001–03.

| Year | Period | RSF model | AICc | Akaike weight |
|---------|-------------|---|---------|---------------|
| 2001 | Calving | Elevation + Dist. Coast + IDW + Ruggedness + Dist. Roads | 759.31 | 0.469 |
| | | Elevation + Dist. Coast + Ruggedness + Dist. Roads | 761.50 | 0.157 |
| | | Elevation + IDW + Ruggedness + Dist. Roads | 761.93 | 0.127 |
| | Postcalving | Elevation + Landcover + Dist. Coast + IDW | 1190.38 | 0.481 |
| | | Elevation + Landcover + Dist. Coast + IDW + Ruggedness | 1192.29 | 0.185 |
| | | Elevation + Dist. Coast + IDW | 1193.41 | 0.106 |
| 2002 | Calving | Elevation + Dist. Coast + IDW + Ruggedness + Dist. Roads | 1352.61 | 0.795 |
| | | Dist. Coast + IDW + Ruggedness + Dist. Roads | 1357.04 | 0.087 |
| | | Elevation + Dist. Coast + IDW + Dist. Roads | 1357.88 | 0.057 |
| | Postcalving | Elevation + Landcover + Dist. Coast + IDW + Dist. Roads | 3446.59 | 0.201 |
| | | Elevation + Landcover + Dist. Coast + Dist. Roads | 3447.05 | 0.160 |
| | | Elevation + Landcover + Dist. Coast + IDW + Ruggedness + Dist. Roads | 3447.67 | 0.117 |
| 2003 | Calving | Elevation + Landcover + Dist. Coast + IDW + Ruggedness + Dist. Roads | 1195.82 | 0.244 |
| | | Elevation + Landcover + Dist. Coast + IDW + Dist. Roads | 1196.16 | 0.205 |
| | | Elevation + Dist. Coast + IDW + Ruggedness + Dist. Roads | 1196.22 | 0.199 |
| | Postcalving | Dist. Platform + Elevation + Dist. Coast + IDW + Ruggedness + Dist. Roads | 4344.38 | 0.398 |
| | | Dist. Platform + IDW + Ruggedness + Dist. Roads | 4345.64 | 0.212 |
| | | Dist. Platform + Elevation + IDW + Ruggedness + Dist. Roads | 4346.74 | 0.122 |
| 2001–03 | Calving | Elevation + Dist. Coast + IDW + Ruggedness + Dist. Roads | 3290.40 | 0.977 |
| | | Elevation + Landcover + Dist. Coast + IDW + Ruggedness + Dist. Roads | 3298.01 | 0.022 |
| | | Elevation + Dist. Coast + IDW + Dist. Roads | 3303.72 | 0.001 |
| | Postcalving | IDW + Ruggedness + Dist. Roads | 9025.63 | 0.224 |
| | | Landcover + IDW + Ruggedness + Dist. Roads | 9026.04 | 0.183 |
| | | Elevation + Dist. Coast + IDW + Ruggedness + Dist. Roads | 9026.52 | 0.144 |

TABLE S4. Mean Pearson's rank correlation coefficient (r) of RSF model of caribou groups observed during aerial surveys fit using k -fold cross-validation by year, period, and type of caribou group, 2001–03.

| Year | Period | All groups | Calf groups |
|---------|-------------|------------|-------------|
| 2001 | Precalving | 0.49 | – |
| | Calving | 0.84 | 0.63 |
| | Postcalving | 0.69 | 0.73 |
| 2002 | Precalving | 0.82 | – |
| | Calving | 0.84 | 0.91 |
| | Postcalving | 0.44 | 0.49 |
| 2003 | Precalving | 0.35 | – |
| | Calving | 0.80 | 0.71 |
| | Postcalving | 0.74 | 0.65 |
| 2001–03 | Precalving | 0.71 | – |
| | Calving | 0.92 | 0.91 |
| | Postcalving | 0.84 | 0.74 |

TABLE S5. Independent variables and their probability of being in the best RSF model (i.e., the sum of all Akaike weights for all models that included the variable) of all caribou group locations, 2001–03.

| Variable | 2001 | | | 2002 | | | 2003 | | |
|----------------|------------|---------|-------------|------------|---------|-------------|------------|---------|-------------|
| | Precalving | Calving | Postcalving | Precalving | Calving | Postcalving | Precalving | Calving | Postcalving |
| Dist. Coast | 0.29 | 0.98 | 0.72 | 0.53 | 0.95 | 0.29 | 0.30 | 1.00 | 0.96 |
| Elevation | 0.31 | 0.99 | 0.51 | 0.33 | 0.79 | 0.36 | 0.28 | 1.00 | 0.91 |
| IDW | 0.98 | 0.96 | 0.91 | 1.00 | 1.00 | 0.36 | 0.30 | 1.00 | 0.99 |
| Ruggedness | 0.52 | 0.98 | 0.43 | 0.27 | 0.42 | 0.32 | 1.00 | 0.36 | 1.00 |
| Dist. Platform | – | – | – | – | – | – | 0.50 | 0.15 | 0.21 |
| Dist. Roads | 0.09 | 1.00 | 0.75 | 0.03 | 0.23 | 0.91 | 0.36 | 1.00 | 1.00 |
| Landcover | 0.15 | 0.02 | 0.87 | 0.75 | 0.56 | 1.00 | 0.09 | 0.98 | 0.05 |

TABLE S6. Independent variables and their probability of being in the best RSF model (i.e., the sum of all Akaike weights for all models that included the variable) of caribou groups with at least one calf, 2001–03.

| Variable | 2001 | | 2002 | | 2003 | |
|----------------|---------|-------------|---------|-------------|---------|-------------|
| | Calving | Postcalving | Calving | Postcalving | Calving | Postcalving |
| Dist. Coast | 0.76 | 1.00 | 0.97 | 0.73 | 1.00 | 0.59 |
| Elevation | 0.88 | 0.98 | 0.88 | 0.76 | 0.95 | 0.63 |
| IDW | 0.80 | 0.98 | 1.00 | 0.68 | 0.99 | 1.00 |
| Ruggedness | 0.92 | 0.28 | 0.94 | 0.36 | 0.55 | 1.00 |
| Dist. Platform | – | – | – | – | 0.13 | 0.83 |
| Dist. Roads | 1.00 | 0.16 | 1.00 | 0.97 | 1.00 | 1.00 |
| Landcover | 0.04 | 0.83 | 0.03 | 0.88 | 0.54 | 0.01 |

TABLE S7. Model-weighted parameter estimates for RSF models during three periods for all groups, 2001–2003. Coefficients in bold type indicate significance at the 0.05 level.

| Variable | 2001 | | | 2002 | | | 2003 | | |
|--|------------|--------------|-------------|-------------|--------------|-------------|------------|--------------|--------------|
| | Precalving | Calving | Postcalving | Precalving | Calving | Postcalving | Precalving | Calving | Postcalving |
| Dist. Coast | -0.02 | -0.51 | -0.15 | -0.07 | -0.19 | 0.00 | 0.01 | -0.53 | 0.25 |
| Elevation | -0.09 | 0.55 | 0.07 | 0.00 | 0.13 | 0.02 | 0.00 | 0.42 | -0.20 |
| IDW | -1.33 | 0.22 | 0.14 | 0.45 | 0.24 | 0.01 | 0.02 | 0.27 | 0.17 |
| Ruggedness | 0.18 | -0.25 | -0.03 | 0.00 | -0.02 | 0.01 | 0.37 | -0.02 | 0.13 |
| Dist. Platform (0–2 km) ¹ | – | – | – | – | – | – | -7.22 | 0.03 | -0.06 |
| Dist. Platform (2–4 km) ¹ | – | – | – | – | – | – | 0.12 | 0.01 | 0.01 |
| Dist. Meltwater (0–2 km) ² | -0.06 | -0.18 | -0.32 | 0.00 | -0.04 | 0.28 | 0.23 | -0.34 | 0.21 |
| Dist. Tarn (0–2 km) ² | -1.46 | -1.79 | 0.31 | 0.00 | -0.06 | 0.13 | 0.19 | -0.96 | 0.40 |
| Dist. Meltwater (2–4 km) ² | 0.02 | 0.20 | -0.26 | 0.01 | -0.02 | 0.29 | 0.26 | 0.05 | 0.38 |
| Dist. Tarn (2–4 km) ² | 0.02 | -0.49 | 0.06 | 0.00 | -0.03 | 0.30 | -0.03 | -0.35 | 0.36 |
| Aquatic sedge ³ | -2.46 | -0.01 | -0.29 | -0.41 | -0.48 | -0.72 | -0.05 | -0.59 | 0.01 |
| Dwarf shrub/ <i>Dryas</i> ³ | -2.25 | -0.01 | 0.04 | 0.30 | 0.15 | 0.04 | 0.10 | -0.40 | 0.02 |
| Mesic herbaceous ³ | -0.02 | -0.01 | 0.07 | 0.17 | -0.07 | -0.02 | -0.05 | -0.77 | 0.01 |
| Riparian/Otherc | 0.18 | -0.02 | -1.64 | -1.01 | 0.20 | -1.11 | -0.05 | -1.19 | 0.00 |
| Wet sedge ³ | -2.42 | 0.00 | -0.40 | -0.58 | -0.07 | -0.57 | -0.06 | -0.53 | 0.00 |

¹ Distance to platform compared with reference category of areas more than 4 km from platform.

² Distance to roads compared with reference category of areas more than 4 km from either road.

³ Landcover classes were compared with the reference class “Sedge–Shrub Tundra.”

TABLE S8. Model-weighted parameter estimates for RSF models during two periods over three years (2001–03), for groups with at least one calf. Coefficients in bold type indicate significance at the 0.05 level.

| Variable | 2001 | | 2002 | | 2003 | |
|--|--------------|--------------|--------------|-------------|--------------|-------------|
| | Calving | Postcalving | Calving | Postcalving | Calving | Postcalving |
| Dist. Coast | -0.39 | -0.77 | -0.52 | -0.19 | -0.84 | 0.11 |
| Elevation | 0.49 | 0.55 | 0.36 | 0.20 | 0.51 | -0.12 |
| IDW | 0.20 | 0.30 | 0.37 | 0.09 | 0.33 | 0.21 |
| Ruggedness | -0.30 | 0.01 | -0.23 | 0.02 | -0.08 | 0.16 |
| Dist. Platform (0–2 km) ¹ | – | – | – | – | -0.03 | -0.44 |
| Dist. Platform (2–4 km) ¹ | – | – | – | – | 0.01 | 0.32 |
| Dist. Meltwater (0–2 km) ² | -1.91 | -0.13 | -2.34 | 0.28 | -1.27 | 0.32 |
| Dist. Tarn (0–2 km) ² | -1.69 | -0.09 | -1.84 | 0.23 | -1.14 | 0.44 |
| Dist. Meltwater (2–4 km) ² | 0.01 | 0.00 | -0.76 | 0.50 | 0.60 | 0.64 |
| Dist. Tarn (2–4 km) ² | -1.26 | -0.02 | -1.72 | 0.51 | -0.70 | 0.43 |
| Aquatic sedge ³ | 0.01 | -0.60 | 0.00 | -0.89 | -0.05 | 0.00 |
| Dwarf shrub/ <i>Dryas</i> ³ | 0.00 | -1.02 | 0.01 | -0.10 | -0.70 | 0.00 |
| Mesic herbaceous ³ | 0.02 | 0.47 | -0.02 | -0.09 | -0.45 | 0.00 |
| Riparian/Other ³ | -0.59 | -11.16 | 0.01 | -0.95 | -0.46 | 0.00 |
| Wet sedge ³ | 0.02 | -0.49 | 0.01 | -0.48 | -0.44 | 0.00 |

¹ Distance to platform compared with reference category of areas more than 4 km from platform.

² Distance to roads compared with reference category of areas more than 4 km from either road.

³ Landcover classes were compared with the reference class “Sedge–Shrub Tundra.”