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Appendix 1–6

Appendix 1

Pearson's correlation coefficient between environmental predictors used for assessment of Svalbard reindeer calving habitat selection

Table A1. Pairwise Pearson's correlation coefficients (r^2) matrix for environmental predictors of Svalbard reindeer calving habitat selection in the (A) inland study area, and (B) coastal study area. Correlations $> \pm 0.7$ are indicated by bold. See Table 2 for an overview of the ecological meaning, resolution and references to reindeer-habitat relations.

A) INLAND	elevation	slope	aspect	heatload	wetness	ruggedness	barren	moss	heath	onset of the growing season	foxdens
elevation	1.00	0.61	-0.02	0.03	-0.53	0.24	0.48	-0.59	-0.01	0.15	0.24
slope	0.61	1.00	-0.02	-0.02	-0.65	0.41	0.46	-0.63	-0.14	0.07	0.20
aspect	-0.02	-0.02	1.00	0.48	0.01	-0.04	0.04	0.07	0.01	-0.06	-0.05
heatload	0.03	-0.02	0.48	1.00	0.02	-0.06	0.30	0.01	0.12	-0.02	0.03
wetness	-0.53	-0.66	0.01	0.02	1.00	-0.32	-0.33	0.47	0.01	-0.11	-0.21
ruggedness	0.24	0.41	-0.04	-0.07	-0.32	1.00	0.19	-0.27	-0.06	0.04	0.06
barren	0.48	0.46	0.04	0.30	-0.32	0.19	1.00	-0.59	-0.24	-0.02	0.16
moss	-0.59	-0.63	0.07	0.01	0.47	-0.27	-0.59	1.00	-0.28	-0.07	-0.21
heath	-0.01	-0.14	0.01	0.12	0.01	-0.06	-0.24	-0.28	1.00	0.17	-0.01
onset of the growing season	0.15	0.07	-0.06	-0.02	-0.11	0.04	-0.02	-0.07	0.17	1.00	0.16
foxdens	0.24	0.20	-0.05	0.03	-0.21	0.06	0.16	-0.21	-0.01	0.16	1.00

B) COASTAL	elevation	slope	aspect	heatload	wetness	ruggedness	barren	moss	heath	onset of the growing season	foxdens
elevation	1.00	0.72	-0.08	0.15	-0.57	0.49	0.31	-0.36	-0.29	-0.03	-0.17
slope	0.72	1.00	-0.11	0.28	-0.72	0.52	0.32	-0.38	-0.31	-0.06	-0.26
aspect	-0.08	-0.11	1.00	0.18	0.09	-0.06	-0.01	0.05	0.04	-0.01	0.11
heatload	0.15	0.28	0.18	1.00	-0.20	0.05	0.30	-0.15	-0.07	-0.04	-0.08
wetness	-0.57	-0.72	0.09	-0.20	1.00	-0.45	-0.28	0.35	0.19	0.04	0.22
ruggedness	0.49	0.52	-0.06	0.05	-0.45	1.00	0.13	-0.17	-0.16	-0.03	-0.10
barren	0.31	0.32	-0.01	0.30	-0.28	0.13	1.00	-0.61	-0.53	-0.18	-0.14
moss	-0.36	-0.38	0.05	-0.15	0.35	-0.17	-0.61	1.00	-0.12	0.10	0.21
heath	-0.29	-0.31	0.04	-0.07	0.19	-0.16	-0.53	-0.12	1.00	0.15	0.05
onset of the growing season	-0.03	-0.06	-0.01	-0.04	0.04	-0.03	-0.18	0.10	0.15	1.00	0.02
foxdens	-0.17	-0.26	0.11	-0.08	0.22	-0.10	-0.14	0.21	0.05	0.02	1.00

Appendix 2

Re-classification of the digital habitat map by Johansen et al. (2012)

Table A2. Overview of the original 37 habitat classes from Johansen et al. (2012) that we regrouped into three coarse habitat types that reflect two main foraging habitats (*moss tundra* and *heath*) for Svalbard reindeer and one class reflecting large parts of the sparsely vegetated foraging landscape for Svalbard reindeer (*barren*). **Moss tundra** includes all vegetation classes that in their description mention moss tundra, and consists of areas dominated by mosses, graminoids and *Salix polaris*. **Heath** includes vegetation classes with drier vegetation dominated by the dwarf *Cassiope tetragona* or *Dryas octopetala*. At the coastal flats, this class is typically dominated by *Saxifraga oppositifolia* and the mesic *Luzula* spp. **Barren** includes classes with polar desert, polygon fields non-vegetated to sparsely vegetated flats, beaches, slopes and ridges. Not classified types are indicated by ‘-’.

Habitat type	Habitat type *	Reclassified coarse habitat type	Biomass (g/m ²) **
Sea and fjords	1	-	0
Inland lakes, broad flooding rivers, melt zones	2,3	-	0
Shadow areas (not classified by the satellite image)	5,29	-	0
Glaciers	4,6,32	-	0
Wet, non-vegetated to sparsely vegetated flats, beaches, slopes and river fans	7,9,30	barren	8
Dry, non-vegetated to sparsely vegetated barrens, slopes and ridges	28,31	barren	8
Vegetated flats, coastal moss tundra, vegetated beaches, slopes and river fans	8,14,15,33	barren	177
Moderate snow bed and snow flush communities	34,35	barren	259
Swamps, mires and wet moss tundra	10,11	moss tundra	406
Moist/wet tussock and moss tundra	12	moss tundra	366
Mires and wet marsh/moss tundra	13	moss tundra	383
Moist moss tundra	37	moss tundra	329
Bird cliff and wet moss tundra communities	36	moss tundra	473
Arctic meadows	19	moss tundra	505
Arctic meadows and bird cliff vegetation	20	moss tundra	505
Open dry-grass communities	25	heath	200
Open <i>Dryas octopetala</i> communities with <i>Carex</i> <i>rupestris</i>	22	heath	218
Dense <i>Dryas octopetala</i> heaths	18	heath	415
<i>Cassiope tetragona</i> heaths with elements of <i>Dryas</i> heaths	21	heath	636
<i>Luzula</i> spp., sparse graminoid vegetation and lichens	16,17	heath	198
Gravel barren communities and polar deserts	23,24	barren	48
Polar deserts, polygon fields	26,27	barren	48

*Original vegetation classes from (Johansen et al. 2012).

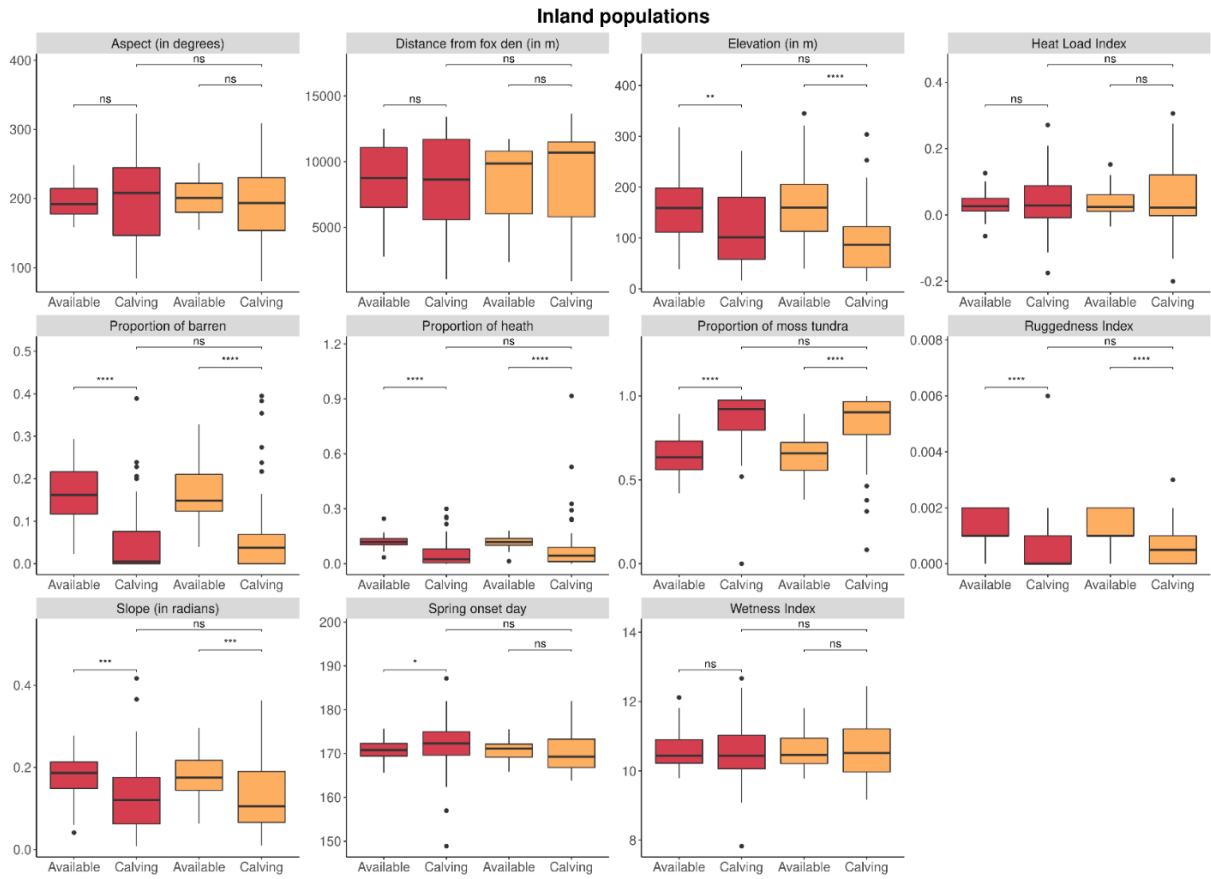
**Brattbakk og Rønning 1978, Zonneveld et al. 2004, Johnsen og Tømmervik 2014.

References

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Appendix 3

Summary statistics of predictor variables used for assessment of Svalbard reindeer calving habitat selection in coastal and inland study areas.



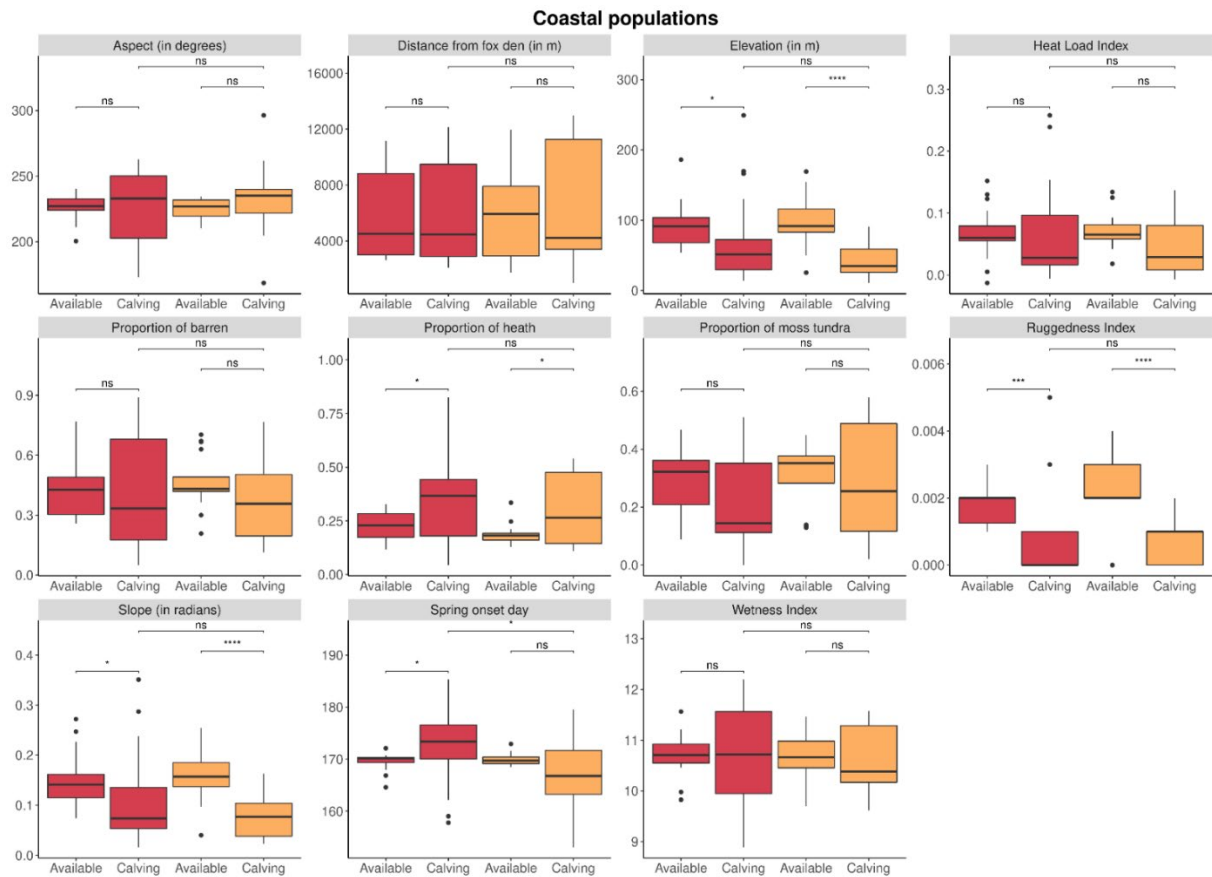


Figure A3. Boxplots of 11 predictor variables used to assess Svalbard reindeer calving habitat selection in inland (upper panel) and coastal (lower panel) populations over the study period (2009–2017). For females with a calf at heel in summer (red boxes), used pixel values were extracted seven days after calving ($N_{\text{inland}}=48$, $N_{\text{coastal}}=18$), while for females without a calf at heel (orange boxes) used pixels values were extracted seven days after median calving day ($N_{\text{inland}}=50$, $N_{\text{coastal}}=18$). Available pixels were extracted from merged spring home ranges (15 May – 30 June) for all females in each reproductive group and study area. Comparison of means between used and available pixels within each reproductive group, and between used pixels for females with and without calves, were calculated using Wilcoxon pairwise comparison test (symbols indicate p-values **** < 0.0001 , *** < 0.001 , ** < 0.01 , * < 0.05 , ns > 0.05). that most likely have given birth to a calf. ‘Spring on set day’ refers to the variable “onset of the growing season”.

Appendix 4

An example of estimated calving day using Recursive Partitioning and First Passage Time methods.

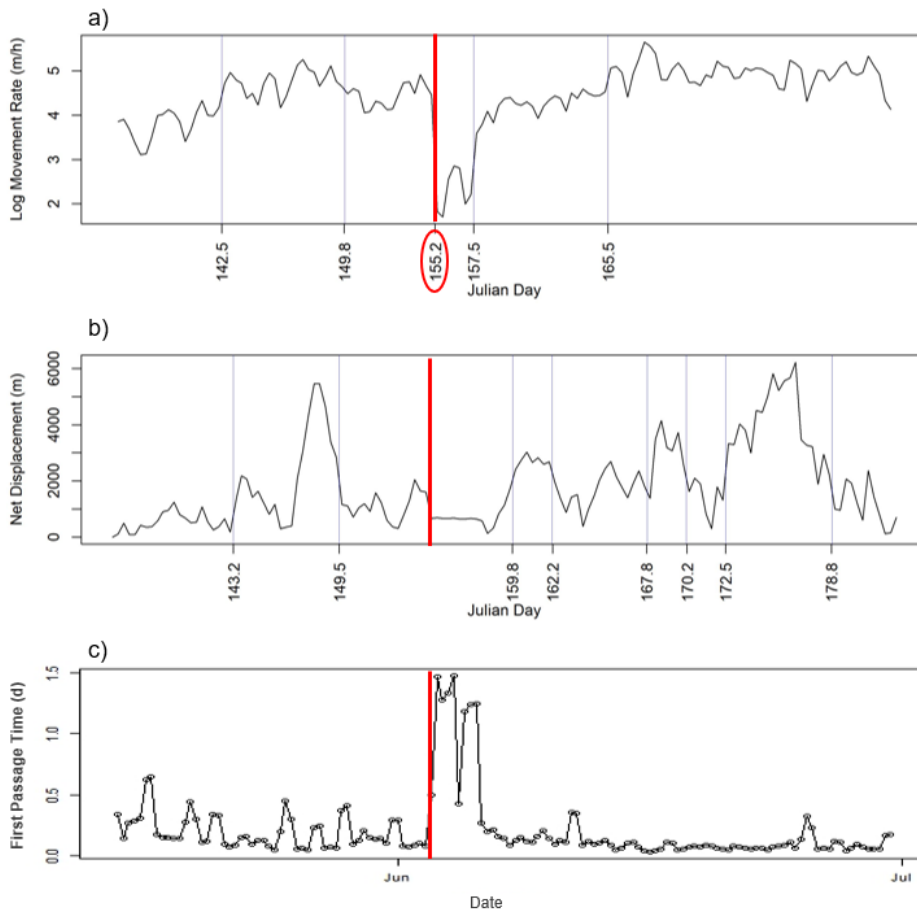


Figure A4. Estimated calving day for one Svalbard reindeer female based on the recursive partitioning (Rudolph and Drapeau 2010) and first passage time (Fauchald and Tveraa 2003) methods. The graphs show an example of recursive partitioning on a) movement rate, b) net displacement and c) First Passage Time for one female in the spring (15 May–30 June) classified as category 1 using the classification criteria (see methods). Calving day, illustrated with the red line, was estimated to be Julian day 155 (4 June).

References

- Fauchald, P. and Tveraa, T. 2003. Using First-Passage Time in the analysis of area-restricted search and habitat selection. - *Ecology* 84: 282-288.
- Rudolph, T. and Drapeau, P. 2010. Using movement behaviour to define biological seasons for woodland caribou. - *Rangifer* 20: 295-307.

Appendix 5

Net displacement before and after calving for GPS-collared Svalbard reindeer females identified with a calving day from movement analyses.

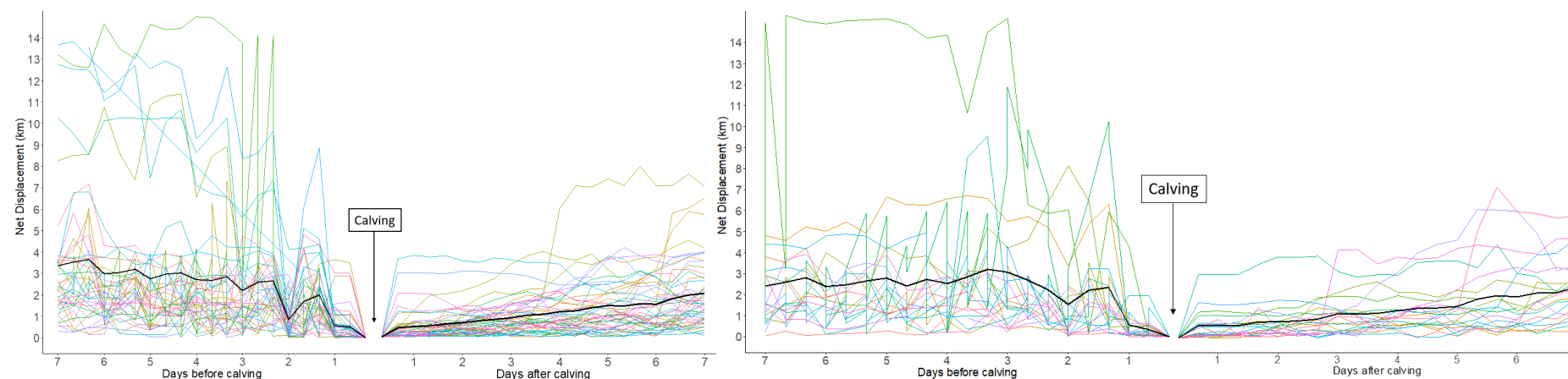


Figure A5. Net displacement one week before and after calving for individuals classified with certainty 1 in inland study area ($N = 36$, left panel), and coastal study area ($N = 14$, right panel). The colored lines are net displacement for individuals and the black line represents mean of net displacement. A few individuals displayed high displacement (8–14 km) in the week prior to calving. The mean net displacement after calving ranged between 0 to 2 km for both inland and coastal population.

Appendix 6

Results from K-select analysis

Table A6-1. Contribution of each environmental variable to the factorial axes for K-select analysis of Svalbard reindeer female habitat selection during the calving period in (A) inland and (B) coastal populations. The eigenvalues for each respective axis are shown in percentage.

Environmental variables with high absolute values explain more of the average marginality for that axis. See Table 2 for an overview of predictor variables in the K-select analysis.

(A) Inland	Axis 1	Axis 2	Axis 3	(B) Coastal	Axis 1	Axis 2	Axis 3
	(44.9%)	(15.5%)	(12.2%)		(37.6%)	(25.2%)	(9.7%)
elevation	-0.36	0.03	0.08	elevation	-0.42	-0.12	-0.01
slope	-0.43	0.07	0.08	slope	-0.42	-0.14	0.04
aspect	-0.05	0.44	0.10	aspect	0.11	0.02	0.08
heatload	0.05	0.26	-0.09	heatload	-0.17	-0.14	0.04
wetness	0.21	-0.06	-0.01	wetness	0.24	0.24	-0.05
ruggedness	-0.23	0.00	0.10	ruggedness	-0.25	0.00	0.04
barren	-0.37	-0.01	0.13	barren	-0.35	-0.17	-0.11
moss	0.64	0.11	0.02	moss	0.00	0.56	0.11
heath	-0.30	-0.03	-0.42	heath	0.56	-0.41	0.01
onset of the growing season	-0.07	0.23	-0.22	onset of the growing season	0.02	0.10	-0.55
foxdens	-0.05	0.16	0.06	foxdens	0.12	-0.12	-0.01

Table A6-2. Observed marginality vector length for each individual Svalbard reindeer female compared to randomized computed marginality lengths (N = 1000 repetitions). The test of marginality for each individual should be compared with Bonferroni alpha level = 0.002857143 (N = 9) for coastal females and Bonferroni alpha level = 0.001020408 (N = 33) for inland females. Asterix denotes whether habitat selection in the calving period deviated significantly from available habitat under the randomization test.

ID	Year	Study area	Observed marginality	p-value
KA_2014_36_0	2014	Coast	7.29	0.000999*
KA_2015_36_1	2015	Coast	6.16	0.000999*
KA_2015_37_1	2015	Coast	5.29	0.000999*
BR_2015_31_0	2015	Coast	3.67	0.001998*
KA_2014_33_1	2014	Coast	8.00	0.001998*
KA_2014_41_0	2014	Coast	3.01	0.001998*
KA_2015_34_1	2015	Coast	3.53	0.001998*
KA_2015_41_0	2015	Coast	4.17	0.001998*
KA_2016_33_1	2016	Coast	4.12	0.001998*
BR_2017_23_1	2017	Coast	2.08	0.002997
KA_2014_35_0	2014	Coast	2.35	0.003996
KA_2015_29_0	2015	Coast	2.40	0.003996
KA_2015_33_0	2015	Coast	3.00	0.003996
KA_2015_40_0	2015	Coast	2.66	0.003996
BR_2015_22_1	2015	Coast	2.47	0.004995
BR_2015_28_0	2015	Coast	2.06	0.004995
KA_2014_39_0	2014	Coast	2.41	0.004995
BR_2015_21_1	2015	Coast	2.23	0.005994
KA_2015_38_1	2015	Coast	2.26	0.006993
BR_2015_25_0	2015	Coast	2.60	0.007992
KA_2014_38_0	2014	Coast	1.99	0.007992
BR_2015_24_1	2015	Coast	1.77	0.00999
BR_2015_26_1	2015	Coast	1.82	0.011988
KA_2015_30_0	2015	Coast	1.72	0.013986
BR_2017_Y80_1	2017	Coast	1.91	0.015984
BR_2015_23_0	2015	Coast	1.73	0.017982

SA_2016_Y84_1	2016	Coast	1.46	0.023976
SA_2017_Y81_1	2017	Coast	1.11	0.05994
BR_2015_32_1	2015	Coast	1.11	0.070929
SA_2016_Y81_1	2016	Coast	1.04	0.070929
BR_2015_27_0	2015	Coast	0.93	0.084915
SA_2016_Y83_1	2016	Coast	0.94	0.100899
SA_2016_Y82_1	2016	Coast	0.75	0.187812
SA_2016_Y85_0	2016	Coast	0.70	0.190809
KA_2014_34_0	2014	Coast	0.62	0.24975
NS_2009_B100_0	2009	Inland	2.12	0.000999*
NS_2009_B106_1	2009	Inland	3.23	0.000999*
NS_2009_W74_0	2009	Inland	3.14	0.000999*
NS_2010_B101_0	2010	Inland	16.32	0.000999*
NS_2010_G89_0	2010	Inland	5.59	0.000999*
NS_2010_W103_0	2010	Inland	3.50	0.000999*
NS_2010_W72_1	2010	Inland	4.08	0.000999*
NS_2010_Y112_0	2010	Inland	7.06	0.000999*
NS_2011_Y112_0	2011	Inland	5.47	0.000999*
NS_2012_B101_0	2012	Inland	4.26	0.000999*
NS_2012_R246_1	2012	Inland	4.16	0.000999*
NS_2013_B105_1	2013	Inland	3.89	0.000999*
NS_2013_B130_0	2013	Inland	3.62	0.000999*
NS_2013_B135_1	2013	Inland	5.83	0.000999*
NS_2013_B156_1	2013	Inland	2.03	0.000999*
NS_2013_B157_1	2013	Inland	4.18	0.000999*
NS_2013_B158_1	2013	Inland	2.29	0.000999*
NS_2013_R264_1	2013	Inland	11.78	0.000999*

NS_2013_Y117_0	2013	Inland	3.49	0.000999*
NS_2014_G95_0	2014	Inland	2.51	0.000999*
NS_2014_W103_1	2014	Inland	3.05	0.000999*
NS_2015_B158_0	2015	Inland	3.43	0.000999*
NS_2015_R246_0	2015	Inland	4.07	0.000999*
NS_2015_W103_0	2015	Inland	3.58	0.000999*
NS_2016_G123_1	2016	Inland	3.20	0.000999*
NS_2016_W127_1	2016	Inland	5.02	0.000999*
NS_2016_Y167_1	2016	Inland	2.73	0.000999*
NS_2017_G118_1	2017	Inland	3.66	0.000999*
NS_2017_R310_1	2017	Inland	3.96	0.000999*
NS_2017_R316_0	2017	Inland	3.78	0.000999*
NS_2017_W150_0	2017	Inland	2.75	0.000999*
NS_2017_Y136_1	2017	Inland	2.62	0.000999*
NS_2017_Y167_0	2017	Inland	5.11	0.000999*
NS_2009_G72_0	2009	Inland	2.84	0.001998
NS_2009_Y105_1	2009	Inland	3.08	0.001998
NS_2010_B103_1	2010	Inland	2.05	0.001998
NS_2010_B96_1	2010	Inland	2.37	0.001998
NS_2013_B139_0	2013	Inland	2.00	0.001998
NS_2013_B140_1	2013	Inland	2.12	0.001998
NS_2014_B130_0	2014	Inland	2.45	0.001998
NS_2017_W127_0	2017	Inland	2.14	0.001998
NS_2009_B103_0	2009	Inland	1.75	0.002997
NS_2010_Y117_1	2010	Inland	2.12	0.002997
NS_2011_B106_1	2011	Inland	1.78	0.002997
NS_2012_B153_1	2012	Inland	2.59	0.002997

NS_2014_B101_1	2014	Inland	3.15	0.002997
NS_2009_B93_1	2009	Inland	1.69	0.003996
NS_2012_G89_1	2012	Inland	2.00	0.003996
NS_2014_Y120_0	2014	Inland	2.12	0.003996
NS_2012_B139_1	2012	Inland	1.51	0.004995
NS_2013_B123_1	2013	Inland	1.80	0.004995
NS_2013_G89_0	2013	Inland	1.96	0.004995
NS_2011_B140_0	2011	Inland	1.68	0.005994
NS_2014_B139_1	2014	Inland	1.53	0.006993
NS_2014_B135_1	2014	Inland	1.44	0.007992
NS_2015_B129_1	2015	Inland	1.45	0.008991
NS_2011_B103_0	2011	Inland	1.36	0.00999
NS_2013_B129_1	2013	Inland	1.64	0.00999
NS_2014_B158_0	2014	Inland	1.37	0.010989
NS_2009_Y112_1	2009	Inland	1.40	0.011988
NS_2011_Y120_0	2011	Inland	1.22	0.012987
NS_2012_B105_0	2012	Inland	1.43	0.014985
NS_2012_B130_0	2012	Inland	1.19	0.014985
NS_2015_B123_1	2015	Inland	1.22	0.015984
NS_2009_B123_0	2009	Inland	1.21	0.01998
NS_2016_B137_1	2016	Inland	1.16	0.01998
NS_2009_W91_1	2009	Inland	1.16	0.021978
NS_2016_B135_0	2016	Inland	1.20	0.021978
NS_2014_B154_1	2014	Inland	0.94	0.022977
NS_2009_W72_0	2009	Inland	1.08	0.023976
NS_2012_B157_0	2012	Inland	1.15	0.023976
NS_2012_B126_0	2012	Inland	1.12	0.024975

NS_2013_Y104_0	2013	Inland	1.04	0.024975
NS_2011_R240c_0	2011	Inland	1.01	0.035964
NS_2010_B100_0	2010	Inland	0.99	0.041958
NS_2012_B123_0	2012	Inland	0.93	0.048951
NS_2011_B93_0	2011	Inland	0.87	0.05994
NS_2013_B93_1	2013	Inland	0.83	0.061938
NS_2015_Y117_1	2015	Inland	0.87	0.070929
NS_2010_R240c_1	2010	Inland	0.81	0.075924
NS_2012_Y120_1	2012	Inland	0.82	0.078921
NS_2016_B151_1	2016	Inland	0.79	0.081918
NS_2017_G141_0	2017	Inland	0.76	0.08991
NS_2017_R297_0	2017	Inland	0.74	0.093906
NS_2010_W91_1	2010	Inland	0.69	0.0999
NS_2012_B156_0	2012	Inland	0.66	0.100899
NS_2012_B140_0	2012	Inland	0.72	0.106893
NS_2017_G117_0	2017	Inland	0.69	0.10989
NS_2014_B140_1	2014	Inland	0.72	0.11988
NS_2017_W139_1	2017	Inland	0.63	0.14985
NS_2010_G39_0	2010	Inland	0.57	0.175824
NS_2009_R240c_0	2009	Inland	0.56	0.181818
NS_2014_G89_1	2014	Inland	0.51	0.228771
NS_2017_G143_1	2017	Inland	0.50	0.238761
NS_2009_Y117_0	2009	Inland	0.48	0.244755
NS_2013_R246_0	2013	Inland	0.39	0.372627
NS_2016_B126_0	2016	Inland	0.38	0.384615
NS_2017_R299_1	2017	Inland	0.25	0.615385
