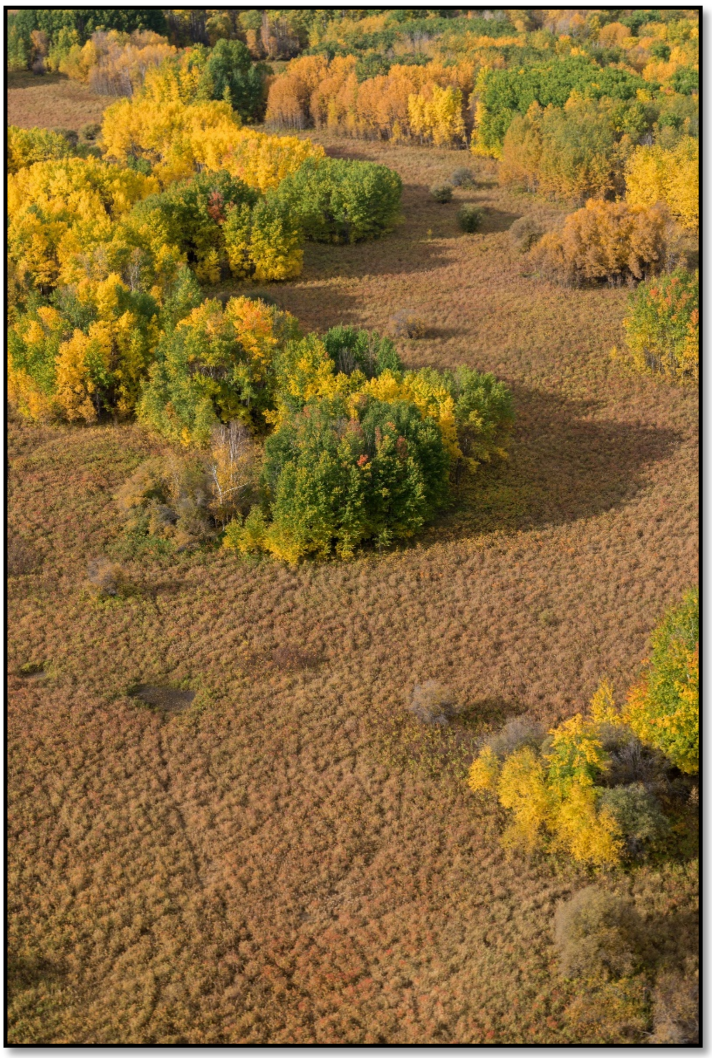
Range Use, Habitat Selection, and the Influence of Natural and Human Disturbance on Wood Bison (*Bison bison athabascae*) in the Ronald Lake Area of Northeastern Alberta

March 2017 Update



(Photo: S. Nielsen)

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DATA SUMMARY

- The data set used in this update consisted of 38 bison (33 females, 5 males), each monitored for various intervals between March 2013 and March 2017 (Table 1). Twelve of these animals were females collared in April 2016. Analyses contained the *March 2016 Report* had a sample size of 26 bison (21 female, 5 males).[1]
- After data screening (see *March 2016 Report* for details), the final data set consisted of 295,859 GPS locations.
- Per-collar fix rates averaged 93% (Table 1).
- As outlined in the *March 2016 Report*, two males were excluded from all habitat selection analyses as each had a total monitoring interval of < 3 months.
- Nine collars switched from a GPS fix rate of every 1.5 hours to every 6 hours in late March / early April 2016 and have remained in that mode to the end of the monitoring period (March 2017).

[1] DeMars, C.A., S.E. Nielsen and M.A. Edwards. 2016. Range use, habitat selection, and the influence of natural and human disturbance on wood bison (*Bison bison athabascae*) in the Ronald Lake area of northeastern Alberta. Technical report prepared for the Ronald Lake Wood Bison Technical Committee. University of Alberta, Edmonton, AB. 79p.

Table 1: Summary statistics of GPS location data by individual bison after data screening procedures. The number of time steps refers to the maximum number of GPS fixes that would have been recorded given the length of time the collar collected data. All radio-collars were originally programmed to record a GPS fix every 1.5 hours. Animal IDs marked with an asterisk (*) indicate radio-collars that switched to collecting fixes every six hours from late March / early April 2016 to the end date.

Animal ID	Sex	No. of Time Steps	No. of Missed Fixes	Begin Date	End Date	Fix Rate
33912	F	15350	793	4/8/2013	11/23/2015	0.95
33913	F	14614	401	4/8/2013	10/8/2015	0.97
33914	F	13173	640	4/8/2013	7/10/2015	0.95
33915	F	3236	249	4/6/2013	10/25/2013	0.92
33916	F	2255	254	4/8/2013	8/27/2013	0.89
33917*	F	17813	589	4/6/2013	7/25/2016	0.97
33919	F	14213	632	4/6/2013	9/11/2015	0.96
33920	F	12528	1085	4/6/2013	5/29/2015	0.91
33921	F	11929	5509	4/6/2013	4/21/2015	0.54
33923*	F	18717	822	4/6/2013	3/8/2017	0.96
33924	F	6868	1983	4/30/2014	7/3/2015	0.71
35447*	F	13046	690	4/4/2014	3/18/2017	0.95
35448*	F	13021	767	4/6/2014	3/20/2017	0.94
35449*	F	13015	613	4/6/2014	3/18/2017	0.95
35450	F	5088	190	4/6/2014	2/18/2015	0.96
35451*	F	13022	624	4/6/2014	3/20/2017	0.95
35452*	F	12535	784	4/6/2014	11/18/2016	0.94
35453	F	7436	203	4/6/2014	7/15/2015	0.97
35454*	F	13012	866	4/6/2014	3/17/2017	0.93
35455*	F	12290	396	4/8/2014	9/26/2016	0.97
35456	F	7432	286	4/6/2014	7/15/2015	0.96
35462	M	4827	37	3/28/2014	1/23/2015	0.99
35463	M	2855	295	3/28/2014	9/22/2014	0.90
35464	M	1407	43	3/28/2014	6/24/2014	0.97
35465	M	615	2	3/28/2014	5/5/2014	1.00
35466	M	5857	409	3/28/2014	3/29/2015	0.93
41225	F	5226	159	4/28/2016	3/20/2017	0.97
41226	F	5209	144	4/29/2016	3/20/2017	0.97
41227	F	5173	224	4/29/2016	3/18/2017	0.96
41228	F	5191	108	4/29/2016	3/19/2017	0.98
41229	F	5211	510	4/29/2016	3/20/2017	0.90
41230	F	5175	576	4/29/2016	3/18/2017	0.89
41231	F	5174	319	4/29/2016	3/18/2017	0.94
41232	F	5138	515	4/29/2016	3/16/2017	0.90
41234	F	5193	218	4/29/2016	3/19/2017	0.96
41236	F	5193	307	4/29/2016	3/19/2017	0.94

41237	F	5203	157	4/29/2016	3/20/2017	0.97
41238	F	5212	194	4/29/2016	3/20/2017	0.96
Mean						0.93
Minimum						0.54
Maximum						1.00

BISON ANNUAL AND SEASONAL HOME RANGES AND CUMULATIVE SPACE USE

- Updated summaries of annual home range sizes, as calculated by minimum convex polygons (MCPs) and utilization distributions (UDs), are contained in Table 2.
- Updated MCPs and UDs show high degree of overlap with those from 2015 analyses (Figs. 1-8).
- Calving appeared to be earlier in 2016 than in the previous three years (Table 3). All female bison had congregated in the calving area by 24 May and all had exited by 14 June.
- Because snow cover data was missing from the Environment Canada weather station in Ft. McMurray for November 2013, November 2015, and November 2016, 1 November was used as the start date for winter in each of those years. Snow cover data was also missing for April 2016 therefore 15 April was used as the start of spring for this year.

Table 2: Metrics of individual home range size (km^2) for female and male (in bold) bison of the Ronald Lake herd of northeastern Alberta. Minimum convex polygons (MCPs) were estimated annually and across years (All Data MCP) per individual. Utilization distributions (UDs) were estimated using all accumulated data per individual with 80% and 95% probability contour boundaries calculated.

Bison ID	Year 1 MCP	Year 2 MCP	Year 3 MCP	% Overlap Year 1 – 2 MCPs	% Overlap Year 2 – 3 MCPs	All Data MCP	All Data 80% UD	All Data 95% UD
33912	594.0	693.6	-	94	-	896.7	377.4	614.9
33913	958.9	1154.9	-	98	-	1273.4	610.8	1005.6
33914	1040.6	625.1	-	50	-	1173.9	413.1	728.4
33915*	650.2	-	-	-	-	650.2	344.3	618.1
33916*	761.3	-	-	-	-	761.3	551.3	962.2
33917	712.9	603.2	947.1	65	91	1037.1	420.0	709.8
33919	945.8	533.0	-	56	-	963.3	450.8	766.7
33920	1212.4	636.9	-	52	-	1289.8	525.1	937.1
33921	1018.6	406.8	-	37	-	1077.1	422.9	791.9
33923	931.7	621.5	850.4	56	99	1100.8	414.5	707.9
33924	703.8	-	-	-	-	844.9	381.0	646.0
35447	633.4	960.9	761.5	100	78	985.7	305.6	554.4
35448	1148.6	805.5	1159.1	64	96	1316.1	465.6	884.4
35449	823.0	759.6	683.6	77	79	1067.3	335.7	624.6
35450	621.1	-	-	-	-	621.1	336.0	553.8
35451	881.0	1321.8	922.3	100	67	1393.0	544.7	953.5
35452	839.1	726.2	944.5	85	76	872.4	343.4	635.9
35453	575.4	-	-	-	-	766.5	334.8	599.1
35454	894.0	951.1	-	90	-	1227.7	419.5	785.9
35455	1092.3	989.4	-	90	-	1124.8	405.4	746.8
35456	468.1	-	-	-	-	534.5	264.1	475.3
35462	1277.7	-	-	-	-	1277.7	263.7	635.3
35463*	1269.7	-	-	-	-	1269.7	996.4	1799.3
35464*	724.4	-	-	-	-	724.4	709.6	1227.2
35465*	70.4	-	-	-	-	70.4	63.6	106.9
35466	1218.3	-	-	-	-	1218.3	698.4	1320.4
41225	766.0	-	-	-	-	766.0	320.3	591.7
41226	972.2	-	-	-	-	972.2	430.8	726.6
41227	783.5	-	-	-	-	783.5	394.4	690.4
41228	668.0	-	-	-	-	668.0	270.6	492.9
41229	913.3	-	-	-	-	913.3	326.6	587.7
41230	779.5	-	-	-	-	779.5	338.7	619.0
41231	698.8	-	-	-	-	698.8	323.9	550.8
41232	794.8	-	-	-	-	794.8	294.5	515.8
41234	846.7	-	-	-	-	846.7	479.1	807.0
41236	577.4	-	-	-	-	577.4	259.1	443.3

41237	813.1	-	-	-	-	813.1	322.4	560.4
41238	678.0	-	-	-	-	678.0	379.5	616.3
Mean	825.2	786.0	895.5	74.3	84	916.6	408.9	726.1
Minimum	70.4	406.8	683.9	37	67	70.4	63.6	106.9
Maximum	1277.7	1321.8	1159.1	100	99	1393.0	996.4	1799.3

* Individual bison that were monitored < 8 months. All other bison had at least 1 year of data to estimate per year MCPs.

Table 3: Seasonal periods used to evaluate seasonal changes in space used and habitat selection by wood bison of the Ronald Lake herd.

Year	Spring	Calving	Summer / Fall	Winter
2013	25 Apr – 4 Jun	5 June – 28 Jun	29 Jun – 31 Oct	1 Nov – 25 Apr
2014	19 Apr – 7 Jun	8 Jun – 25 Jun	26 Jun – 6 Nov	7 Nov – 7 Apr
2015	8 Apr – 28 May	29 May – 23 Jun	24 Jun – 31 Oct	1 Nov – 15 Apr
2016	15 Apr – 23 May	24 May – 13 Jun	14 Jun – 31 Oct	1 Nov – 20 Mar *

* Current data set extends to 20 March 2017

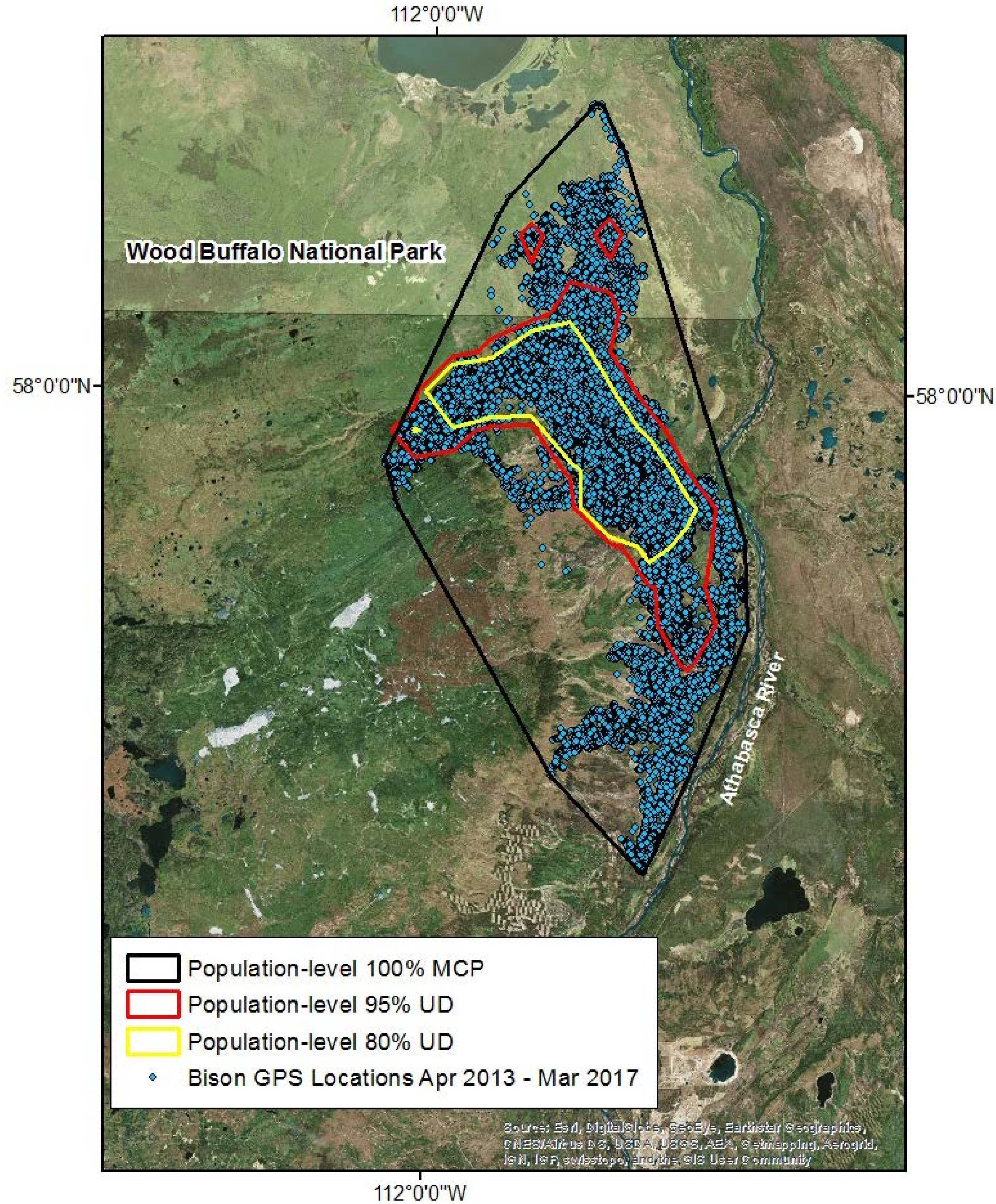

Figure 1: Cumulative space use, as represented by a minimum convex polygon (MCP) and utilization distributions (UDs), for wood bison of the Ronald Lake herd from April 2013 – March 2017.

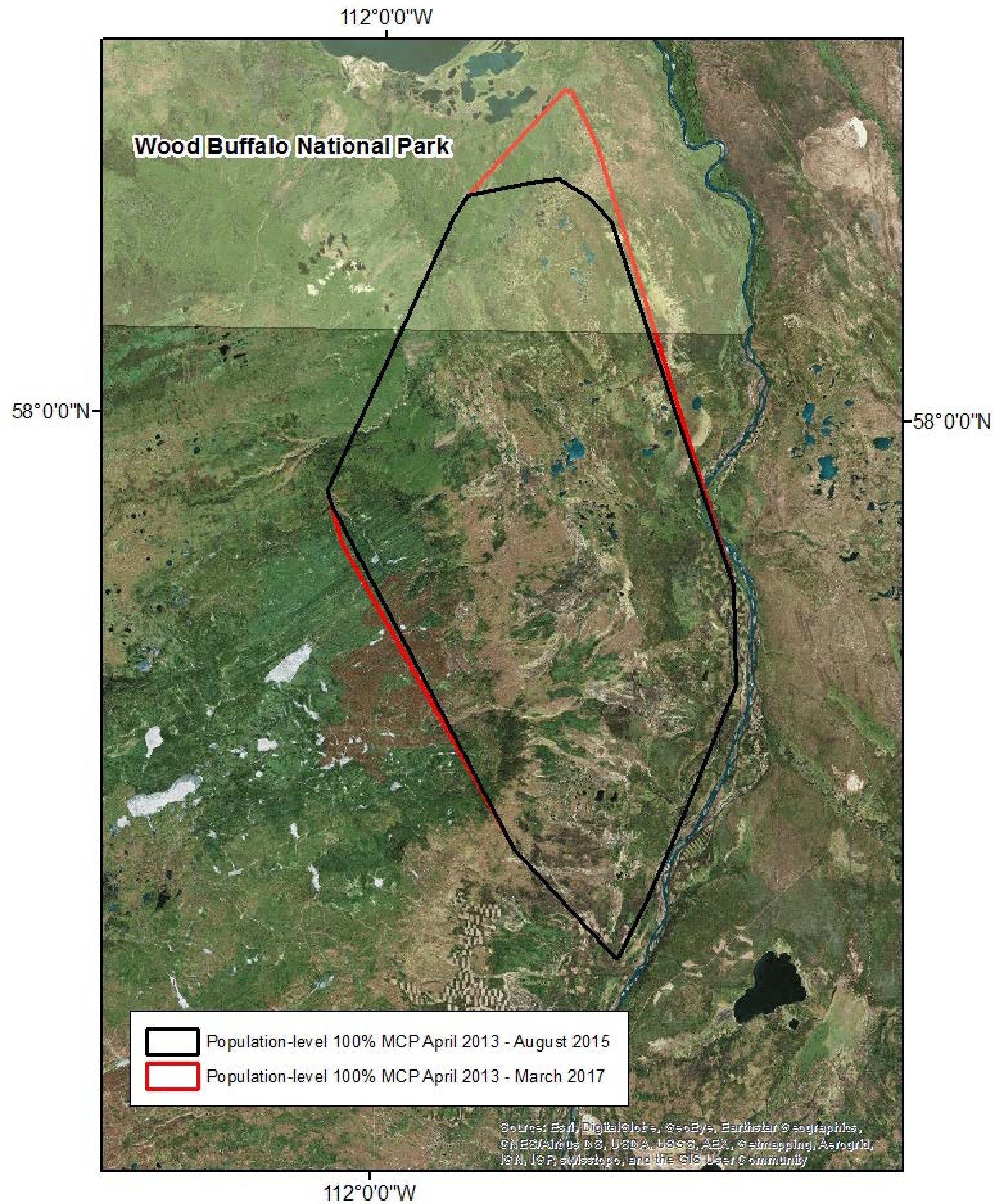

Figure 2: Comparison of 100% minimum convex polygons (MCPs) characterizing cumulative space use by wood bison of the Ronald Lake herd. MCPs were calculated using all GPS locations collected from April 2013 – August 2015 (black line) and from April 2013 – March 2017 (red line).

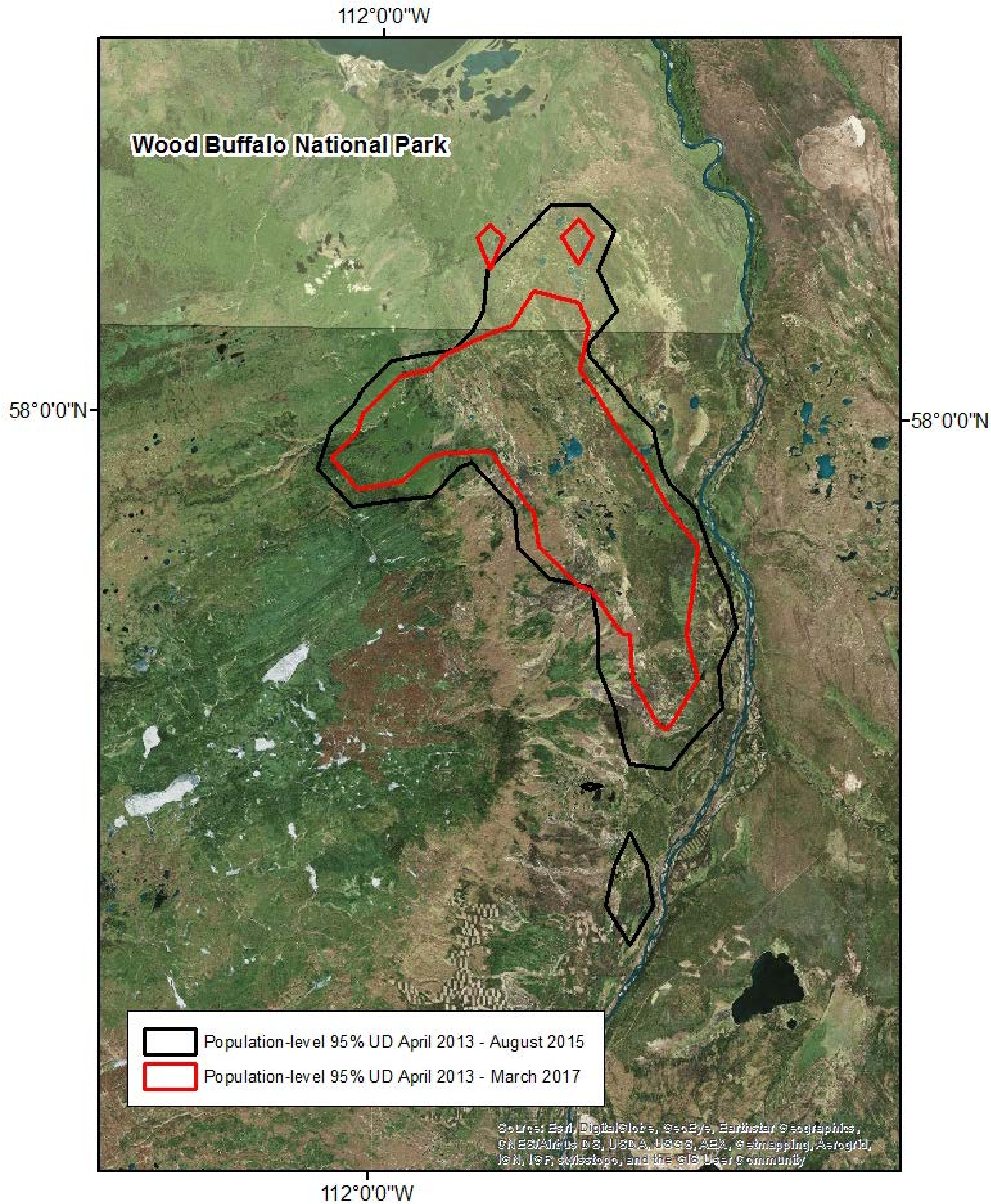

Figure 3: Comparison of 95% utilization distributions (UDs) characterizing cumulative space use by wood bison of the Ronald Lake herd. UDs were calculated using all GPS locations collected from April 2013 – August 2015 (black line) and from April 2013 – March 2017 (red line).

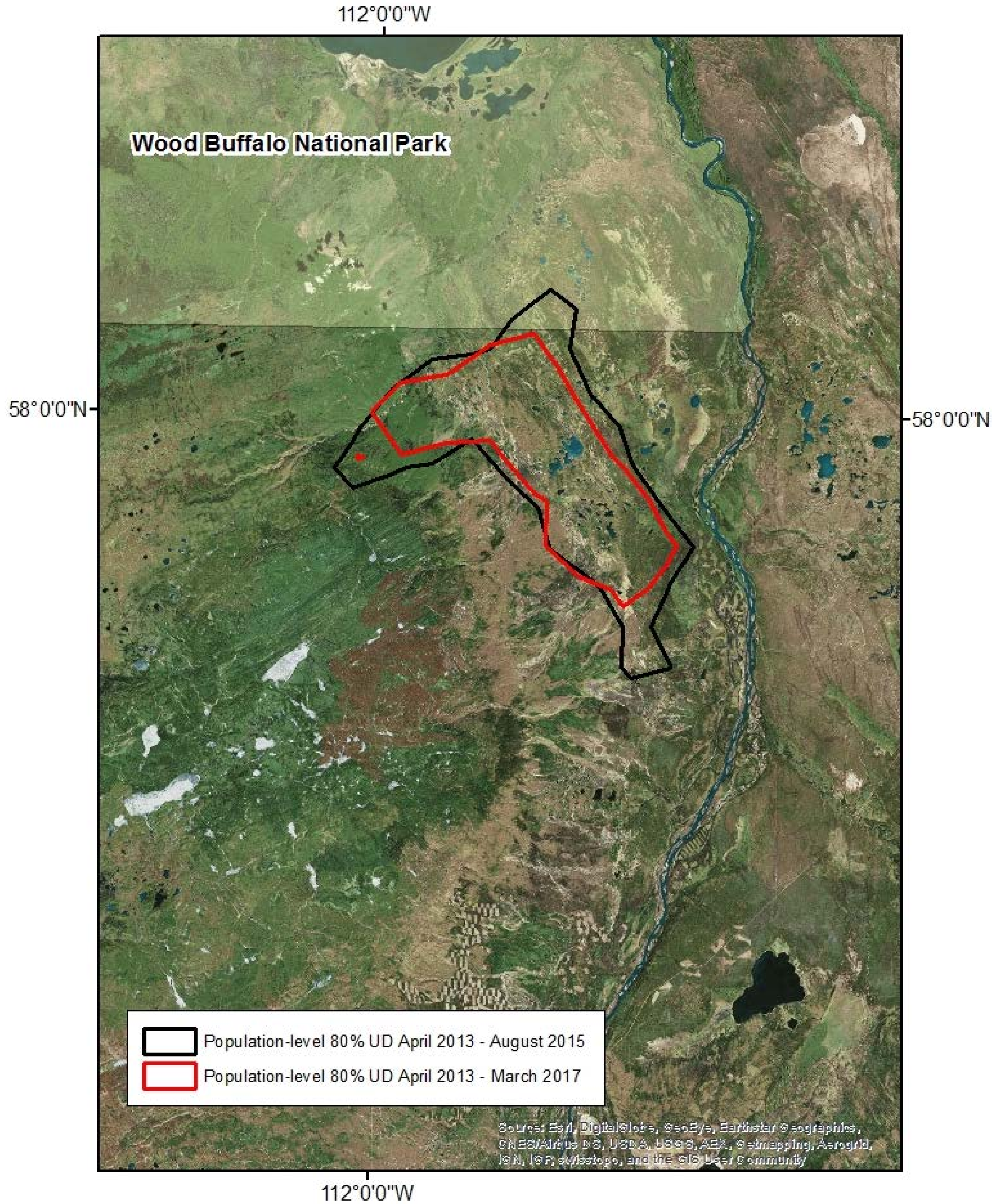

Figure 4: Comparison of 80% utilization distributions (UDs) characterizing cumulative space use by wood bison of the Ronald Lake herd. UDs were calculated using all GPS locations collected from April 2013 – August 2015 (black line) and from April 2013 – March 2017 (red line).

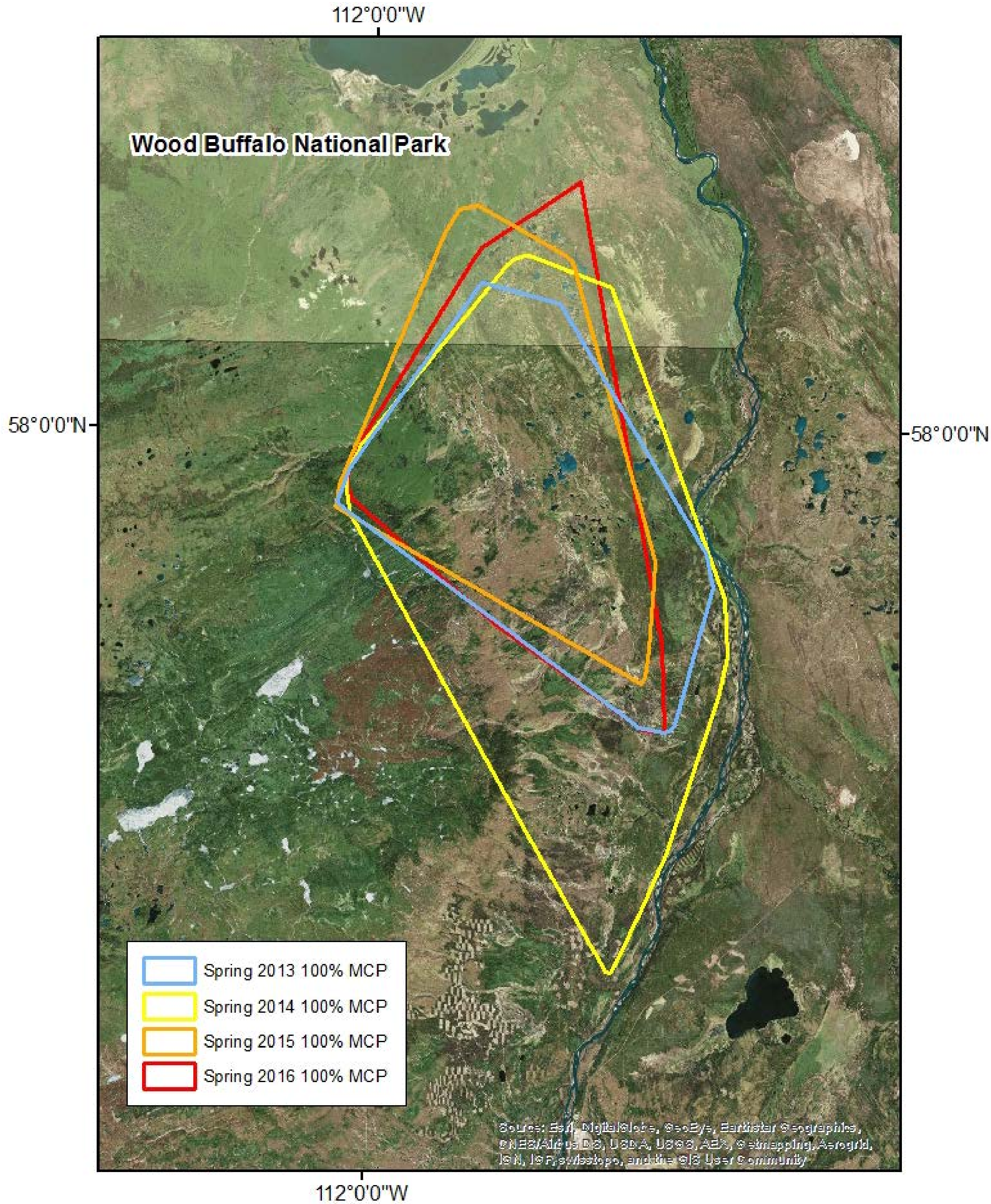

Figure 5: Comparison of 100% minimum convex polygons (MCPs) characterizing space use during the spring by wood bison of the Ronald Lake herd. MCPs were calculated annually using GPS locations confined to the spring seasons of 2013 – 2017.

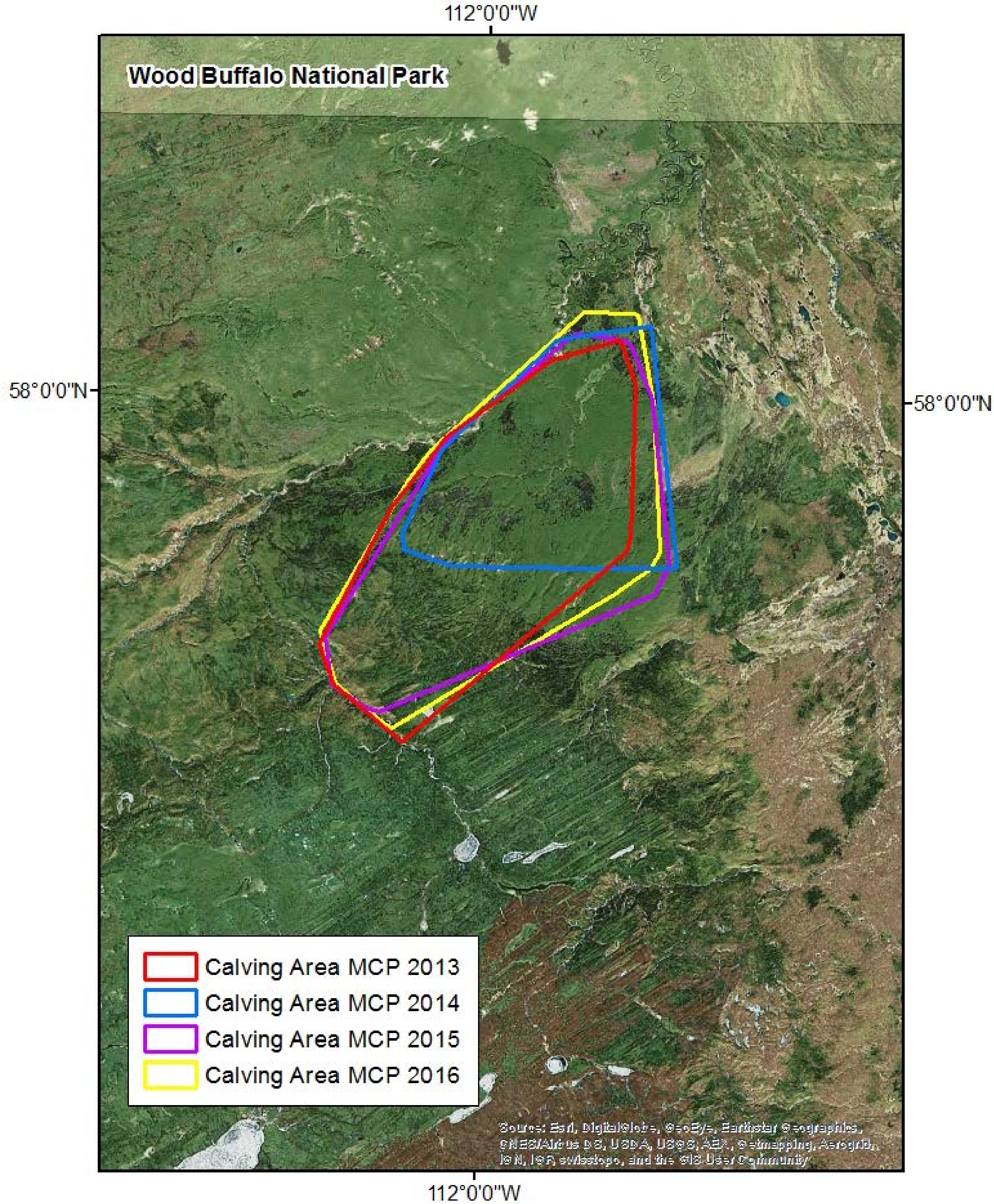

Figure 6: Comparison of 100% minimum convex polygons (MCPs) characterizing space use during the calving season by wood bison of the Ronald Lake herd. MCPs were calculated annually using GPS locations confined to the calving seasons of 2013 – 2017.

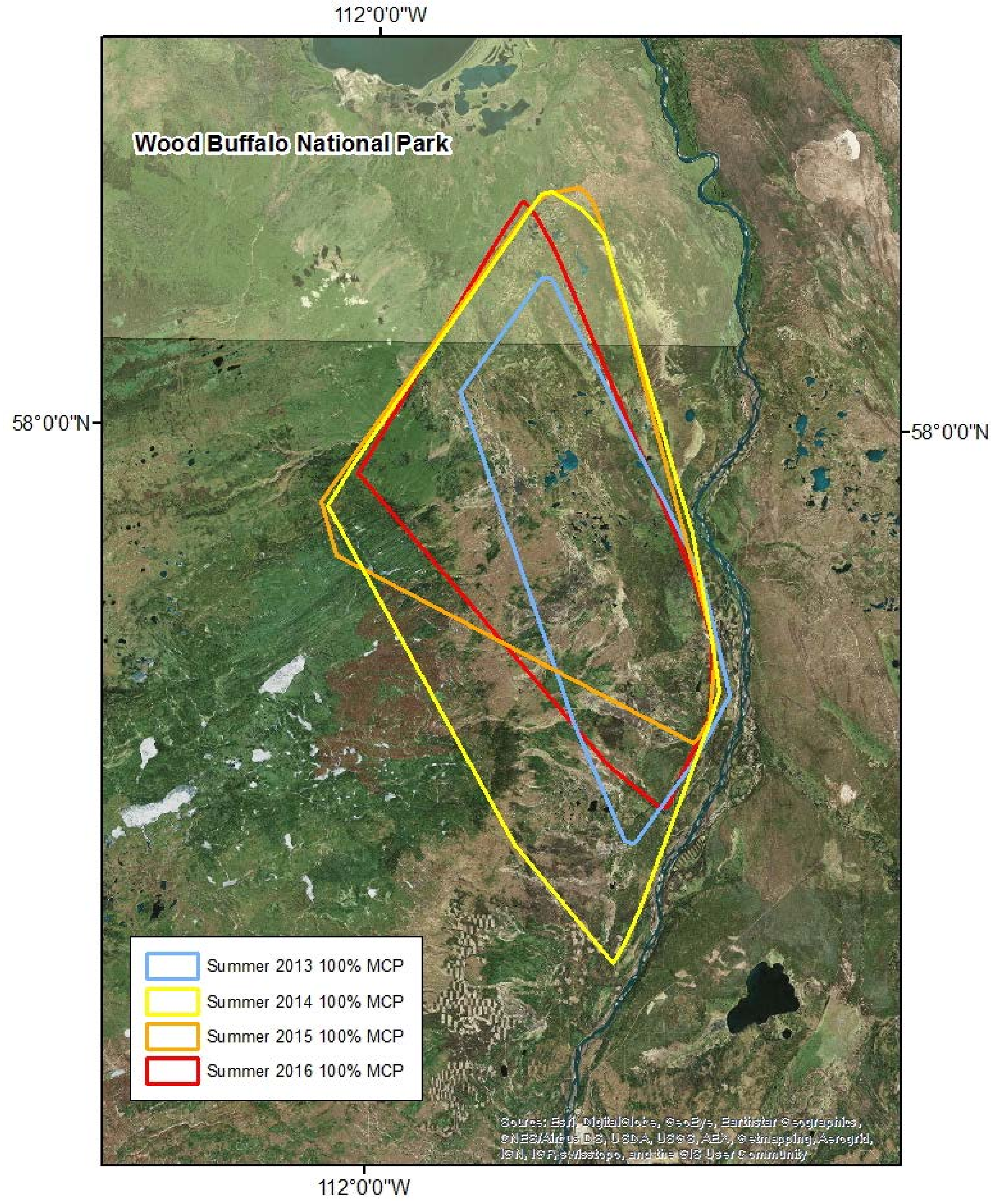

Figure 7: Comparison of 100% minimum convex polygons (MCPs) characterizing space use during the summer / fall by wood bison of the Ronald Lake herd. MCPs were calculated annually using GPS locations confined to the summer and fall seasons of 2013 – 2017.

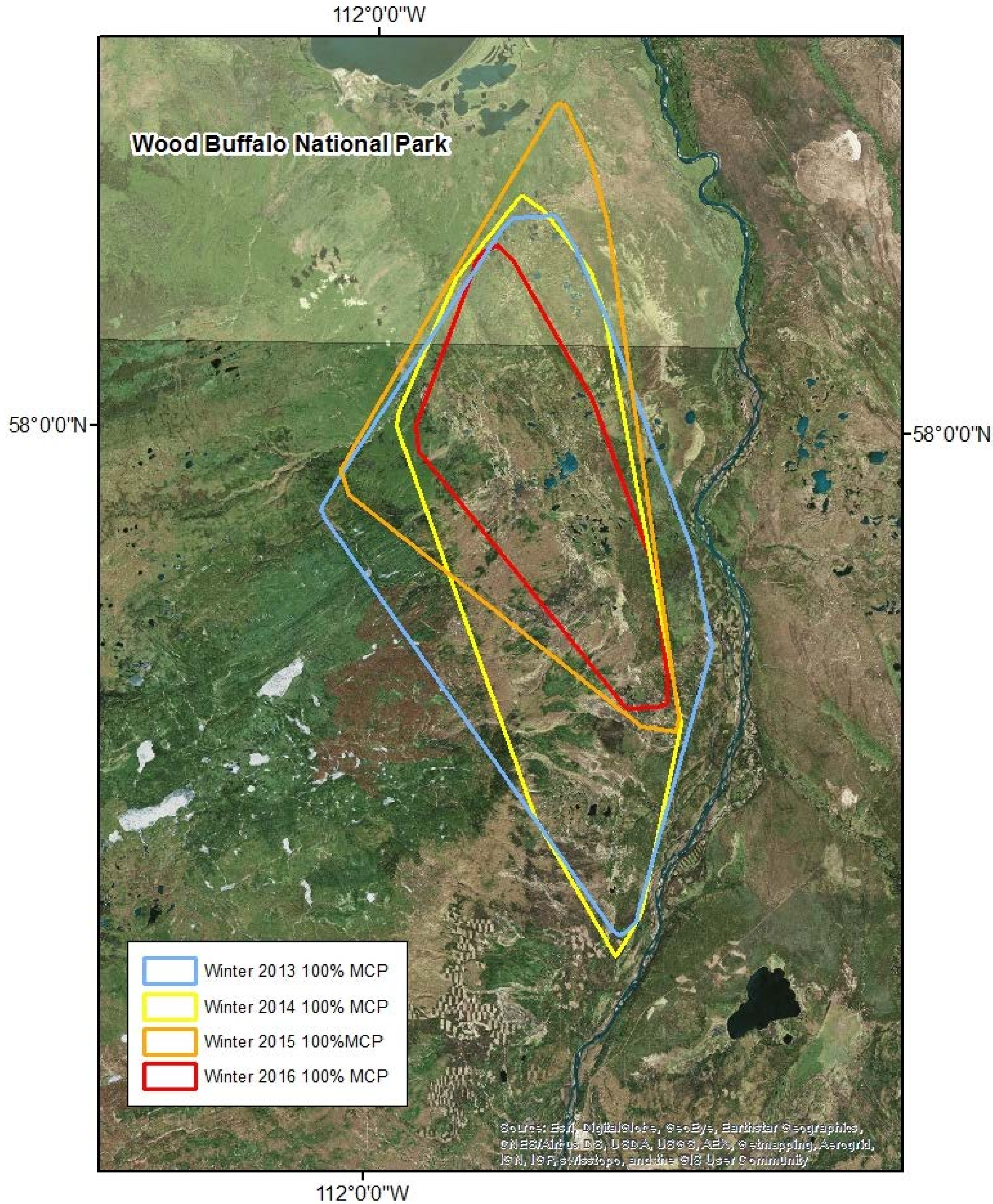

Figure 8: Comparison of 100% minimum convex polygons (MCPs) characterizing space use during the winter by wood bison of the Ronald Lake herd. MCPs were calculated annually using GPS locations confined to the winter seasons of 2013 – 2017.

HABITAT SELECTION ANALYSES

Explanatory Variable Notes

- Ducks Unlimited Enhanced Wetland Classification (EWC) was acquired for Wood Buffalo National Park. This data set included a new land cover designation – upland pine.
- No new forest fires in 100% MCP or 95% UDs since previous report.
- Recently acquired cutblock data was "burned" in as new land cover categories within the EWC land cover data. The pre-existing "cutblock" category in the EWC data appears to be cutblocks harvested before 2006. We burned in the new cutblock data as two distinct land cover categories: cutblocks harvested after prior to 2006 (cutblock pre06) and cutblocks harvested between 2006 and 2016 (cutblock post05). This distinction was necessary because the majority of cutblocks harvested prior to 2006 did not have metadata identifying the exact year of harvest. For habitat selection analyses during the spring and calving seasons, we did not consider these age-specific variables because no bison had GPS locations in post-2005 cutblocks; therefore we combined these categories into one 'cutblock' land cover.

Habitat Selection Analyses: Notes on Results

- When comparing results from the current analyses (Tables 4 – 12) with those contained in the *March 2016 Report*, bison patterns of selection stayed relatively constant across all seasons. Specifically, no parameter estimates (i.e., the β's) switched from being significantly positive to significantly negative or vice versa. Rankings of land cover also stayed remarkably consistent. These results are perhaps not unexpected given that bison patterns of space use have strongly overlapped from year to year.
- In general, bison avoided cutblocks regardless of age, except for male bison in the summer / fall. During this season, males selected for more recent cutblocks (post-2005) and avoided older ones (pre-2006). These patterns may be related to human activity (see next section) as most post-2005 cutblocks were more recent (i.e. since 2014) and human activity occurs primarily during the winter.
- Predictive performance was strong across all seasonal and gender-specific models with ordinal RSF bin values positively correlating with bison selection ratios (Spearman's rank correlation coefficients all ≥ 0.98, all $p \leq 0.001$; Table 12).

Table 4: Selection coefficients (β; with standard errors [SE] and p-values) from the top resource selection functions estimated during **spring for female wood bison** of the Ronald Lake herd of northeast Alberta. Shown are coefficients from the previous March 2016 report (Apr 2013 – Aug 2015 data) and coefficients using the latest data (Apr 2013 – Mar 2017) .For land cover (first grouping), positive coefficients (> 0) indicate relative selection compared to Upland Deciduous forests while negative coefficients indicate relative avoidance. For fire interactions (second grouping), coefficients indicate relative selection compared to the coefficients of the given land cover. Anthropogenic disturbance coefficients (third grouping) are in reference to selection of undisturbed areas. Dashes indicate variables not included in a given data-specific top model.

	Apr 2013 – Aug 2015 (*n* = 21)			Apr 2013-Mar2017 (*n* = 33)		
Variable	β	SE	*p*	β	SE	*p*
Intercept	-2.13	0.08	< 0.001	-2.19	0.06	< 0.001
Open Water	-0.91	0.07	< 0.001	-0.94	0.06	< 0.001
Aquatic Bed	-2.02	0.28	< 0.001	-3.17	0.22	< 0.001
Emergent Marsh	0.38	0.06	< 0.001	0.40	0.05	< 0.001
Meadow Marsh	1.83	0.03	< 0.001	1.49	0.03	< 0.001
Graminoid Rich Fen	-0.55	0.12	< 0.001	-0.61	0.10	< 0.001
Graminoid Poor Fen	-0.80	0.09	< 0.001	-0.69	0.07	< 0.001
Shrubby Rich Fen	0.01	0.06	0.837	-0.14	0.05	0.004
Shrubby Poor Fen	0.25	0.05	< 0.001	0.02	0.05	0.654
Treed Rich Fen	-0.42	0.04	< 0.001	-0.66	0.03	< 0.001
Treed Poor Fen	-0.54	0.04	< 0.001	-0.64	0.03	< 0.001
Shrubby Bog	-0.57	0.11	< 0.001	-0.79	0.11	< 0.001
Treed Bog	0.22	0.06	0.001	-0.15	0.06	0.015
Shrub Swamp	-0.09	0.04	0.016	-0.19	0.03	< 0.001
Hardwood Swamp	-0.03	0.05	0.503	-0.11	0.04	0.004
Mixedwood Swamp	-0.35	0.06	< 0.001	-0.42	0.05	< 0.001
Tamarack Swamp	-2.12	0.17	< 0.001	-1.81	0.11	< 0.001
Conifer Swamp	0.05	0.03	0.094	0.07	0.03	0.005
Upland Conifer	-0.66	0.06	< 0.001	-0.59	0.05	< 0.001
Upland Pine [1]	-	-	-	0.52	0.09	< 0.001
Upland Mixedwood	-2.20	0.17	< 0.001	-2.23	0.17	< 0.001
Cutblock	0.24	0.13	0.052	-0.43	0.11	< 0.001
Anthropogenic	-2.11	0.25	< 0.001	-1.10	0.52	0.036
Fire: Low Severity	-0.62	0.04	< 0.001	-0.99	0.04	< 0.001
Fire: High Severity	-0.21	0.03	< 0.001	-0.37	0.03	< 0.001
Open Water: Fire Low	1.35	0.20	< 0.001	1.33	0.19	< 0.001
Open Water: Fire High	2.25	0.14	< 0.001	1.80	0.12	< 0.001
Emergent Marsh: Fire Low	0.34	0.22	0.121	-0.18	0.25	0.469
Emergent Marsh: Fire High	1.04	0.13	< 0.001	0.67	0.13	< 0.001
Meadow Marsh: Fire Low	-1.48	0.23	< 0.001	-1.27	0.21	< 0.001

Variable	Apr 2013 – Aug 2015 (n = 21) β	SE	p	Apr 2013-Mar2017 (n = 33) β	SE	p
Meadow Marsh: Fire High	-1.12	0.11	< 0.001	-1.04	0.11	< 0.001
Graminoid Rich Fen: Fire Low	-7.34	0.85	< 0.001	-6.94	0.56	< 0.001
Graminoid Rich Fen: Fire High	2.02	0.13	< 0.001	1.89	0.11	< 0.001
Graminoid Poor Fen: Fire Low	1.00	0.26	< 0.001	1.56	0.22	< 0.001
Graminoid Poor Fen: Fire High	0.50	0.13	< 0.001	0.58	0.11	< 0.001
Shrubby Rich Fen: Fire Low	1.11	0.23	< 0.001	1.01	0.20	< 0.001
Shrubby Rich Fen: Fire High	0.30	0.08	< 0.001	0.27	0.07	< 0.001
Shrubby Poor Fen: Fire Low	2.56	0.24	< 0.001	1.94	0.32	< 0.001
Shrubby Poor Fen: Fire High	-0.21	0.09	0.024	0.04	0.08	0.647
Treed Rich Fen: Fire Low	0.41	0.14	0.003	0.46	0.14	0.001
Treed Rich Fen: Fire High	0.69	0.06	< 0.001	0.84	0.05	< 0.001
Treed Poor Fen: Fire Low	0.44	0.18	0.016	1.01	0.12	< 0.001
Treed Poor Fen: Fire High	0.49	0.07	< 0.001	0.68	0.06	< 0.001
Treed Bog: Fire Low	1.12	0.20	< 0.001	0.94	0.60	0.121
Treed Bog: Fire High	-0.75	0.18	< 0.001	-0.28	0.16	0.075
Shrub Swamp: Fire Low	0.92	0.17	< 0.001	0.93	0.18	< 0.001
Shrub Swamp: Fire High	0.04	0.09	0.680	0.18	0.08	0.021
Hardwood Swamp: Fire Low	-	-	-	0.25	0.22	0.266
Hardwood Swamp: Fire High	-	-	-	0.24	0.13	0.054
Conifer Swamp: Fire Low	-0.65	0.19	< 0.001	-0.65	0.17	< 0.001
Conifer Swamp: Fire High	0.24	0.07	< 0.001	0.19	0.07	0.004
Upland Conifer: Fire Low	0.30	0.09	0.001	0.28	0.08	0.001
Upland Conifer: Fire High	1.35	0.07	< 0.001	1.19	0.06	< 0.001
Upland Pine: Fire Low	-	-	-	0.14	0.18	0.462
Upland Pine: Fire High	-	-	-	0.59	0.09	< 0.001
Disturbance (no age effect)[2]	0.43	0.05	< 0.001	-	-	
Disturbance: ≤ 2005 [3]	-	-	-	0.03	0.06	0.588
Disturbance: ≥ 2006	-	-	-	0.69	0.05	< 0.001

[1] Upland pine occurs in the Ducks Unlimited land cover data set covering Wood Bison National Park and therefore was not considered in the 2013-2015 analysis.

[2] AIC of disturbance models for females from Apr 2013 – Aug 2015 data set: age effects = 152652; no age effects = 152576

[3] AIC of disturbance models for females from Apr 2013 – Mar 2017 data set: age effects = 212084, no age effects = 212146

Table 5: Selection coefficients (β; with standard errors [SE] and p-values) from the top resource selection functions estimated during **spring for male wood bison** of the Ronald Lake herd of northeast Alberta. Shown are coefficients from the previous March 2016 report (Apr 2013 – Aug 2015 data) and coefficients using the latest data (Apr 2013 – Mar 2017). For land cover (first grouping), positive coefficients (> 0) indicate relative selection compared to Upland Deciduous forests while negative coefficients indicate relative avoidance. For fire interactions (second grouping), coefficients indicate relative selection compared to the coefficients of the given land cover. Anthropogenic disturbance coefficients (third grouping) are in reference to selection of undisturbed areas. Dashes indicate variables not included in a given data-specific top model.

	Apr 2013 – Aug 2015 (*n* = 3)			Apr 2013-Mar2017 (*n* = 3)		
Variable	β	SE	*p*	β	SE	*p*
Intercept	-3.70	0.25	< 0.001	-3.23	0.13	< 0.001
Open Water	-1.72	0.93	0.063	-1.90	0.68	0.005
Aquatic Bed	-0.43	0.99	0.665	-0.25	0.95	0.794
Emergent Marsh	-0.09	0.59	0.886	-12.50	1.98	< 0.001
Meadow Marsh	-0.01	0.43	0.988	0.19	0.33	0.570
Graminoid Rich Fen	0.37	0.29	0.201	-0.25	0.26	0.331
Graminoid Poor Fen	-1.08	0.51	0.035	-1.22	0.40	0.002
Shrubby Rich Fen	-0.21	0.23	0.380	-0.05	0.17	0.758
Shrubby Poor Fen	-0.82	0.51	0.108	-1.33	0.50	0.008
Treed Rich Fen	-0.38	0.15	0.010	-0.70	0.14	< 0.001
Treed Poor Fen	-1.28	0.49	0.009	-1.14	0.32	< 0.001
Shrubby Bog	-0.36	0.60	0.550	-0.16	0.44	0.724
Treed Bog	-0.35	0.38	0.353	-0.59	0.35	0.093
Shrub Swamp	-1.36	0.49	0.005	-1.37	0.40	0.001
Hardwood Swamp	0.04	0.32	0.908	-0.27	0.31	0.393
Mixedwood Swamp	-1.54	0.51	0.002	-2.20	0.49	< 0.001
Tamarack Swamp	-2.69	0.92	0.004	-2.39	0.58	< 0.001
Conifer Swamp	0.60	0.13	< 0.001	0.26	0.12	0.030
Upland Conifer	-1.82	0.65	0.005	-2.51	0.81	0.002
Upland Pine	-	-	-	2.81	0.22	< 0.001
Upland Mixedwood	-0.14	0.14	0.289	-0.49	0.12	< 0.001
Cutblock	-13.69	3.30	< 0.001	-1.40	0.24	< 0.001
Anthropogenic	0.25	0.12	0.034	0.21	0.68	0.307
Fire: Low Severity	1.05	0.11	< 0.001	0.72	0.11	< 0.001
Fire: High Severity	1.72	0.09	< 0.001	1.62	0.09	< 0.001
Treed Poor Fen: Fire Low	-0.43	1.06	0.688	1.49	0.52	0.004
Treed Poor Fen: Fire High	2.25	0.49	< 0.001	1.90	0.33	< 0.001
Shrub Swamp: Fire Low	1.90	0.59	0.001	2.33	0.52	< 0.001
Shrub Swamp: Fire High	1.13	0.51	0.028	0.62	0.43	0.151
Hardwood Swamp: Fire Low	0.93	0.56	0.098	-0.06	0.68	0.932
Hardwood Swamp: Fire High	-1.18	0.67	0.078	-1.14	0.66	0.084

	Apr 2013 – Aug 2015 (*n* = 3)			Apr 2013-Mar2017 (*n* = 3)		
Variable	β	SE	*p*	β	SE	*p*
Upland Conifer: Fire Low	2.06	0.67	0.002	2.49	0.83	0.003
Upland Conifer: Fire High	2.89	0.66	< 0.001	3.20	0.81	< 0.001
Upland Pine: Fire Low	-	-	-	-1.18	0.42	0.005
Upland Pine: Fire High	-	-	-	-1.09	0.24	< 0.001
Disturbance: ≤ 2005 [1]	0.81	0.15	< 0.001	1.72	0.18	< 0.001
Disturbance: ≥ 2006	2.09	0.10	< 0.001	2.45	0.10	< 0.001

[1] AIC of disturbance models for males from Apr 2013 – Aug 2015 data set: age effects = 4815, no age effects = 4895. AIC of disturbance models for males from Apr 2013 – Mar 2017 data set: age effects = 11105; no age effects = 11116.

Table 6: Selection coefficients (β; with standard errors [SE] and p-values) from the top resource selection functions estimated during **calving for female wood bison** of the Ronald Lake herd of northeast Alberta. Shown are coefficients from the previous March 2016 report (Apr 2013 – Aug 2015 data) and coefficients using the latest data (Apr 2013 – Mar 2017). For land cover (first grouping), positive coefficients (> 0) indicate relative selection compared to Upland Deciduous forests while negative coefficients indicate relative avoidance. For fire interactions (second grouping), coefficients indicate relative selection compared to the coefficients of the given land cover. Anthropogenic disturbance coefficients (third grouping) are in reference to selection of undisturbed areas. Dashes indicate variables not included in a given data-specific top model.

	Apr 2013 – Aug 2015 (*n* = 21)			Apr 2013-Mar2017 (*n* = 33)		
Variable	β	SE	*p*	β	SE	*p*
Intercept	-2.37	0.03	< 0.001	-2.29	0.03	< 0.001
Open Water	-2.80	0.20	< 0.001	-2.49	0.13	
Aquatic Bed		*perfect avoidance*			*perfect avoidance*	
Emergent Marsh	-3.17	0.38	< 0.001	-2.40	0.21	< 0.001
Meadow Marsh	1.57	0.04	< 0.001	1.08	0.03	< 0.001
Graminoid Rich Fen	-2.31	0.23	< 0.001	-2.74	0.22	< 0.001
Graminoid Poor Fen	-2.20	0.17	< 0.001	-1.72	0.11	< 0.001
Shrubby Rich Fen	-4.32	0.38	< 0.001	-3.73	0.21	< 0.001
Shrubby Poor Fen	-2.81	0.21	< 0.001	-2.38	0.13	< 0.001
Treed Rich Fen	-1.66	0.06	< 0.001	-1.76	0.05	< 0.001
Treed Poor Fen	-1.32	0.06	< 0.001	-1.32	0.04	< 0.001
Shrubby Bog	-4.63	1.00	< 0.001	-3.42	0.45	< 0.001
Treed Bog		*perfect avoidance*		-3.79	0.38	< 0.001
Shrub Swamp	-1.58	0.07	< 0.001	-1.64	0.06	< 0.001
Hardwood Swamp	0.55	0.04	< 0.001	0.41	0.03	< 0.001
Mixedwood Swamp	-0.13	0.06	0.039	-0.29	0.05	< 0.001
Tamarack Swamp	-4.49	0.71	< 0.001	-3.76	0.38	< 0.001
Conifer Swamp	-0.88	0.05	< 0.001	-0.68	0.03	< 0.001
Upland Conifer	-3.44	0.11	< 0.001	-3.04	0.07	< 0.001
Upland Pine	-	-	-		*perfect avoidance*	
Upland Mixedwood		*perfect avoidance*		-5.33	0.71	
Cutblock		*perfect avoidance*			*perfect avoidance*	
Anthropogenic		*perfect avoidance*			*perfect avoidance*	
Disturbance (no age effects)[1]	0.86	0.05	< 0.001	-	-	-
Disturbance (≤ 2005)[1]	-	-	-	0.90	0.06	< 0.001
Disturbance(≥ 2006)	-	-	-	0.62	0.07	< 0.001

[1] Age of disturbance effects not considered using data from Apr 2013 – Aug 2015.

[2] AIC of disturbance models for females from Apr 2013 – Mar 2017: age effects = 115367, no age effects = 115374.

Table 7: Selection coefficients (β; with standard errors [SE] and p-values) from the top resource selection functions estimated during **calving for male wood bison** of the Ronald Lake herd of northeast Alberta. Shown are coefficients from the previous March 2016 report (Apr 2013 – Aug 2015 data) and coefficients using the latest data (Apr 2013 – Mar 2017).For land cover (first grouping), positive coefficients (> 0) indicate relative selection compared to Upland Deciduous forests while negative coefficients indicate relative avoidance. For fire interactions (second grouping), coefficients indicate relative selection compared to the coefficients of the given land cover. Anthropogenic disturbance coefficients (third grouping) are in reference to selection of undisturbed areas. Dashes indicate variables not included in a given data-specific top model.

	Apr 2013 – Aug 2015 (*n* = 3)			Apr 2013-Mar2017 (*n* = 3)		
Variable	β	SE	*p*	β	SE	*p*
Intercept	-2.83	0.13	< 0.001	-2.47	0.13	< 0.001
Open Water		*perfect avoidance*			*perfect avoidance*	
Aquatic Bed		*perfect avoidance*			*perfect avoidance*	
Emergent Marsh	-0.78	0.72	0.278	-1.47	0.74	0.049
Meadow Marsh	-0.27	0.41	0.511	-0.80	0.51	0.118
Graminoid Rich Fen		*perfect avoidance*			*perfect avoidance*	
Graminoid Poor Fen	-1.02	0.52	0.048	-3.00	1.01	0.003
Shrubby Rich Fen[2]	-2.40	0.72	0.001		*perfect avoidance*	
Shrubby Poor Fen		*perfect avoidance*		-2.70	1.01	0.007
Treed Rich Fen	-2.40	0.36	< 0.001	-3.00	0.39	< 0.001
Treed Poor Fen	-3.04	0.51	< 0.001	-2.74	0.34	< 0.001
Shrubby Bog	-1.48	1.01	0.143		*perfect avoidance*	
Treed Bog	-2.07	0.73	0.004	-2.79	1.00	0.006
Shrub Swamp	-1.59	0.25	< 0.001	-2.73	0.35	< 0.001
Hardwood Swamp	-1.00	0.29	0.001	-1.76	0.36	< 0.001
Mixedwood Swamp	-3.40	1.01	0.001	-4.10	1.01	< 0.001
Tamarack Swamp	-1.83	0.60	0.002	-3.31	0.72	< 0.001
Conifer Swamp	-3.98	1.00	< 0.001	-2.30	0.36	< 0.001
Upland Conifer	-1.97	0.21	< 0.001	-2.38	0.22	< 0.001
Upland Pine	-	-	-		*perfect avoidance*	
Upland Mixedwood	-0.65	0.19	0.001	-1.39	0.19	< 0.001
Cutblock		*perfect avoidance*		-4.55	1.01	< 0.001
Anthropogenic	0.14	0.11	0.183	-0.04	0.77	0.955
Disturbance (≤ 2005)[1]	1.03	0.25	< 0.001	1.89	0.28	< 0.001
Disturbance (≥ 2006)	2.95	0.09	< 0.001	3.20	0.10	< 0.001

[1] AIC of disturbance models for males from Apr 2013 – Aug 2015: age effects = 4815, no age effects = 4895. AIC of disturbance models for males from Apr 2013 – Mar 2017: age effects = 4369, no age effects = 4391.

[2] The switch to perfect avoidance was due to the burning of the cutblock data; thus, the previous estimate of selection for shrubby rich fen was likely due to bison using an unclassified cutblock.

Table 8: Selection coefficients (β; with standard errors [SE] and p-values) from the top resource selection functions estimated during **summer / fall for female wood bison** of the Ronald Lake herd of northeast Alberta. Shown are coefficients from the previous March 2016 report (Apr 2013 – Aug 2015 data) and coefficients using the latest data (Apr 2013 – Mar 2017). For land cover (first grouping), positive coefficients (> 0) indicate relative selection compared to Upland Deciduous forests while negative coefficients indicate relative avoidance. For fire interactions (second grouping), coefficients indicate relative selection compared to the coefficients of the given land cover. Anthropogenic disturbance coefficients (third grouping) are in reference to selection of undisturbed areas. Dashes indicate variables not included in a given data-specific top model.

	Apr 2013 – Aug 2015 (n = 21)			Apr 2013-Mar2017 (n = 33)		
Variable	β	SE	p	β	SE	p
Intercept	-1.67	0.06	<0.001	-1.27	0.05	< 0.001
Open Water	-0.93	0.06	<0.001	-0.51	0.03	< 0.001
Aquatic Bed	-0.25	0.14	0.064	-0.54	0.11	< 0.001
Emergent Marsh	-0.01	0.06	0.916	0.31	0.04	< 0.001
Meadow Marsh	0.85	0.04	<0.001	0.72	0.03	< 0.001
Graminoid Rich Fen	-0.13	0.05	0.009	-0.38	0.04	< 0.001
Graminoid Poor Fen	-0.52	0.06	<0.001	-0.55	0.04	< 0.001
Shrubby Rich Fen	-0.95	0.07	<0.001	-0.83	0.04	< 0.001
Shrubby Poor Fen	-0.71	0.06	<0.001	-0.63	0.04	< 0.001
Treed Rich Fen	-0.15	0.03	<0.001	-0.48	0.02	< 0.001
Treed Poor Fen	-0.34	0.03	<0.001	-0.75	0.02	< 0.001
Shrubby Bog	-0.35	0.10	<0.001	-0.31	0.06	< 0.001
Treed Bog	-1.02	0.08	<0.001	-1.04	0.06	< 0.001
Shrub Swamp	-0.89	0.04	<0.001	-0.86	0.03	< 0.001
Hardwood Swamp	-0.68	0.05	<0.001	-1.07	0.04	< 0.001
Mixedwood Swamp	-1.21	0.07	<0.001	-1.84	0.07	< 0.001
Tamarack Swamp	-0.17	0.07	0.014	-0.93	0.06	< 0.001
Conifer Swamp	0.64	0.02	<0.001	0.35	0.02	< 0.001
Upland Conifer	0.75	0.03	<0.001	0.70	0.02	< 0.001
Upland Pine				-0.70	0.10	< 0.001
Upland Mixedwood	-0.04	0.11	0.719	-0.57	0.09	< 0.001
Cutblock	-1.27	0.13	<0.001	-	-	-
Cutblock Pre2006	-	-	-	-1.15	0.10	< 0.001
Cutblock Post 2005				-0.50	0.11	< 0.001
Anthropogenic	-1.48	0.16	<0.001	-0.25	0.13	0.054
Fire: Low Severity	1.39	0.02	<0.001	1.16	0.02	< 0.001
Fire: High Severity	0.61	0.02	<0.001	0.27	0.02	< 0.001
Open Water: Fire Low	1.24	0.12	<0.001	0.93	0.08	< 0.001
Open Water: Fire High	2.33	0.10	<0.001	1.70	0.07	< 0.001
Emergent Marsh: Fire Low	0.56	0.13	<0.001	0.31	0.09	0.001

	Apr 2013 – Aug 2015 (*n* = 21)			Apr 2013-Mar2017 (*n* = 33)		
Variable	β	SE	*p*	β	SE	*p*
Emergent Marsh: Fire High	0.43	0.12	<0.001	0.28	0.09	0.002
Meadow Marsh: Fire Low	-0.55	0.12	<0.001	-0.24	0.09	0.007
Meadow Marsh: Fire High	0.00	0.08	0.956	0.07	0.06	0.290
Graminoid Poor Fen: Fire Low	0.14	0.16	0.369	0.57	0.12	< 0.001
Graminoid Poor Fen: Fire High	-0.40	0.09	<0.001	-0.44	0.08	< 0.001
Shrubby Rich Fen: Fire Low	1.52	0.15	<0.001	1.13	0.13	< 0.001
Shrubby Rich Fen: Fire High	0.79	0.08	<0.001	0.42	0.05	< 0.001
Shrubby Poor Fen: Fire Low	1.96	0.17	<0.001	1.18	0.13	< 0.001
Shrubby Poor Fen: Fire High	0.05	0.09	0.543	0.00	0.06	0.972
Treed Rich Fen: Fire Low	-0.18	0.07	0.009	-0.14	0.05	0.007
Treed Rich Fen: Fire High	0.00	0.04	0.931	0.19	0.04	< 0.001
Treed Poor Fen: Fire Low	-0.15	0.09	0.087	0.35	0.06	< 0.001
Treed Poor Fen: Fire High	-0.15	0.05	0.004	0.10	0.04	0.013
Shrubby Bog: Fire Low	-0.46	0.33	0.167	0.45	0.17	0.009
Shrubby Bog: Fire High	-0.36	0.16	0.026	-0.31	0.11	0.004
Treed Bog: Fire Low	0.62	0.20	0.001	0.74	0.14	< 0.001
Treed Bog: Fire High	0.84	0.13	<0.001	0.35	0.11	0.002
Shrub Swamp: Fire Low	0.20	0.14	0.162	-0.04	0.10	0.683
Shrub Swamp: Fire High	1.13	0.06	<0.001	1.21	0.05	< 0.001
Hardwood Swamp: Fire Low	0.70	0.12	<0.001	0.81	0.10	< 0.001
Hardwood Swamp: Fire High	1.17	0.09	<0.001	1.44	0.08	< 0.001
Mixedwood Swamp: Fire Low	-0.99	0.18	<0.001	-0.10	0.14	0.489
Mixedwood Swamp: Fire High	0.20	0.14	0.164	0.58	0.15	< 0.001
Tamarack Swamp: Fire Low	-1.65	0.20	<0.001	-0.98	0.13	< 0.001
Tamarack Swamp: Fire High	-0.43	0.13	<0.001	0.30	0.11	0.007
Conifer Swamp: Fire Low	-0.69	0.06	<0.001	-0.50	0.05	< 0.001
Conifer Swamp: Fire High	-0.83	0.05	<0.001	-0.65	0.04	< 0.001
Upland Conifer: Fire Low	-0.27	0.04	<0.001	-0.29	0.03	< 0.001
Upland Conifer: Fire High	-0.58	0.04	<0.001	-0.66	0.03	< 0.001
Upland Pine: Fire Low				-0.78	0.15	< 0.001
Upland Pine: Fire High				0.85	0.10	< 0.001
Upland Mixedwood: Fire Low	0.00	0.11	0.995	0.48	0.09	< 0.001
Upland Mixedwood: Fire High	0.39	0.12	0.001	0.68	0.09	< 0.001
Disturbance (No age effect) [1]	-	-	-	0.03	0.03	0.262
Disturbance: ≤ 2005 [2]	-0.06	0.05	0.234		-	-
Disturbance: ≥ 2006	0.11	0.05	0.055	-	-	-

[1] AIC of disturbance models for females from Apr 2013 – Mar 2017: age effects = 431029, no age effects = 431029.

[2] AIC of disturbance models for females from Apr 2013 – Aug 2015: age effects = 258557, no age effects = 258560.

Table 9: Selection coefficients (β; with standard errors [SE] and p-values) from the top resource selection functions estimated during **summer / fall for male wood bison** of the Ronald Lake herd of northeast Alberta. Shown are coefficients from the previous March 2016 report (Apr 2013 – Aug 2015 data) and coefficients using the latest data (Apr 2013 – Mar 2017). For land cover (first grouping), positive coefficients (> 0) indicate relative selection compared to Upland Deciduous forests while negative coefficients indicate relative avoidance. For fire interactions (second grouping), coefficients indicate relative selection compared to the coefficients of the given land cover. Anthropogenic disturbance coefficients (third grouping) are in reference to selection of undisturbed areas Dashes indicate variables not included in a given data-specific top model.

	Apr 2013 – Aug 2015 (*n* = 3)			Apr 2013-Mar2017 (*n* = 3)		
Variable	β	SE	*p*	β	SE	*p*
Intercept	-1.11	0.15	<0.001	-0.83	0.14	<0.001
Open Water	-2.29	0.4 2	<0.001	-1.73	0.27	<0.001
Aquatic Bed	-1.09	0.56	0.054	-0.81	0.55	0.145
Emergent Marsh	-1.25	0.43	0.004	-1.48	0.42	<0.001
Meadow Marsh	0.58	0.19	0.002	0.62	0.20	0.002
Graminoid Rich Fen	1.58	0.30	<0.001	-0.13	0.28	0.640
Graminoid Poor Fen	-1.40	0.31	<0.001	-1.21	0.26	<0.001
Shrubby Rich Fen	-2.44	0.46	<0.001	-3.10	0.46	<0.001
Shrubby Poor Fen	-2.53	0.58	<0.001	-2.62	0.50	<0.001
Treed Rich Fen	-0.27	0.10	0.007	-0.69	0.10	<0.001
Treed Poor Fen	-0.70	0.12	<0.001	-1.45	0.12	<0.001
Shrubby Bog	-1.95	0.55	<0.001	-1.43	0.45	0.002
Treed Bog	-1.43	0.25	<0.001	-1.98	0.30	<0.001
Shrub Swamp	-1.63	0.18	<0.001	-1.27	0.15	<0.001
Hardwood Swamp	-0.45	0.12	<0.001	-0.68	0.13	<0.001
Mixedwood Swamp	-2.61	0.34	<0.001	-3.21	0.35	<0.001
Tamarack Swamp	-1.26	0.26	<0.001	-2.14	0.27	<0.001
Conifer Swamp	0.36	0.10	<0.001	-0.26	0.10	0.009
Upland Conifer	1.14	0.08	<0.001	-0.19	0.13	0.153
Upland Pine	-	-	-	-14.78	3.20	<0.001
Upland Mixedwood	-0.79	0.33	0.015	-1.39	0.35	<0.001
Cutblock Pre2006	-0.68	0.33	0.040	-0.44	0.23	0.054
Cutblock Post2005				0.48	0.12	<0.001
Anthropogenic	-0.64	0.08	<0.001	0.00	0.56	0.998
Fire: Low Severity	-0.15	0.07	0.024	-0.47	0.07	<0.001
Fire: High Severity	-0.37	0.07	<0.001	-0.71	0.07	<0.001
Open Water: Fire Low	2.67	0.79	<0.001	1.72	0.60	0.004
Open Water: Fire High	3.58	0.57	<0.001	2.71	0.44	<0.001
Emergent Marsh: Fire Low	1.88	0.78	0.016	2.67	0.84	0.002
Emergent Marsh: Fire High	1.32	0.72	0.066	0.48	0.76	0.528
Meadow Marsh: Fire Low	1.56	0.51	0.002	1.77	0.64	0.006

	Apr 2013 – Aug 2015 (n = 3)			Apr 2013-Mar2017 (n = 3)		
Variable	β	SE	p	β	SE	p
Meadow Marsh: Fire High	0.15	0.39	0.694	-0.93	0.50	0.065
Graminoid Rich Fen: Fire Low	-12.69	4.05	0.002	-16.44	27.32	0.547
Graminoid Rich Fen: Fire High	-3.42	0.61	<0.001	-1.64	0.56	0.003
Shrubby Rich Fen: Fire Low	2.50	0.82	0.002	3.05	0.72	<0.001
Shrubby Rich Fen: Fire High	2.13	0.50	<0.001	2.91	0.49	<0.001
Shrubby Poor Fen: Fire Low	5.56	1.18	<0.001	5.61	1.05	<0.001
Shrubby Poor Fen: Fire High	0.73	0.79	0.354	1.98	0.62	0.001
Treed Rich Fen: Fire Low	0.84	0.22	<0.001	0.22	0.28	0.441
Treed Rich Fen: Fire High	0.32	0.16	0.050	0.74	0.16	<0.001
Treed Poor Fen: Fire Low	0.57	0.32	0.077	1.25	0.33	<0.001
Treed Poor Fen: Fire High	0.55	0.18	0.002	1.37	0.18	<0.001
Shrub Swamp: Fire Low	0.48	0.40	0.224	-0.03	0.49	0.957
Shrub Swamp: Fire High	0.57	0.26	0.030	-0.20	0.26	0.434
Tamarack Swamp: Fire Low	-0.69	0.91	0.447	-0.21	0.87	0.809
Tamarack Swamp: Fire High	0.96	0.44	0.030	0.59	0.56	0.295
Conifer Swamp: Fire Low	0.56	0.22	0.011	0.92	0.22	<0.001
Conifer Swamp: Fire High	0.09	0.17	0.596	0.86	0.17	<0.001
Upland Conifer: Fire Low	-0.06	0.12	0.639	1.25	0.16	<0.001
Upland Conifer: Fire High	-0.49	0.11	<0.001	0.79	0.15	<0.001
Upland Pine: Fire Low	-	-	-	0.32	4.45	0.943
Upland Pine: Fire High	-	-	-	0.58	5.82	0.920
Upland Mixedwood: Fire Low	0.91	0.35	0.009	1.35	0.37	<0.001
Upland Mixedwood: Fire High	0.20	0.36	0.579	0.61	0.38	0.105
Disturbance: ≤ 2005 [1]	0.49	0.12	<0.001	1.42	0.15	<0.001
Disturbance: ≥ 2006	1.97	0.07	<0.001	2.14	0.07	<0.001

[1] AIC of disturbance models for males from Apr 2013 – Aug 2015: age effects = 20752, no age effects = 20879. AIC of disturbance models for males from Apr 2013 – Mar 2017: age effects = 19391, no age effects = 19408.

Table 10: Selection coefficients (β; with standard errors [SE] and p-values) from the top resource selection functions estimated during **winter for female wood bison** of the Ronald Lake herd of northeast Alberta. Shown are coefficients from the previous March 2016 report (Apr 2013 – Aug 2015 data) and coefficients using the latest data (Apr 2013 – Mar 2017). For land cover (first grouping), positive coefficients (> 0) indicate relative selection compared to Upland Deciduous forests while negative coefficients indicate relative avoidance. For fire interactions (second grouping), coefficients indicate relative selection compared to the coefficients of the given land cover. Anthropogenic disturbance coefficients (third grouping) are in reference to selection of undisturbed areas. Dashes indicate variables not included in a given data-specific top model.

	Apr 2013 – Aug 2015 (*n* = 21)			Apr 2013-Mar2017 (*n* = 31		
Variable	β	SE	*p*	β	SE	*p*
Intercept	-1.41	0.05	< 0.001	-1.33	0.03	< 0.001
Open Water	0.87	0.03	< 0.001	1.05	0.02	< 0.001
Aquatic Bed	-2.18	0.41	< 0.001	-0.58	0.15	< 0.001
Emergent Marsh	2.46	0.04	< 0.001	2.54	0.03	< 0.001
Meadow Marsh	3.36	0.03	< 0.001	3.23	0.02	< 0.001
Graminoid Rich Fen	1.96	0.07	< 0.001	1.51	0.05	< 0.001
Graminoid Poor Fen	1.22	0.04	< 0.001	1.14	0.03	< 0.001
Shrubby Rich Fen	1.88	0.03	< 0.001	1.77	0.02	< 0.001
Shrubby Poor Fen	1.60	0.03	< 0.001	1.55	0.02	< 0.001
Treed Rich Fen	0.72	0.02	< 0.001	0.50	0.02	< 0.001
Treed Poor Fen	0.06	0.03	0.04	-0.17	0.02	< 0.001
Shrubby Bog	-0.74	0.14	< 0.001	-0.38	0.08	< 0.001
Treed Bog	-0.55	0.08	< 0.001	-0.71	0.06	< 0.001
Shrub Swamp	1.98	0.02	< 0.001	1.66	0.01	< 0.001
Hardwood Swamp	0.68	0.03	< 0.001	0.49	0.03	< 0.001
Mixedwood Swamp	0.09	0.05	0.059	-0.37	0.04	< 0.001
Tamarack Swamp	-1.58	0.15	< 0.001	-0.69	0.06	< 0.001
Conifer Swamp	-0.38	0.03	< 0.001	-0.65	0.02	< 0.001
Upland Conifer	-0.53	0.06	< 0.001	-0.39	0.04	< 0.001
Upland Pine	-	-	-	1.26	0.06	< 0.001
Upland Mixedwood	-0.67	0.11	< 0.001	-0.80	0.07	< 0.001
Cutblock	-1.07	0.31	< 0.001	-	-	-
Cutblock Pre2006	-	-	-	-1.96	0.26	< 0.001
Cutblock Post2005	-	-	-	-10.51	28.83	< 0.001
Anthropogenic	-0.78	0.29	0.007	0.63	0.20	0.002
Fire: Low Severity	-1.22	0.05	< 0.001	-1.41	0.04	< 0.001
Fire: High Severity	-0.78	0.04	< 0.001	-0.68	0.02	< 0.001
Open Water: Fire Low	-1.97	0.72	0.006	-0.16	0.20	0.421
Open Water: Fire High	0.67	0.15	< 0.001	0.68	0.08	< 0.001
Emergent Marsh: Fire Low	-1.42	0.29	< 0.001	-2.08	0.25	< 0.001
Emergent Marsh: Fire High	-1.45	0.20	< 0.001	-1.53	0.13	< 0.001

Variable	Apr 2013 – Aug 2015 (*n* = 21) β	SE	*p*	Apr 2013-Mar2017 (*n* = 31 β	SE	*p*
Meadow Marsh: Fire Low	-2.51	0.26	< 0.001	-1.42	0.15	< 0.001
Meadow Marsh: Fire High	-1.57	0.10	< 0.001	-1.73	0.07	< 0.001
Graminoid Rich Fen: Fire Low	-10.01	98.41	0.919	-11.33	97.10	0.907
Graminoid Rich Fen: Fire High	0.71	0.08	< 0.001	0.49	0.06	< 0.001
Graminoid Poor Fen: Fire Low	-0.40	0.42	0.342	-0.17	0.33	0.612
Graminoid Poor Fen: Fire High	-1.04	0.11	< 0.001	-0.95	0.08	< 0.001
Shrubby Rich Fen: Fire Low	-2.21	0.73	0.002	-0.42	0.25	0.090
Shrubby Rich Fen: Fire High	-0.99	0.07	< 0.001	-1.20	0.05	< 0.001
Shrubby Poor Fen: Fire Low	1.23	0.44	0.0050	0.39	0.31	0.206
Shrubby Poor Fen: Fire High	-0.77	0.08	< 0.001	-0.53	0.05	< 0.001
Treed Rich Fen: Fire Low	0.25	0.13	0.048	0.00	0.11	0.991
Treed Rich Fen: Fire High	-0.28	0.06	< 0.001	-0.32	0.04	< 0.001
Treed Poor Fen: Fire Low	0.61	0.17	< 0.001	1.24	0.11	< 0.001
Treed Poor Fen: Fire High	0.17	0.07	0.017	0.39	0.05	< 0.001
Shrubby Bog: Fire Low	-7.16	65.27	0.913	-9.44	129.29	0.942
Shrubby Bog: Fire High	1.29	0.22	< 0.001	0.86	0.15	< 0.001
Treed Bog: Fire Low	2.85	0.34	< 0.001	2.28	0.27	< 0.001
Treed Bog: Fire High	1.75	0.17	< 0.001	1.11	0.13	< 0.001
Shrub Swamp: Fire Low	-1.07	0.23	< 0.001	-1.09	0.21	< 0.001
Shrub Swamp: Fire High	0.08	0.06	0.194	0.14	0.04	0.001
Hardwood Swamp: Fire Low	-0.59	0.35	0.094	0.31	0.20	0.121
Hardwood Swamp: Fire High	0.46	0.14	< 0.001	1.12	0.08	< 0.001
Conifer Swamp: Fire Low	-0.32	0.26	0.22	-0.30	0.22	0.162
Conifer Swamp: Fire High	-0.79	0.15	< 0.001	-0.53	0.10	< 0.001
Upland Conifer: Fire Low	0.14	0.10	0.196	0.05	0.08	0.535
Upland Conifer: Fire High	-0.18	0.08	0.02	-0.09	0.05	0.087
Upland Pine: Fire Low	-	-	-	-0.16	0.14	0.242
Upland Pine: Fire High	-	-	-	0.00	0.07	0.940
Disturbance: ≤ 2005 [1]	-0.48	0.07	< 0.001	-0.47	0.05	< 0.001
Disturbance: ≥ 2006	-1.04	0.10	< 0.001	-1.32	0.08	< 0.001

[1] AIC of disturbance models for females from Apr 2013 – Aug 2015: age effects = 185694, no age effects = 185714. AIC of disturbance models for females from Apr 2013 – Mar 2017: age effects = 380373, no age effects = 380452.

Table 11: Selection coefficients (β; with standard errors [SE] and p-values) from the top resource selection functions estimated during **winter for male wood bison** of the Ronald Lake herd of northeast Alberta. Shown are coefficients from the previous March 2016 report (Apr 2013 – Aug 2015 data) and coefficients using the latest data (Apr 2013 – Mar 2017). For land cover (first grouping), positive coefficients (> 0) indicate relative selection compared to Upland Deciduous forests while negative coefficients indicate relative avoidance. For fire interactions (second grouping), coefficients indicate relative selection compared to the coefficients of the given land cover. Anthropogenic disturbance coefficients (third grouping) are in reference to selection of undisturbed areas. Dashes indicate variables not included in a given data-specific top model.

	Apr 2013 – Aug 2015 (*n* = 3)			Apr 2013-Mar2017 (*n* = 2)		
Variable	β	SE	*p*	β	SE	*p*
Intercept	-2.25	0.19	< 0.0012	-1.22	0.06	< 0.001
Open Water	0.46	0.27	0.088	1.47	0.13	< 0.001
Aquatic Bed	2.35	0.30	< 0.001	1.98	0.36	< 0.001
Emergent Marsh	0.58	0.39	0.137	-0.39	0.45	0.392
Meadow Marsh	-0.33	0.46	0.471	-0.52	0.37	0.159
Graminoid Rich Fen	2.12	0.18	< 0.001	0.29	0.20	0.144
Graminoid Poor Fen	0.87	0.34	0.001	-1.00	0.53	0.059
Shrubby Rich Fen	0.36	0.35	0.314	1.65	0.13	< 0.001
Shrubby Poor Fen	1.25	0.31	< 0.001	0.02	0.33	0.953
Treed Rich Fen	-0.14	0.20	0.49	-0.45	0.13	0.001
Treed Poor Fen	-0.05	0.20	0.803	-0.63	0.14	< 0.001
Shrubby Bog	0.00	0.43	0.999	0.18	0.31	0.566
Treed Bog	-1.09	0.45	0.0154	-2.02	0.42	< 0.001
Shrub Swamp	0.04	0.20	0.841	-0.31	0.16	0.058
Hardwood Swamp	-0.23	0.21	0.263	-1.20	0.22	< 0.001
Mixedwood Swamp	-1.50	0.42	< 0.001	-3.00	0.51	< 0.001
Tamarack Swamp	1.00	0.17	< 0.001	-0.48	0.18	0.007
Conifer Swamp	-1.75	0.54	0.001	-4.18	1.00	< 0.001
Upland Conifer	-1.49	0.44	< 0.001	-1.67	0.37	< 0.001
Upland Pine				1.61	0.21	< 0.001
Upland Mixedwood	0.52	0.40	0.186	-0.81	0.44	0.063
Cutblock	-12.84	4.28	0.003	-	-	-
Cutblock Pre2006	-	-	-	-2.22	0.51	< 0.001
Cutblock Post2005	-	-	-	-14.57	211.78	0.945
Anthropogenic	1.05	0.09	< 0.001	2.05	0.48	< 0.001
Fire: Low Severity	-0.22	0.12	0.057	-0.87	0.11	< 0.001
Fire: High Severity	0.40	0.09	< 0.001	0.14	0.08	0.085
Emergent Marsh: Fire Low	-	-	-	3.57	0.94	< 0.001
Emergent Marsh: Fire High	-	-	-	3.36	0.59	< 0.001
Graminoid Poor Fen: Fire Low	-12.98	11.57	0.2617	-12.47	1385.38	0.993
Graminoid Poor Fen: Fire High	0.90	0.43	0.0347	1.68	0.58	0.004

	Apr 2013 – Aug 2015 (n = 3)			Apr 2013-Mar2017 (n = 2)		
Variable	β	SE	p	β	SE	p
Shrubby Rich Fen: Fire Low	2.11	0.70	0.0024	0.44	0.53	0.405
Shrubby Rich Fen: Fire High	0.84	0.39	0.0328	-1.11	0.20	< 0.001
Shrubby Poor Fen: Fire Low	-13.09	7.75	0.0914	-13.50	2399.54	0.996
Shrubby Poor Fen: Fire High	0.94	0.40	0.0201	0.59	0.44	0.180
Treed Rich Fen: Fire Low	1.91	0.31	< 0.001	1.60	0.28	< 0.001
Treed Rich Fen: Fire High	1.24	0.24	< 0.001	0.58	0.18	0.001
Treed Poor Fen: Fire Low	0.22	0.55	0.6967	2.24	0.30	< 0.001
Treed Poor Fen: Fire High	1.06	0.23	< 0.001	0.81	0.18	< 0.001
Shrub Swamp: Fire Low	1.37	0.33	< 0.001	1.84	0.31	< 0.001
Shrub Swamp: Fire High	-0.27	0.27	0.328	-0.88	0.25	< 0.001
Conifer Swamp: Fire Low	0.83	0.87	0.34	5.02	1.05	< 0.001
Conifer Swamp: Fire High	2.27	0.57	< 0.001	4.33	1.02	< 0.001
Upland Conifer: Fire Low	1.21	0.49	0.0139	0.86	0.44	0.053
Upland Conifer: Fire High	2.19	0.45	< 0.001	1.87	0.38	< 0.001
Upland Pine: Fire Low	-	-	-	0.04	0.37	0.915
Upland Pine: Fire High	-	-	-	-0.09	0.23	0.680
Upland Mixedwood: Fire Low	-0.94	0.50	0.058	-0.36	0.55	0.509
Upland Mixedwood: Fire High	-1.32	0.45	0.004	-1.08	0.50	0.030
Disturbance (no age effects) [1]	0.38	0.10	< 0.001	0.78	0.11	< 0.001

[1] AIC of disturbance models for males from Apr 2013 – Aug 2015: age effects = 9758, no age effects = 9757. AIC of disturbance models for males from Apr 2013 – Mar 2017: age effects = 12779, no age effects = 12777.

Table 12: Model validation of seasonal resource selection functions estimated for female and male wood bison of the Ronald Lake herd in northeastern Alberta. Listed seasonal values by gender are selection ratios, defined as the proportion of GPS locations falling within an ordinal RSF bin divided by the bin's proportional area. Values > 1 indicate selection while values < 1 indicate avoidance. Predictive performance was evaluated by the strength of correlation (Spearman's correlation coefficient, r_S) between selection ratios and RSF bin rank. Note that validation procedures resulted in the total number of RSF bins varying by season.

	Spring		Calving		Summer / Fall		Winter	
RSF Bin	Females	Males	Females	Males	Females	Males	Females	Males
1	0.32	0.04	0.02	0.01	0.29	0.06	0.13	0.05
2	0.55	0.04	0.06	0.09	0.41	0.25	0.20	0.18
3	0.62	0.12	0.11	0.10	0.52	0.43	0.33	0.32
4	0.82	0.17	0.31	0.14	0.74	0.64	0.37	0.42
5	0.94	0.51	0.36	0.17	0.89	0.64	0.52	0.62
6	1.10	0.64	0.70	0.66	1.12	0.83	067	0.97
7	0.97	1.17	1.41	2.80	1.21	1.01	1.30	0.90
8	1.95	2.70	2.04	-	2.78	1.16	4.69	1.15
9	-	3.49	-	-	-	2.28	-	1.40
10	-	-	-	-	-	-	-	4.03
Statistical rank correlation:								
r_S	0.98	0.98	1	1	1	1	1	0.99
p	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.001

BISON RESPONSE TO HUMAN ACTIVITY

- Bison response to human activity levels was assessed from 2013 – 2016. Note that 2013 activity was primarily related to oil and gas development, 2014 activity was related to both logging and oil and gas development and 2015-2016 activity was primarily due to logging. We therefore modelled human activity level as a five-category variable: 0 = no disturbance; 1 = disturbance with no human activity; 2 = oil and gas development activity; 3= logging activity; 4 = both logging and oil and gas development activity.
- In this update, only the response of female bison is assessed as the data set for male bison is unchanged from the *March 2016 Report*.
- As in the *March 2016 Report*, female bison generally avoided disturbed areas during the winter (Table 13). Avoidance of these areas, however, increased significantly if human activity was also present. Indeed, no bison locations occurred in areas of active logging during the winters of 2015 and 2016.

Table 13: Selection coefficients (β; with standard errors [SE] and p-values) from a resource selection function assessing the response of female wood bison of the Ronald Lake herd to human activity levels on anthropogenic disturbance features (e.g., roads, seismic lines and well sites) during the winters of 2013 - 2016. Coefficients for disturbance effects (in bold) are relative to undisturbed areas.

	Females (*n* = 33)		
Variable	β	SE	*p*
Intercept	-1.50	0.03	< 0.001
Open Water	1.19	0.02	< 0.001
Aquatic Bed	-0.45	0.15	0.003
Emergent Marsh	2.53	0.03	< 0.001
Meadow Marsh	3.19	0.02	< 0.001
Graminoid Rich Fen	1.55	0.03	< 0.001
Graminoid Poor Fen	0.97	0.03	< 0.001
Shrubby Rich Fen	1.35	0.02	< 0.001
Shrubby Poor Fen	1.39	0.02	< 0.001
Treed Rich Fen	0.41	0.02	< 0.001
Treed Poor Fen	-0.08	0.02	< 0.001
Shrubby Bog	-0.16	0.07	0.019
Treed Bog	-0.41	0.05	< 0.001
Shrub Swamp	1.74	0.01	< 0.001
Hardwood Swamp	0.68	0.02	< 0.001
Mixedwood Swamp	-0.29	0.04	< 0.001
Tamarack Swamp	-0.67	0.06	< 0.001
Conifer Swamp	-0.64	0.02	< 0.001
Upland Conifer	-0.94	0.02	< 0.001
Upland Pine	0.81	0.02	< 0.001
Upland Mixedwood	-1.34	0.07	< 0.001
Cutblock Pre 2006	-2.47	0.26	< 0.001
Cutblock Post 2005	-10.75	28.99	0.711
Anthropogenic	0.26	0.20	0.200
Disturbance, no activity	-1.09	0.09	< 0.001
Disturbance, oil and gas	-2.53	0.32	< 0.001
Disturbance, logging	-8.94	79.53	0.911
Disturbance, logging and oil and gas	-10.67	192.75	0.956

PREDICTIVE MAPS OF SEASONAL HABITAT SELECTION BY MALE AND FEMALE WOOD BISON

We used the output from seasonal resource selection functions (RSFs) to generate spatial predictions (i.e., maps) of habitat selection by male and female wood bison of the Ronald Lake herd (Figs.). Predictions are constrained to the maximal extent of bison range use from April 2013 – March 2017, as defined by a 100% minimum convex polygon surrounding all bison GPS locations recorded during that time period. Note that predictions may only be applicable to each gender's season-specific extent of use. We further highlight the following caveats:

1. Each predictive map represents a continuum of relative habitat suitability. It does not represent the absolute probability that a bison will occur at a given location.
2. Even in areas with apparently high suitability, the actual probability of bison occurrence may be relatively low because bison groups likely occur at low densities throughout their range.
3. Bison can – and probably do – occur in areas with relatively low suitability.

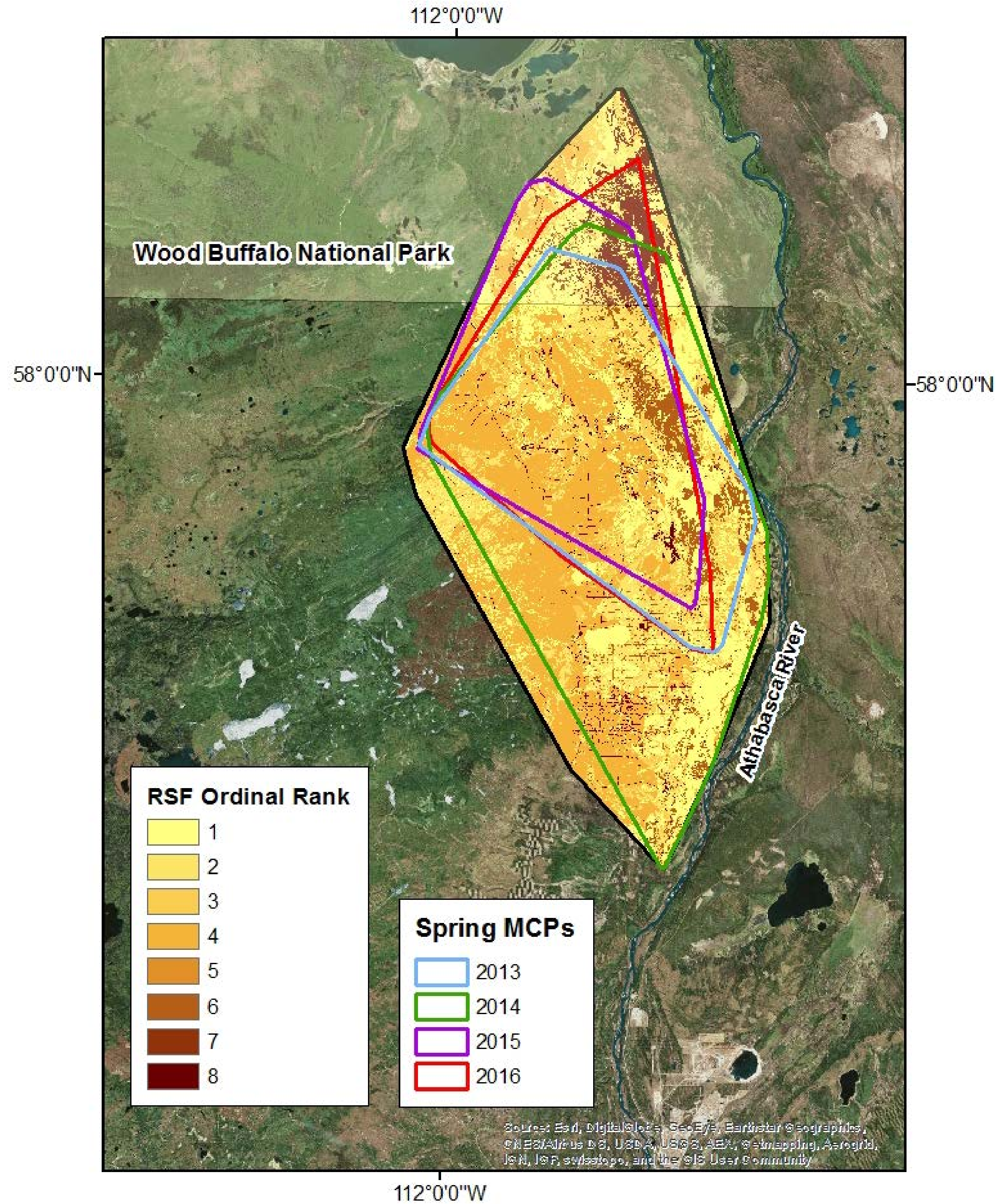

Figure 9: Spatially explicit predictions of habitat selection by female wood bison of the Ronald Lake herd during the spring (c.a. mid-April to early-June). Annual 100% minimum convex polygons (MCPs) surrounding bison GPS locations (males and females) recorded during the spring are shown for reference. Females showed disproportionate use of areas with RSF ordinal rank values ≥ 6.

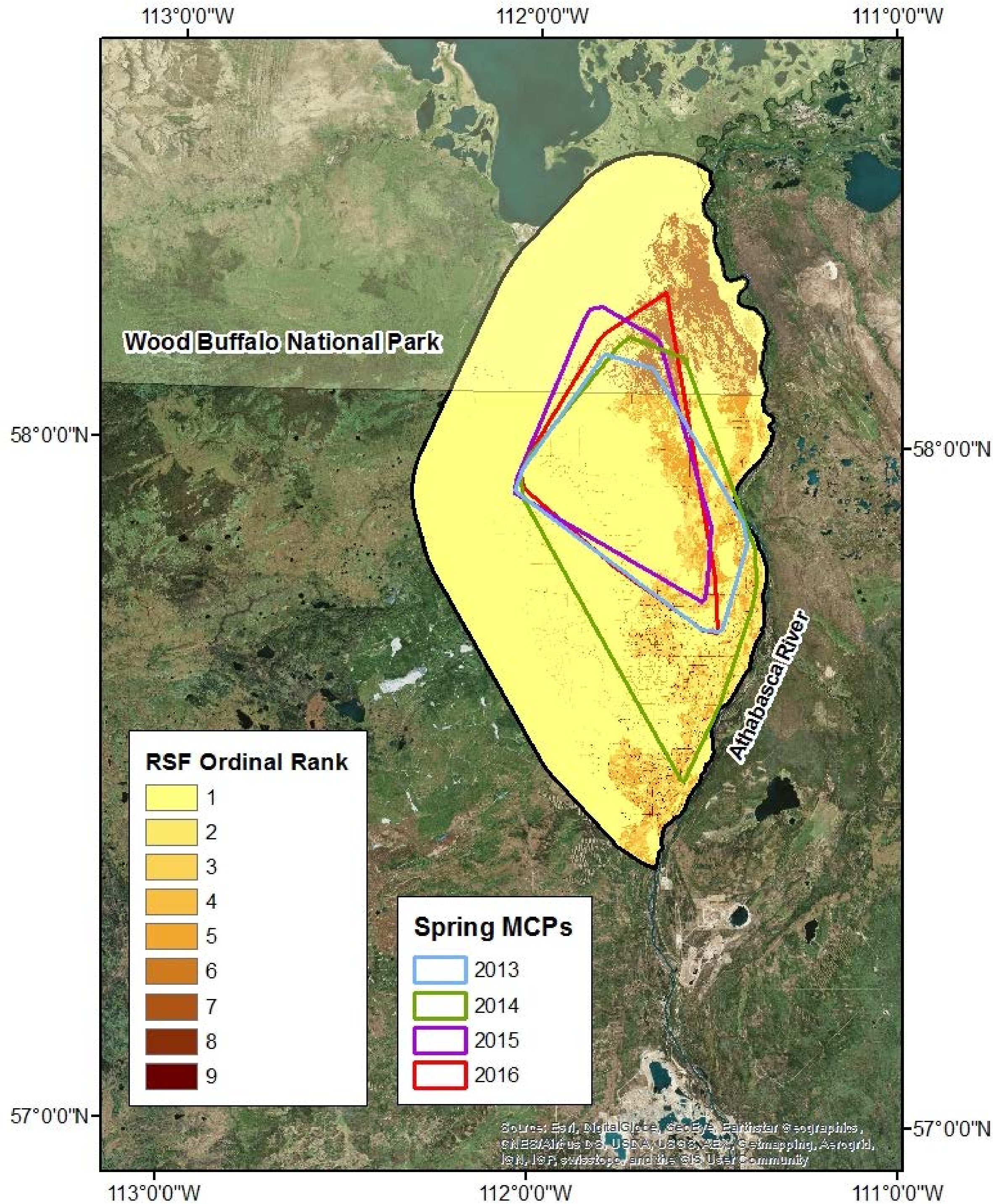

Figure 10: Spatially explicit predictions of habitat selection by male wood bison of the Ronald Lake herd during the spring (c.a. mid-April to early-June). Annual 100% minimum convex polygons (MCPs) surrounding bison GPS locations (males and females) recorded during the spring are shown for reference. Males showed disproportionate use of areas with RSF ordinal rank values ≥ 7.

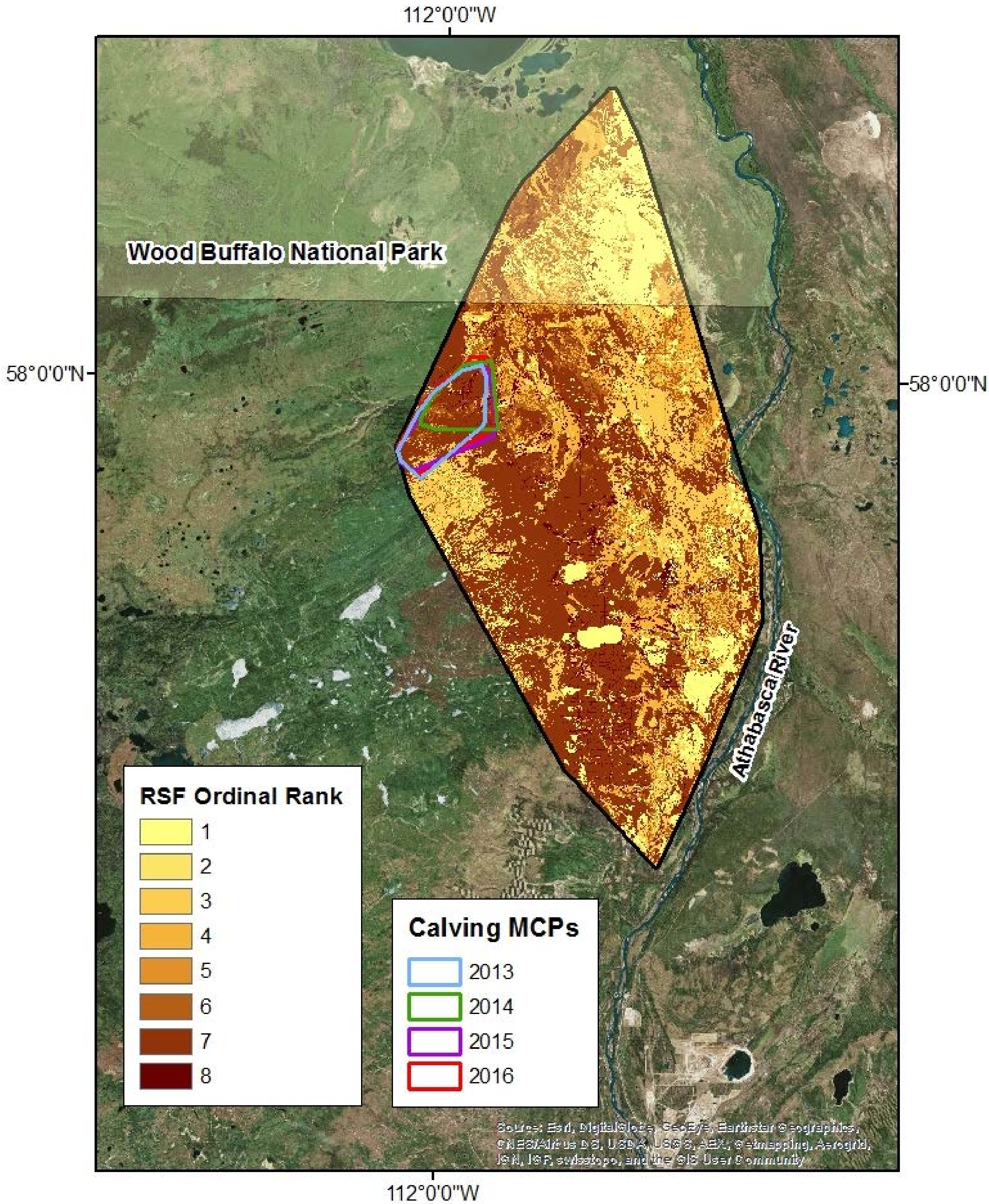

Figure 11: Spatially explicit predictions of habitat selection by female wood bison of the Ronald Lake herd during calving (c.a. early-June to end-June). Annual 100% minimum convex polygons (MCPs) surrounding female bison GPS locations recorded during calving are shown for reference. Females showed disproportionate use of areas with RSF ordinal rank values ≥ 7.

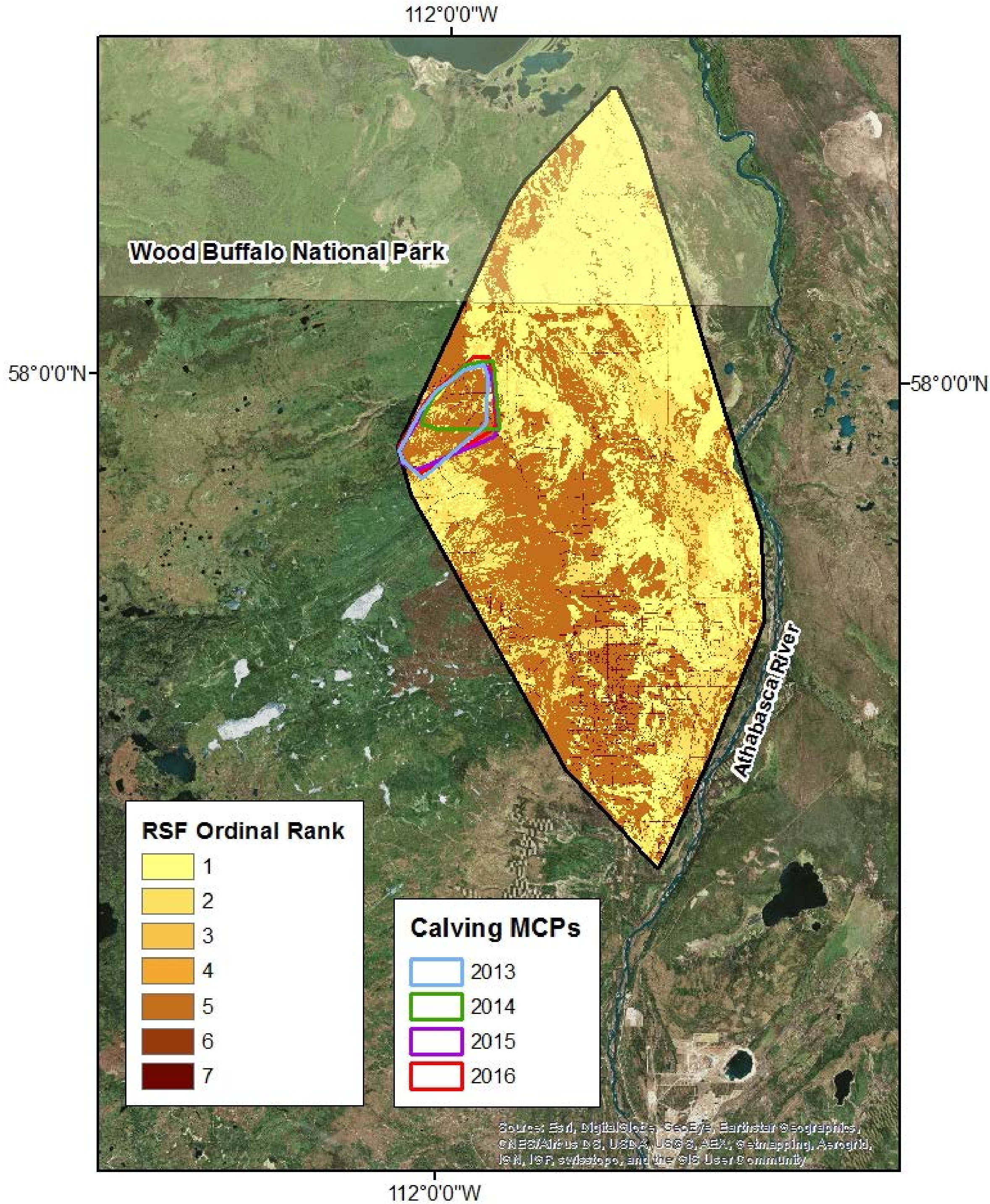

Figure 12: Spatially explicit predictions of habitat selection by male wood bison of the Ronald Lake herd during calving (c.a. early-June to end-June). Annual 100% minimum convex polygons (MCPs) surrounding female bison GPS locations recorded during calving are shown for reference. Because males are predominantly segregated from females at calving, GPS locations for male bison area also shown. Males disproportionately used of areas with RSF ordinal rank values ≥ 7.

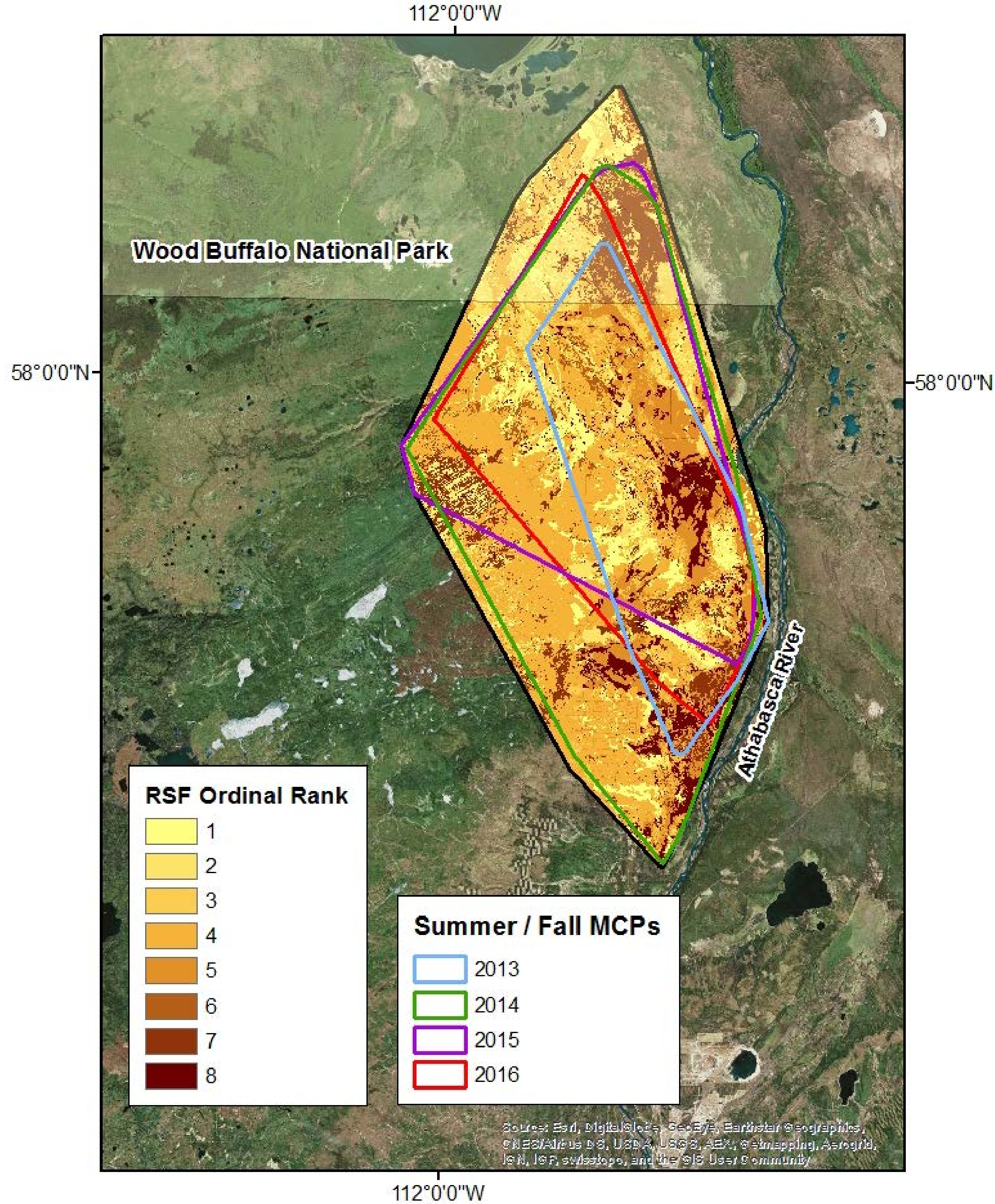

Figure 13: Spatially explicit predictions of habitat selection by female wood bison of the Ronald Lake herd during the summer and fall (c.a. early-November to end-October). Annual 100% minimum convex polygons (MCPs) surrounding all bison GPS locations (female and male) recorded during summer and fall are shown for reference. Females showed disproportionate use of areas with RSF ordinal rank values ≥ 6.

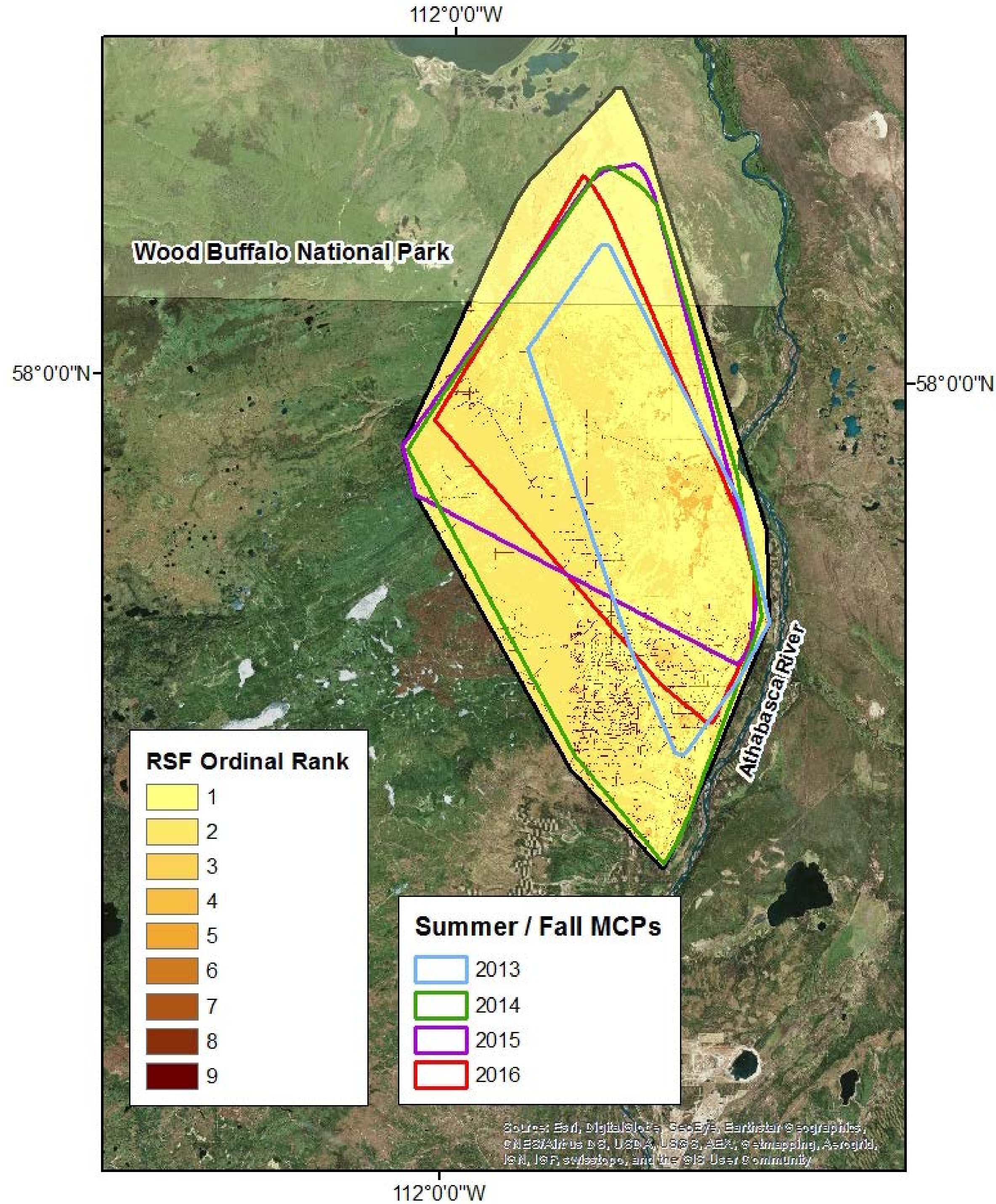

Figure 14: Spatially explicit predictions of habitat selection by male wood bison of the Ronald Lake herd during the summer and fall (c.a. early-November to end-October). Annual 100% minimum convex polygons (MCPs) surrounding all bison GPS locations (female and male) recorded during summer and fall are shown for reference. Males showed disproportionate use of areas with RSF ordinal rank values ≥ 7.

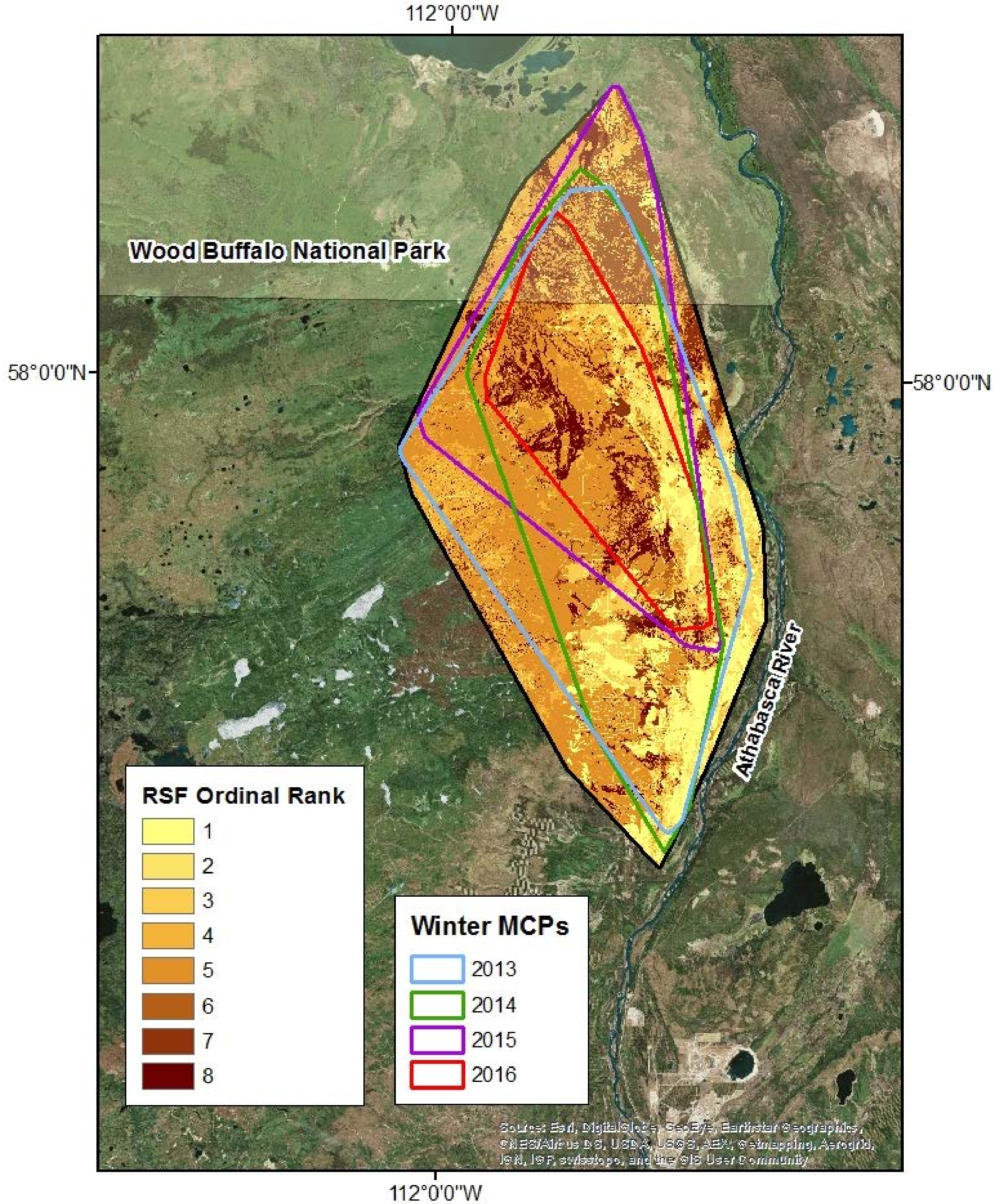

Figure 15: Spatially explicit predictions of habitat selection by female wood bison of the Ronald Lake herd during the winter (c.a. early-November to mid-April). Annual 100% minimum convex polygons (MCPs) surrounding all bison GPS locations (female and male) recorded during winter are shown for reference. Females showed disproportionate use of areas with RSF ordinal rank values ≥ 7.

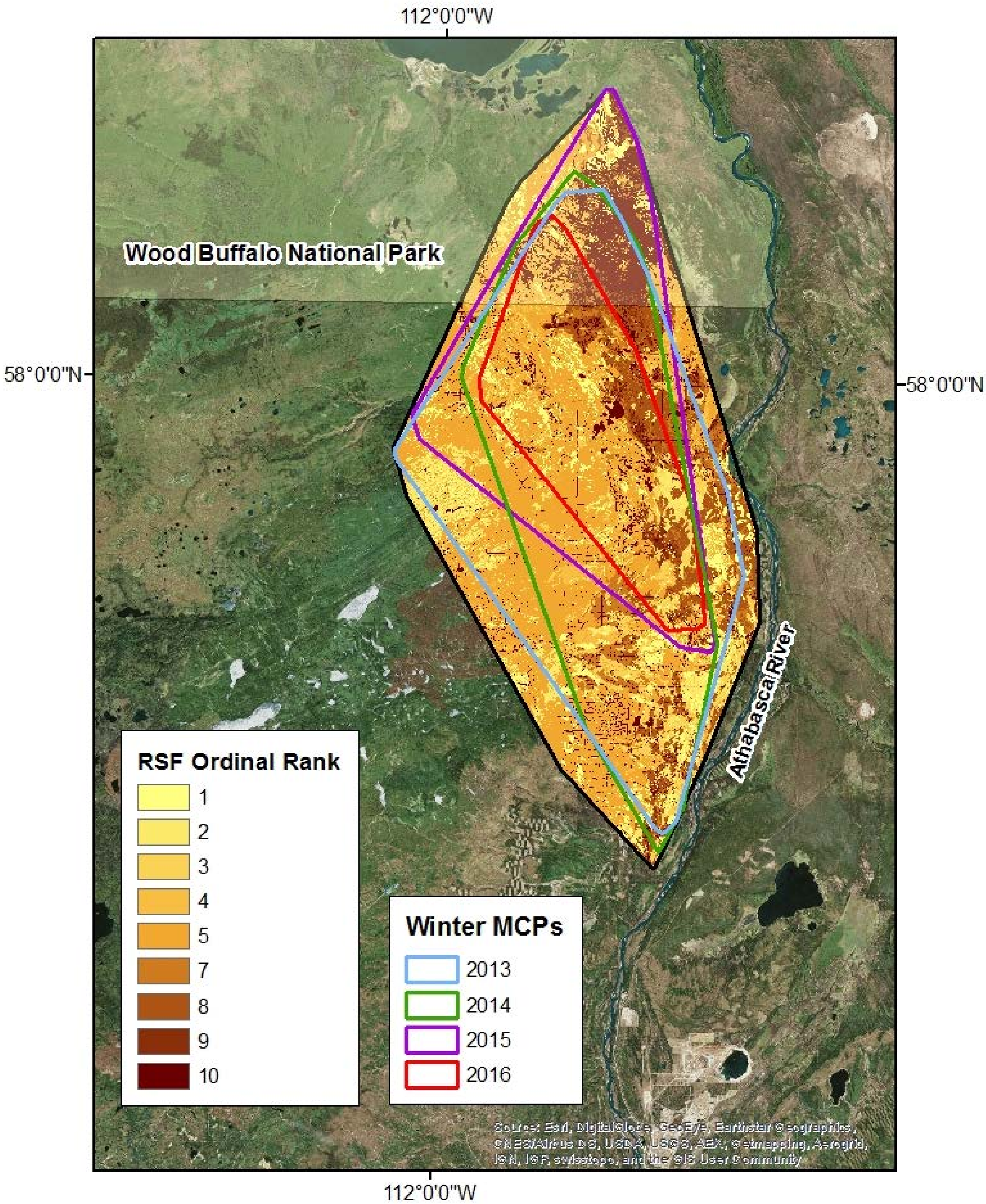

Figure 16: Spatially explicit predictions of habitat selection by male wood bison of the Ronald Lake herd during the winter (c.a. early-November to mid-April). Annual 100% minimum convex polygons (MCPs) surrounding all bison GPS locations (female and male) recorded during winter are shown for reference. Males showed disproportionate use of areas with RSF ordinal rank values ≥ 6.