Mule Deer Capture and Initial Movements on Canadian Forces Base Wainwright Progress Report

11 March to 30 July 2017

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PROJECT BACKGROUND.

Chronic wasting disease (CWD) is a fatal neurodegenerative prion disease of cervids that was first detected in the wild cervids in Alberta in 2005 and has since continued to spread across the province. Previous efforts to predict the rate of transmission of CWD within a population and its spread across the landscape has been hindered by detailed information on factors influencing direct and indirect contact rates. In support of modeling efforts to obtain these estimates to improve management of the disease, we initiated a pilot study to quantify movements, habitat use, and sex-specific contact rates of mule deer (*Odocoileus hemionus*) on Canadian Forces Base Wainwright (Base) in winter 2017. This report covers the early period of deer capture and monitoring.

RESULTS AND DISCUSSION

Capture and Collaring Deer. A total of 35 animals (15 males; 20 females) were captured by helicopter net gunning and collared on 11-12 March in collaboration with Base staff and the Alberta Fish and Wildlife (Appendix I). Capture was conducted with two crews working in tandem because rectal samples were taken for CWD status by a trained team. Helicopter capture crew captured, hobbled, blindfolded the deer, and drew blood. While the net-gunner was handling the deer, the pilot flew to pick up the second crew. Upon arrival, the helicopter capture crew administered chemical immobilant Rompin™(Xylazine HCl) nasally via an atomizer and applied a lidocane cream to the rectal biopsy site. Body measurements and ear tissue sample were taken, and an Alberta Fish and Wildlife ear tag was attached (Fig. 1). Once the deer was considered sedated and the lidocaine cream effective, a fecal sample was collected, and a biopsy of the rectal lymphoid tissue was taken (Fig. 2).

Fig. 1 Second capture crew headed up by Trevor Pettitt, Alberta Fish & Wildlife.

Fig. 2. Rectal biopsy to determine CWD status of the deer.

Fig. 3 Penned deer used to test *Wildscope* collars in SK.

Two types of collars were deployed. Fifteen females were fit with proximity collars manufactured by Wildscope (University Trento, Italy). These collars (called Wildmon) register deer locations based on global positioning system every 2-hrs as well as at the time when two collars come into "contact" (within ~ 1-5 m) of each other (GPS). Functioning of these collars were evaluated on penned deer at the Goodale Farm, University of Saskatchewan in spring 2015 (Fig. 3, Pettitt et al. 2015). *Wildscope* collars down load via the cellular network. Also, twenty Lotek Iridium TrackM 3D collars with expandable belts (15 males; 5 females) located on males. GPS locations were set to register every 2-hrs. All collars had drop-offs programed for 44 weeks, which will be in early January 2018.

Our original design was to capture deer both in the shrubby habitats of the Battle River drainage and in the open aspen-prairie habitats just east of the Battle River. During capture most deer were found in the Battle River drainage. As a result, deer captures were focused along the Battle River during this pilot year (Fig.4). We found most males inhabiting the southern portions or the Battle River whereas females were spread along the Battle River drainage and a few were located in the aspen parklands plateau east of the Battle River. Thus, our original design was compromised to a degree.

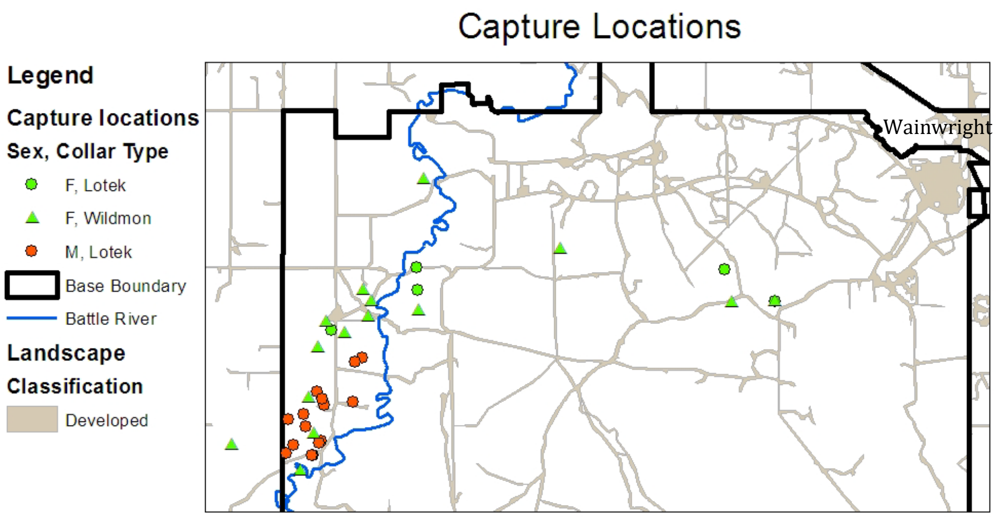

Fig. 4. Capture locations of 20 female and 15 male mule deer with either Wildmon or Lotek Iridium collars.

Survival and CWD status of collared deer.

Three deer (1 male; 2 females) died within 15 days of capture. Causes of death are unknown because remains were consumed, too deteriorated, or necropsy results inconclusive; however, we cannot rule out capture-related reasons. Assessment of handling protocols have been made in terms of timing of capture and handling protocols to minimize any potential contributions to future captures (see UA Incident report #AUP0001369, ABF&W necropsy report 17-029 and 17-033 for details). A fourth deer died three months after capture. Again, the cause of death is unknown due to heavy scavenging on the carcass, but the death is not considered to be capture related.

Thirty-five deer were biopsied for rectal tissue samples. Twelve samples were submitted with less than 6 follicles and 18 samples were hemorrhaged due to freezing under extreme field conditions, thus rendering 30 samples unusable (this was not known until lab analysis). However, we were able to repeat biopsy and analyze samples of two of these deer before scavenging was too extensive. Samples of rectal tissue from the deer captured were sent to the Canadian Food Inspection Agency lab in Ottawa for CWD testing. Of these, tissue sample were adequate (6+ follicles observable) from 5 deer (3 males, 2 females). Of these, one of the three male mule deer is CWD positive (Appendix II).

Collared Deer Monitoring. We currently are monitoring 16 Lotek collars (13 males; 3 females) remotely by satellite and 14 deer (all females) with Wildmon collars from the ground using VHF telemetry. The cellular network of the Wildmon collars unfortunately is not functioning and we are working on the cause. Because of the consistency of the malfunction, we believe this may be related to interference of the cellular network on the Base during their spring exercises between 1 May and 7 June 2017. To remedy this situation we would be required to recapture the deer and reset the collars, which is not feasible at this time nor is it in the best interest of the deer. Any contacts among these deer are being stored on-board the collar and the data will be retrieved with the collars when they drop off in early January.

We monitored movement of the 16 deer with Iridium Lotek collars between 20 March and July 3 2017, but do not include data for the first week of monitoring after capture in our preliminary analyses below. We also do not include early movements of the 3 deer that died within 2 weeks; those movements are reported in our incident reports (UA Incident report #AUP0001369, ABF&W necropsy report 17-029 and 17-033). We radio-located deer collared with Wildmon collars on 12-14 June and verified that 13 of the 15 deer were alive. We failed to observe one of the deer but received telemetry signals from this collar on the Base in vicinity of one of the permanent danger areas (PDA3). The final deer (a fifth mortality) was found dead in a patch of aspen trees in Base section C1 (Appendix II). We will continue to locate the remaining 13 deer 1-2 times per month. Because of the infrequency of the relocations of these deer we present only their capture locations in this report. However, we note that as of this writing, these deer have been located a second time between 17-19 July and all 13 deer were observed alive within an average of 1.3+0.65 km of the first telemetry observations.

Deer Distribution and Movements On/Off the Base. The distribution of locations of iridium-collared mule deer is shown in Figure 5. Although the time deer spend on and off the base depended on their capture site, two female mule deer spent almost all of their time on the base (97-100%) whereas the third female spent 18% of its time off the Base (Figure 6, Appendix III). Of the females (n=13) with Wildmon collars that have been relocated 3 times at this writing, with nearly all locations were on the Base. The exception is the female deer that was collared adjacent to the Base (Wildmon collar). We do not know her complete movements due to the Wildmon collar malfunction; however, VHF ground telemetry has located her within the base boundary at least once. There appears to be high overlap in the winter (March-April) and spring (May-June) movements of female (Figure 6), but this is a small sample of female deer. More information on female deer will be obtained when Wildmon collars are recovered.

Male mule deer, which were captured further to the west in the Battle River drainage, spent on average 43±31% (mean, SD, range: 0-91%) of their time on the base (Figure 7, Appendix III). Of the 12 collared males, 9 followed a seasonal movement pattern with greater numbers of locations being recorded east and further into the base in the spring compared to the winter when they were located farther west and more likely to be off the Base.

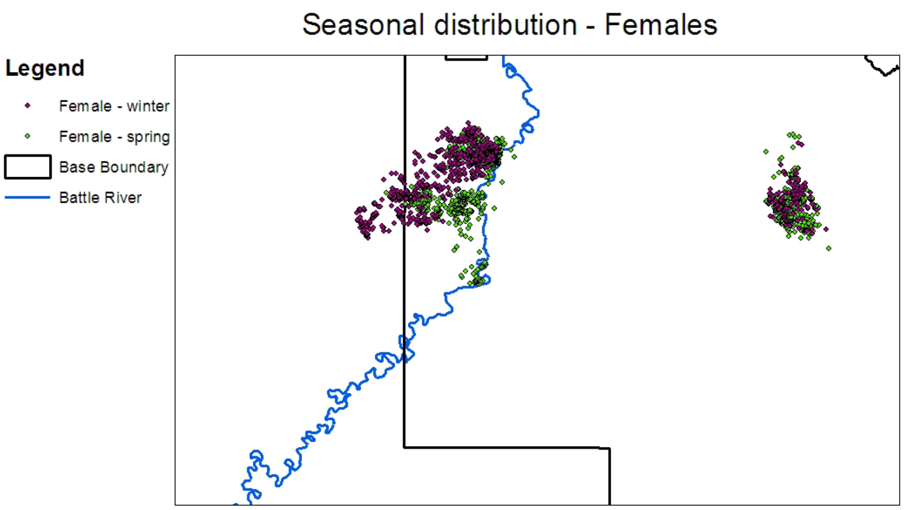

Fig. 5. Winter and spring locations of 3 female collared mule deer. Winter is March-April and spring is May-June.

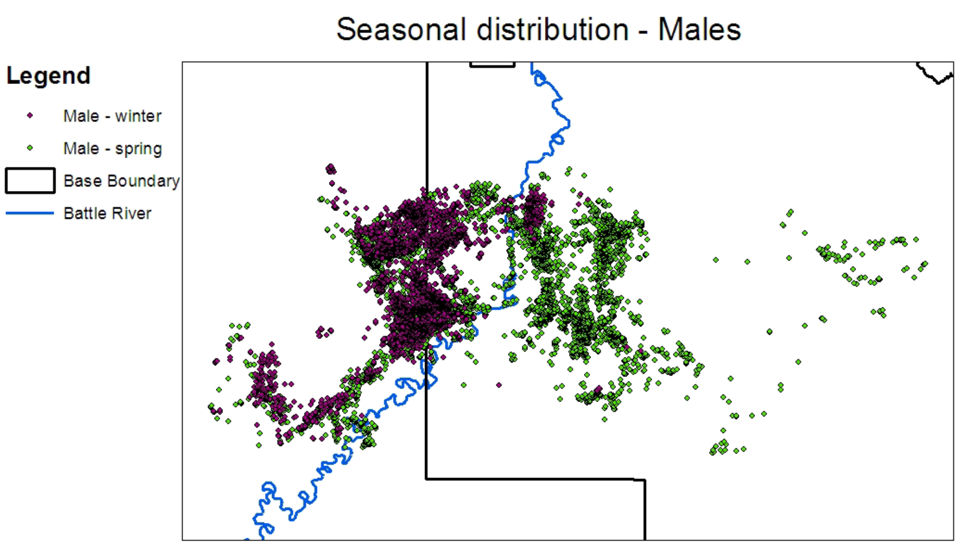

Fig. 6. Winter and spring locations of 12 male collared mule deer. Winter is March-April and spring is May-June.

Deer use areas, daily movements, and habitat use.

Females (11.2 $\pm$1.23 km^2) areas of use were smaller than male mule deer areas (33.7$\pm$ 5.5 km^2, mean, SE); Figures 8-9, Appendix IV) based on minimum convex polygon analysis of GPS locations.

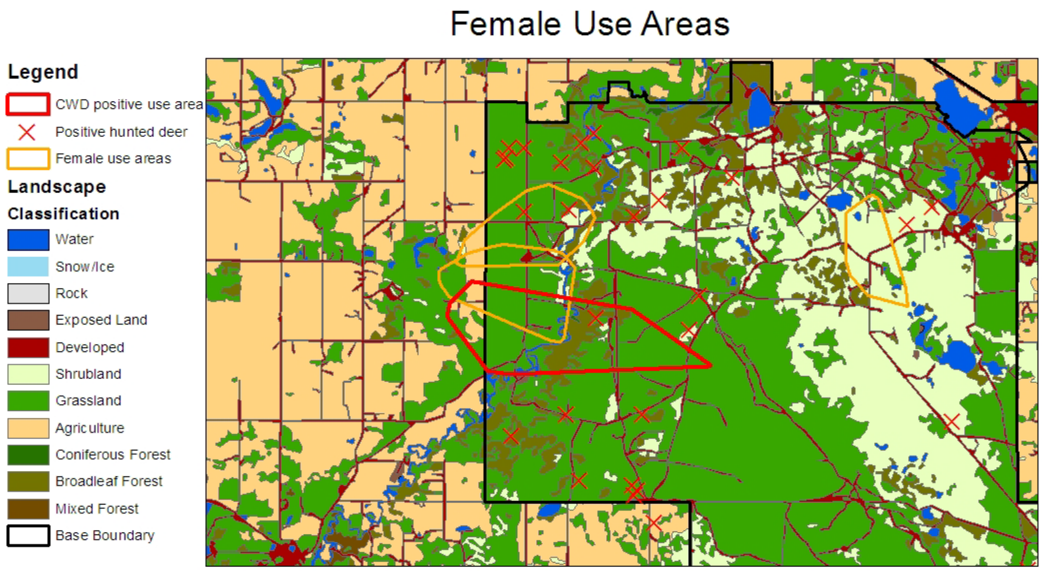

Fig. 7. Use areas of the 3 iridium-collared female deer. Use area of CWD-positive, iridium-collared male in red and locations of CWD positive harvested deer since 2009 are indicated by red crosses.

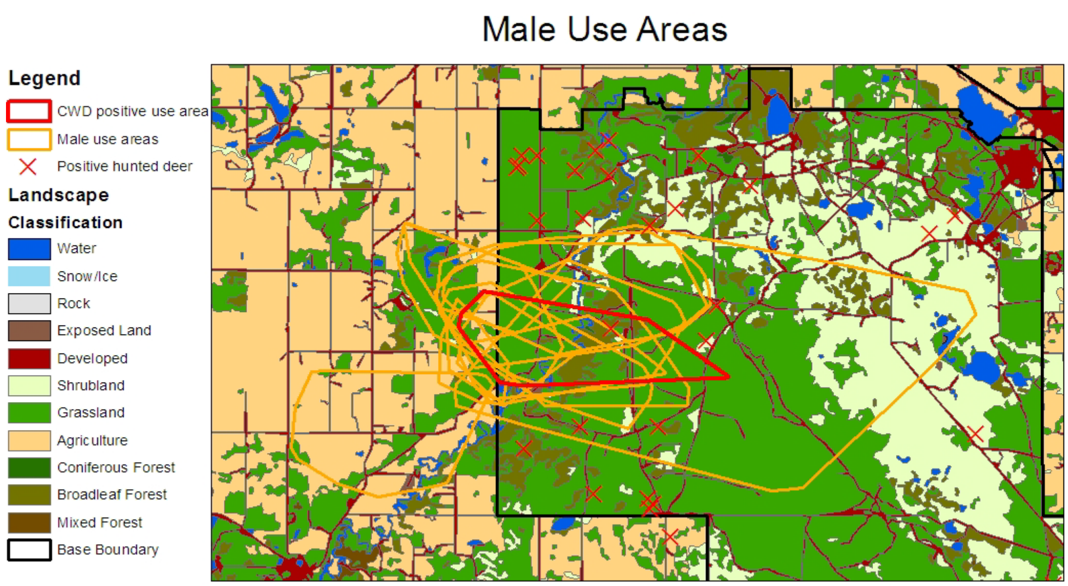

Fig. 9. Location and sizes of use areas of 11 iridium-collared male deer. The area of use of the CWD-positive, iridium-collared male is shown in red and locations of CWD-positive deer harvested on the based deer since 2009 are indicated by red crosses.

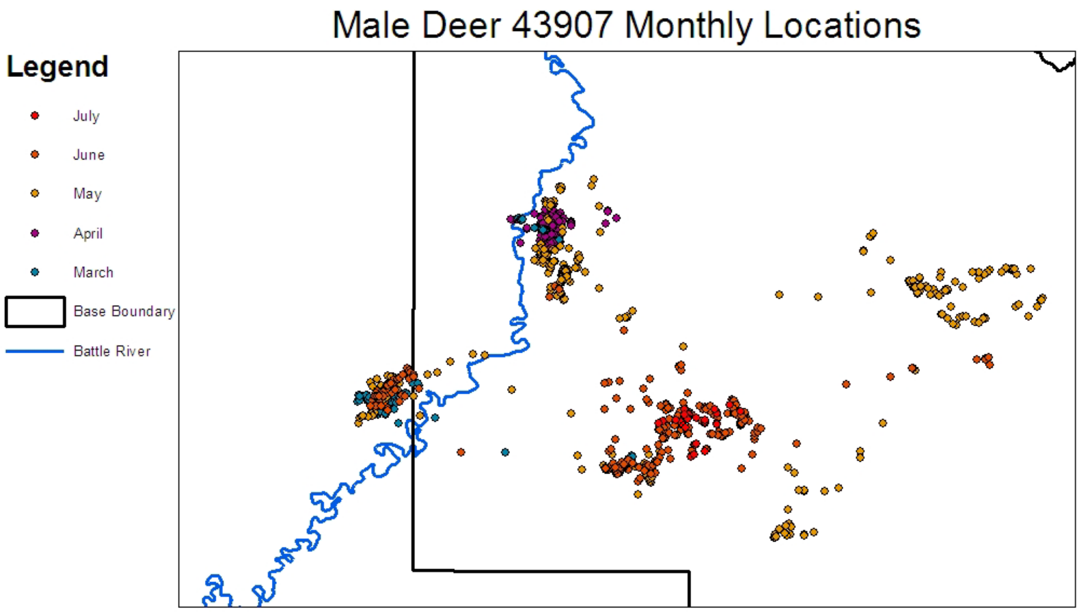

Fig. 10. Seasons movement of male mule deer ID1710009 that moved most widely across the Base exhibiting the largest on range in Fig. 9.

Mean distance travelled in a two-hour period by female deer (n=3) was 0.31±0.39 km in winter and 0.21±0.28 km in spring. Mean distance travelled by male deer was 0.22+0.37 in winter and 0.22±0.35 in spring. The greatest distance travelled within a two-hour period was by a male deer (ID 43907) was 7.45km (Figure 10). The maximum distance travelled by a female was 3.04km. Sample sizes are too small at this time to test for differences between sexes. Deer showed the typical bi-model patterns in movement during the day being most active early morning and late afternoon/early evening (Figure 8). The apparent shifts in movement periods between winter and spring in Figure 11 is likely to due to changing day length.

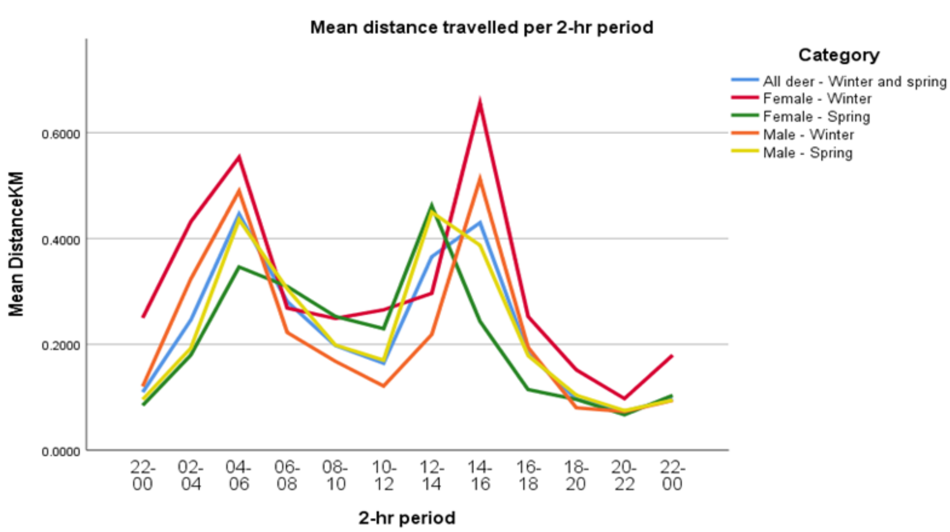

Fig. 11. Variation in mean distance (km) travelled by season and sex of deer during a 2hr-hour period in 24 hours.

Habitat Use. Male mule deer tended to use agricultural areas more in both spring and winter and grasslands in spring than females (Fig. 12 and 13), whereas females used woody cover in the upland shrublands and broadleaf forests more than males in both seasons.

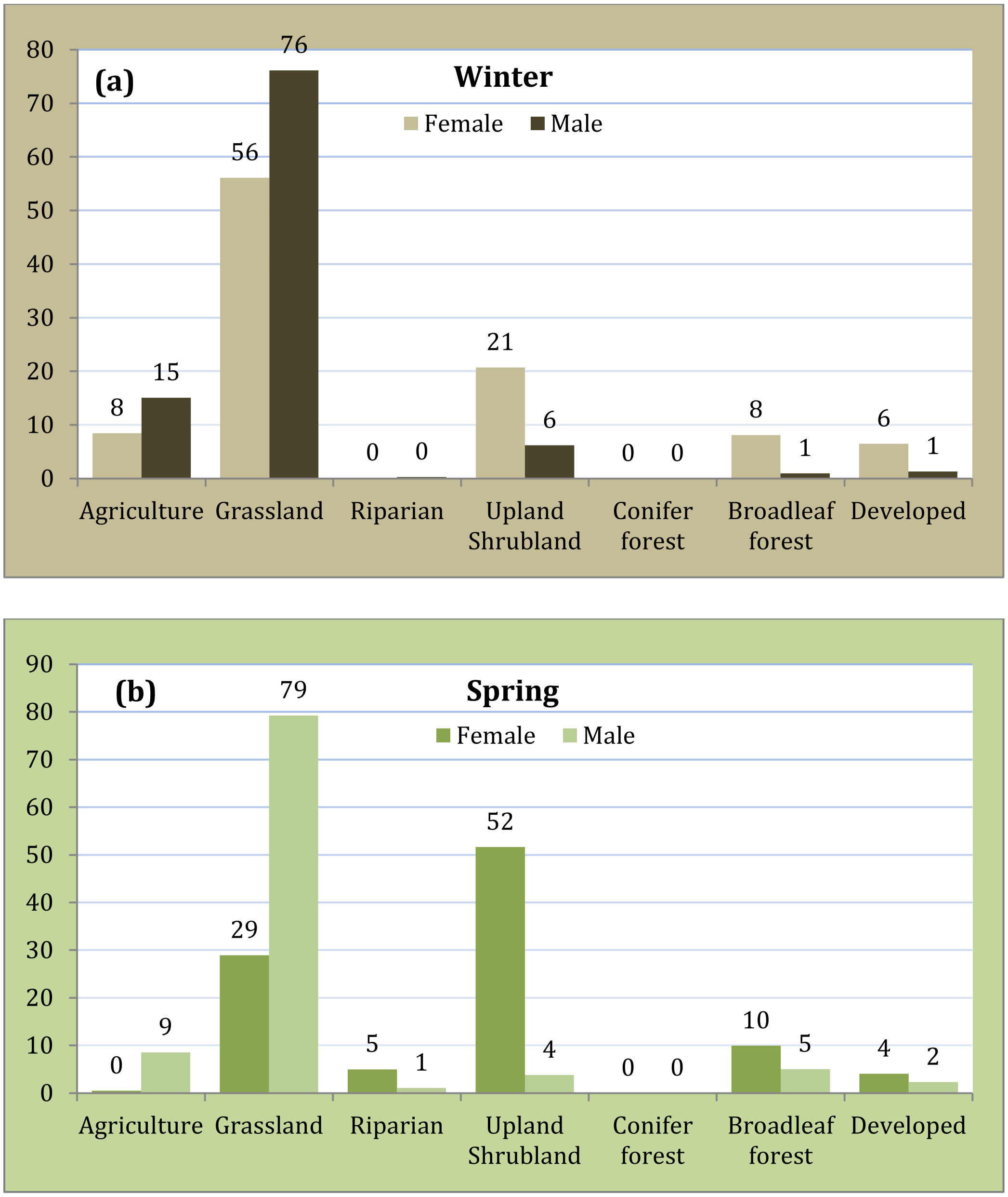

Fig. 12. Percent of GPS location recorded in each habitat type for female and male mule deer in (a) winter and (b) spring. Spring is March-April and winter is May-June.

Summary and Conclusions of Progress to Date. We captured and marked 35 mule deer on the base this winter. Cellular retrieval of data from the Wildmon collars has not been possible due to cellular interference on the Base, but the data on the deer movements and contact rates should be collected and stored on the collars, which we will retrieve in January. We had 4 of our 20 iridium-collared deer die, but the remaining 16 collars are working properly and have supplied us with information on the activities of this species in this location. We expect these collars to continue to function until after hunting season.

The movement data collected during the first 15 weeks of this pilot project has shown that the collared deer spend time both on and off the base and that seasonal movement patterns are present. The majority of the male collared deer showed a seasonal pattern and moved easterly in the spring. Migratory behaviour has been identified as a significant mechanism for transmission of CWD (Conner and Miller 2004). It is too premature to indicate whether these movements might reflect regular migratory patterns representing an interface for potential disease exchange on and off the Base. Seasonal movement is often driven by the pattern in spring 'green-up', suggesting that available habitat further east and on the Base may be greening up earlier and attract deer to the Base at this time of year. Even without regular migratory movements, the movement of male deer on the Base is likely to spread the disease more broadly because they travel more widely than the females. While we not yet analyzed the contact rates between the collared male deer, the high levels of overlap in the use areas between the deer increases the likelihood of contact as well as the possibility of indirect transmission (Waddell *et al* 2017, Saunders *et al* 2012).

In contrast, female collared deer were more localized in their movement patterns, which could reflect more frequent contacts within localized social groups. Further, the habitat use of female deer appears to reflect use of woody patches of vegetation, such aspen stand and shrub areas, which also may concentrate animals in localized areas and increase disease transmission both directly and through the environment. However, these are very preliminary suggestions because movement data analyzed to date on female deer consist of only 3 of the total 13 female mule deer collared, and will be a focus of further work. We also will be extend our understanding of seasonal movements on/off the base during the summer in response to agricultural practices and in the fall related to hunting.

It is also clear that the male and female deer we collared have high overlap with potential areas and animals with CWD, and we are well on our way to understanding their movements and habitat use patterns. Reducing the number of mortality incidents, improving techniques for rectal biopsies and resolving the difficulty with cellular retrieval of the movement and contacts data from collared-deer will be key to achieving the study goals.

References

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Appendix I. Summary of adult (AD, young of the year (YOY) of male (M) and female (F) mule deer captured and collared in winter 2017.

UA Deer ID	ABFW CWD ID[1]	Sex	Age[2]	Capture date	UTM_E	UTM_N	AB F&W Ear tag#	VHF freq	Collar type	Collar Serial No.	Collar color[3]
1710001	95286	M	YOY	12-Mar-17	488527	5845763	1817	153.200	Lotek	43906	Brown
1710002	--	M	YOY	12-Mar-17	487361	5844272	1818	153.400	Lotek	43910	Brown
1720003	--	F	AD	11-Mar-17	500904	5849934	1819	153.900	Lotek	43916	Brown
1710004	--	M	AD	12-Mar-17	487971	5845100	1820	152.500	Lotek	43901	Brown
1710005	--	M	AD	11-Mar-17	488169	5844198	1821	153.300	Lotek	43908	Brown
1720006	96217	F	AD	11-Mar-17	491380	5850008	1822	153.500	Lotek	43912	Brown
1710007	--	M	AD	12-Mar-17	488306	5846171	1823	152.400	Lotek	43900	Brown
1710008	--	M	AD	11-Mar-17	488155	5844194	1824	152.300	Lotek	43899	Brown
1710009	--	M	AD	11-Mar-17	488430	5844639	1825	153.350	Lotek	43909	Brown
1710010	--	M	AD	12-Mar-17	487587	5844513	1826	153.250	Lotek	43907	Brown
1710011	--	M	AD	11-Mar-17	488370	5844603	1827	152.200	Lotek	43989	Brown
1710012	--	M	AD	11-Mar-17	489686	5847218	1828	152.700	Lotek	43903	Brown
1710013	--	M	AD	12-Mar-17	487417	5845313	1829	153.100	Lotek	43905	Brown
1710014	--	M	AD	12-Mar-17	487883	5845481	1830	152.100	Lotek	43897	Brown
1720015	--	F	AD	11-Mar-17	491420	5849307	1831	153.800	Lotek	43915	Brown
1710016	--	M	AD	11-Mar-17	488454	5845939	1832	152.600	Lotek	43902	Brown
1710017	--	M	AD	11-Mar-17	489494	5847103	1833	152.800	Lotek	43904	Brown
1720018	--	F	AD	11-Mar-17	502450	5848981	1834	153.700	Lotek	43914	Brown
1720019	--	F	AD	12-Mar-17	488759	5848069	1835	153.600	Lotek	43913	Brown
1710020	--	M	AD	11-Mar-17	489429	5845860	1837	153.450	Lotek	43911	Brown
1720021	--	F	AD	11-Mar-17	488224	5844912	1838	148.010	Wildmon	62	Red/yellow
1720022	--	F	YOY	11-Mar-17	488047	5846004	1839	148.162	Wildmon	63	Red/white
1720023	--	F	AD	11-Mar-17	491608	5852777	1840	148.371	Wildmon	64	Yellow/red
1720024	--	F	YOY	11-Mar-17	487798	5843753	1841	149.082	Wildmon	66	Green
1720025	--	F	AD	12-Mar-17	488579	5848359	1836	149.573	Wildmon	67	Green/blue
1720026	--	F	AD	12-Mar-17	489988	5849003	1842	149.653	Wildmon	68	Green/orange

1720027	--	F	AD	11-Mar-17	501107	5848980	1853	151.619	Wildmon	79	Silver/orange
1720028	--	F	AD	12-Mar-17	485685	5844546	1843	149.942	Wildmon	70	Silver/red
1720029	--	F	AD	11-Mar-17	502466	5848983	1844	150.189	Wildmon	71	Silver/yellow
1720030	--	F	AD	11-Mar-17	489896	5848522	1846	150.362	Wildmon	72	Yellow
1720031	--	F	AD	12-Mar-17	489723	5849350	1845	150.563	Wildmon	73	Yellow/white
1720032	--	F	AD	11-Mar-17	491456	5848710	1847	150.793	Wildmon	74	Yellow/green
1720035	--	--	--	--	--	--	--	--	--	--	--
1720037	--	--	--	--	--	--	--	--	--	--	--
1720038	--	F	AD		489155	5848002	1850	151.473	Wildmon	77	Green/red
1710036	--	--	--	--	--	--	--	--	--	--	--
1710037	--	F	AD		488329	5847562	1852	151.717	Wildmon	80	Orange/red
1710038	--	F	AD		495816	5850610	1856	151.867	Wildmon	81	Orange/green

1 An Alberta CWD number was given to the 2 deer carcasses that were collected in the field and sent to the Alberta F&W disease lab.

2 Age was estimated based on antler size when available. The two female YOY were captured beside what was estimated to be their mothers at the same time.

3 Lotek collars all have the same brown belt colour but Wildmon collars have different colour belts and flaps for visual identification.

APPENDIX III. Summary of body measurements, estimated weights and tissue sampling of mule deer in winter 2017.

UA Deer ID	Sex	Age[1]	Girth (cm)	Total Length (cm)	Hind foot (cm)	Est. weight (kg)	Live weight est. (kg)[2]	Body score	Pregnant	CWD status[3]	CWD Source	Date died (dd/mm/yy)	Cause of death[4]
1710001	M	YOY	106	187	50	45	82	3	--	Neg	Rectal	24/03/17	Unknown
1710002	M	YOY	100	183	51	60	73	3	--	Pos	Rectal		
1720003	F	AD	106	175	50	50	82	2	No	Unk	Rectal	15/03/17	Unknown
1710004	M	AD	118	199	53	89	95	4	--	Unk	Rectal		
1710005	M	AD	104	184	51	70	79	4	--	Neg	Rectal		
1720006	F	AD	106	148	48	60	82	3	Yes	Neg	Lymph	04/04/17	Unknown
1710007	M	AD	118	208	51	80	95	4	--	Unk	Rectal		
1710008	M	AD	120	205	53	80	97	4	--	Unk	Rectal		
1710009	M	AD	102	196	49	75	76	3	--	Unk	Rectal		
1710010	M	AD	108	177	50	67	85	4	--	Unk	Rectal		
1710011	M	AD	114	195	52	78	93	3	--	Unk	Rectal		
1710012	M	AD	112	193	54	80	90	4	--	Unk	Rectal		
1710013	M	AD	108	188	52	60	85	3	--	Unk	Rectal		
1710014	M	AD	112	200	50	70	90	4	--	Unk	Rectal		
1720015	F	AD	112	179	49	65	90	3	Yes	Unk	Rectal		
1710016	M	AD	108	183	50	60	85	3	--	Unk	Rectal	11/06/17	Unknown
1710017	M	AD	115	213	51	80	93	4	--	Unk	Rectal		
1720018	F	AD	118	177	62	80	95	4	Yes	Unk	Rectal		
1720019	F	AD	106	202	51	70	82	4	Yes	Unk	Rectal		
1710020	M	AD	114	196	52	75	93	4	--	Unk	Rectal		
1720021	F	YOY	98	178	48	40	71	2	Yes	Neg	Rectal		
1720022	F	AD	118	187	48	47	95	2	Yes	Unk	Rectal		
1720023	F	AD	108	187	50	68	85	3	Yes	Unk	Rectal		
1720024	F	YOY	108	176	50	45	85	3	Yes	Unk	Rectal		
1720025	F	AD	104	181	49	55	79	3	Yes	Unk	Rectal		
1720026	F	AD	104	174	48	60	79	3	Yes	Unk	Rectal		

1720027	F	AD	100	181	48	70	73	4	Yes	Unk	Rectal	13/06/17	Unknown
1720028	F	AD	102	188	38	55	76	3	Yes	Unk	Rectal		
1720029	F	AD	114	187	51	80	93	4	Yes	Unk	Rectal		
1720030	F	AD	102	185	48	70	76	3	Yes	Unk	Rectal		
1720031	F	AD	100	180	47	55	73	2	Yes	Unk	Rectal		
1720032	F	AD	106	171	46	60	82	3	Yes	Unk	Rectal		
1720033	F	AD	98	170	47	60	71	3	Yes	Unk	Rectal		
1710037	F	AD	102	182	50	70	76	4	Yes	Unk	Rectal		
1710038	F	AD	114	182	54	77	93	3	Yes	Unk	Rectal		

1 Age was estimated based on antler size when available. The two female YOY were captured beside what was estimated to be their mothers at the same time.

2 Live weight was estimated based on girth, length and hind foot length calculations.

3 CWD status was tested in all deer by the CFIA in Ottawa from rectal lymphoid samples. Where possible, deceased animals were further tested based on retropharyngeal lymph nodes at the Alberta disease wildlife lab.

4 Investigations and sample analysis were inconclusive when attempting to identify cause of death.

Appendix II. The percentage of GPS locations on the base for each individually collared deer

Deer ID	Percent locations on Base	Total locations
Female		
43915	97	1272
43914	100	668
43913	82	643
Mean	**93.0**	
SD	**9.6**	
Male		
43911	9	863
43910	73	1272
43909	38	1272
43908	44	1272
43907	82	1272
43905	52	1272
43904	76	1272
43903	91	1019
43901	10	1272
43900	0	1272
43899	2	1042
43898	44	1272
43897	41	1272
Mean	**43.2**	
SD	**31.2**	

Appendix III. Area (km^2) of use area for each individual deer.

	Area (km^2)		
Deer	**Total area**	**Day (7am-7pm)**	**Night (7pm-7am)**
<u>Males</u>			
43897	36.3	35.1	33.2
43898	17.1	15.5	15.4
43899	7.3	4.7	6.8
43900	30.5	28.9	29.4
43901	14.4	11.2	14.1
43903	36.4	33.0	32.4
43904	40.6	38.0	36.8
43905	36.4	33.5	33.0
43907	134.9	133.9	128.7
43908	12.1	9.3	11.8
43909	23.5	21.9	21.0
43910	25.0	22.8	22.8
43911	23.3	22.4	19.6
Average for males	**33.7**	**31.5**	**31.2**
SD for males	**32.2**	**32.5**	**30.8**
<u>Females</u>			
43913	14.4	14.0	13.4
43914	7.1	6.1	4.9
43915	12.2	11.0	10.8
Average for females	**11.2**	**10.4**	**9.7**
SD for females	**7.2**	**4.0**	**4.4**