July 14, 2017

WHALE TAIL COMMITMENTS 9 AND 10

Cumulative Encounter and Residency Assessment for Caribou

Submitted to:
Agnico Eagle Mines Limited

REPORT

Report Number: Doc128_1658927.3100.3130

Golder Associates

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1.0 INTRODUCTION

During the April 28 to May 2, 2017 Technical Session for the Whale Tail Project (Project), additional summary of caribou encounters with development zones of influence (ZOIs) and residency time within ZOIs was requested by the Kivalliq Inuit Association (KivIA) and the Government of Nunavut (GN). Agnico Eagle Mines Limited (Agnico Eagle) made commitments (numbers 9, 10) to provide this analysis for the Beverly, Ahiak, Lorillard, and Wager Bay caribou herds on their spring, fall, and winter seasonal ranges. The methods and results of collared caribou cumulative encounters and residency times with development ZOIs are provided in the following sections.

2.0 METHODS

2.1 Collar Data

Since 1996, satellite telemetry has been used to describe movements of numerous barren-ground caribou herds across their annual ranges. For many of the herds in Nunavut and Northwest Territories, initially as few as four transmitting collars were deployed in 1996, after which time the number of collars has varied among years (Table 1). In general, the caribou satellite data were based on a duty cycle that varied from every approximately 7 days to every 1 day, and became more frequent during more recent years.

Starting in 2006, transmitters were also programmed to transmit at 1-day intervals to better describe post-calving movements. In 2009, the frequency of locations was increased to approximately every three hours during the summer to autumn period. When multiple locations were obtained for an individual caribou during a single day, the best location each day was used as classified by on-board collar software. To support the analyses requested by KivIA and GN, the GN committed to provide Agnico Eagle with collar data for the Ahiak, Beverly, Lorillard, and Wager Bay caribou herds. On behalf of the GN, Caslys Consulting Ltd. (Caslys) provided collar location data for the Ahiak (2008 to 2017), Lorillard (1998 to 2017) and Wager Bay (1999 to 2017) herds and seasonal range definitions (Table 2). Data for the Ahiak and Beverly herds provided by GN were incomplete and required a separate a request of Beverly caribou herd and pre-2008 Ahiak herd collar data from the Government of the Northwest Territories (GNWT). The GNWT provided the Beverly and Ahiak collar data on June 23, 2017.

Within a GIS platform, movement paths were created per animal, season and year by joining sequences of successive locations for each herd. Because the frequency of satellite collar locations has increased during the last eight years, the number of segments (distance intervals or partial paths) between successive locations for each animal has also increased.

Table 1: Available Number of Collared Caribou per Year, Season, and Herd

	Spring				Fall				Winter			
Year	Ahiak	Beverly	Lorillard	Wager Bay	Ahiak	Beverly	Lorillard	Wager Bay	Ahiak	Beverly	Lorillard	Wager Bay
1996	-	-	-	-	5	-	-	-	-	-	-	-
1997	4	-	-	-	5	-	-	-	4	-	-	-
1998	4	-	1	-	4	-	2	-	4	-	1	-
1999	-	-	2	-	-	-	8	1	-	-	2	-
2000	-	-	7	1	-	-	9	6	-	-	7	1
2001	5	1	9	6	5	1	7	4	5	1	9	6
2002	8	1	7	4	8	1	10	3	8	1	7	4
2003	4	1	10	3	3	1	12	12	4	1	10	3
2004	2	1	12	11	2	1	9	10	2	1	12	11
2005	8	1	8	8	8	-	3	3	8	1	8	8
2006	20	7	3	3	19	5	-	1	20	7	3	3
2007	19	5	-	1	18	11	-	-	19	5	-	1
2008	19	40	-	-	42	8	-	-	19	40	-	-
2009	42	7	-	-	34	2	-	1	42	7	-	-
2010	27	4	-	1	24	-	-	1	27	4	-	1
2011	19	-	-	1	15	-	8	2	19	-	-	1
2012	34	-	8	2	25	-	5	1	34	-	8	2
2013	18	-	5	1	13	-	5	-	18	-	5	1
2014	8	22	5	-	10	23	2	-	8	22	5	-
2015	5	45	2	-	3	39	5	2	5	45	2	-
2016	2	34	5	2	2	26	12	6	2	34	5	2
2017	-	36	12	5	-	-	-	-	-	36	12	5

Table 2: Seasonal range length for the Ahiak, Beverly, Lorillard and Wager Bay Caribou Herds Considered in the Assessment

Herd	Spring (days)	Fall (days)	Winter (days)
Ahiak	Apr 6 to Jun 12 (67)	Sep 22 to Dec 15 (115)	Dec 16 to Apr 5 (110)
Beverly	Apr 10 to Jun 5 (56)	Sep 12 to Dec 15 (125)	Dec 16 to Apr 9 (114)
Lorillard	Apr 5 to May 28 (53)	Sep 22 to Dec 15 (115)	Dec 16 to Apr 4 (109)
Wager Bay	Apr 1 to May 29 (58)	Sep 22 - Dec 15 (115)	Dec 16 - Mar 31 (105)

2.2 Cumulative Effects Scenarios

Sources of information on the location and duration of known past and existing and potential future developments, such as permit inventories and contaminated sites, were used to create development scenarios in combination with assumed ZOIs for different development types (Table 3). Point disturbances originated from spreadsheet databases of land use permits (except for campgrounds, contaminated sites, mines, and parks), so the locations are not precise. While land use permits are generally issued for five-year spans, information on the duration or seasonality of activity within that five years (or if development proceeded at all) is not recorded by any agency in the NWT or Nunavut. Thus, it was assumed that all developments were active throughout the entire year for all five years following issuance, with the exception of winter roads, which were assumed to be active only in winter. Because permit data does not describe the footprint of developments, the physical area of the footprint was assumed (Table 3). Linear disturbances originated from Nunavut Planning Commission permitting information and CanVec. Actual footprints (polygons) were used for mines and communities.

Table 3: Types of Developments, Footprints and Assumed Zones of Influence in the Assessment

Development Type	Feature Type	Footprint Buffer (m)	Zone of Influence (km)
Camp	point	25	1
Community	polygon	actual	15
Contaminated Site, High	point	200	0
Contaminated Site, Med	point	200	0
Fuel Storage	point	25	0
Mine	polygon	actual	15
Mineral Exploration	point	500	5
Miscellaneous	point	25	1
Quarrying	point	25	5
Research Projects	point	25	1
Territorial Campground	point	25	1
Tourism/Caribou Hunting & Fishing	point	25	5
Tourism/Fishing	point	25	5
All-Season Road	line	20	5
Winter Road	line	20	5

Reasonably Foreseeable Developments

Cumulative effects assessment should include all other human activities that affect the environment, including past, present, and reasonably foreseeable future projects (MVEIRB 2004). Although there is uncertainty in predicting which projects proceed to development, it is a necessary exercise to investigate possible future scenarios from a cumulative effects perspective.

For the purposes of this assessment, it is assumed that each of the reasonably foreseeable developments (RFDs) listed below are carried forward to full development, and their effects have spatial and temporal overlap with effects from the Project. Seasonal ranges were based on 95% kernel density estimates (KDE) for each herd and season (see Table 2). The seasonal KDEs were based on the default search radius, which has been shown to overestimate range (Gitzen and Millspagh 2003; Gitzen et al. 2006) and so was used as a conservatism to maximize cumulative effects. The number and type of RFDs in each seasonal range are shown in Figures 1 to 8. Note that for projects that have not yet been developed, locations have been estimated from publicly available information.

N

Cambridge Bay
Taloyoak
Kugluktuk
Coronation Gulf
Gjoa Haven
Kugaaruk
Queen Maud Gulf
Umingmaktok
Great Bear Lake
Bathurst Inlet
NUNAVUT
Whale Tail Project
Meadowbank Mine
All-weather Access Road
Baker Lake
Gameti
Wekweèti
Whati
Behchokǫ̀
3
Yellowknife
4
Dettah
NORTHWEST TERRITORIES
Łutsel K'e
Great Slave Lake
Hay River
Fort Resolution
Pine Point
6
5
Fort Smith
Chesterfield Inlet
Rankin Inlet
Whale Cove
Arviat
Hudson Bay
ALBERTA
Lake Athabasca
SASKATCHEWAN
MANITOBA

LEGEND

- POPULATED PLACE

PAST AND PRESENT DEVELOPMENTS

- CAMP, INACTIVE
- COMMUNITY
- CONTAMINATED SITE, HIGH
- CONTAMINATED SITE, MEDIUM
- FUEL STORAGE, INACTIVE
- MINE, ACTIVE
- MINE, INACTIVE
- MINERAL EXPLORATION, ACTIVE
- MINERAL EXPLORATION, INACTIVE
- MISCELLANEOUS, INACTIVE
- QUARRYING, INACTIVE
- TOURISM/CARIBOU HUNTING & FISHING, ACTIVE
- TOURISM/FISHING, ACTIVE
- ALL-WEATHER ACCESS ROAD
- ALL-SEASON ROAD
- WINTER ROAD
- WATERCOURSE
- AHIAK CARIBOU SPRING SEASONAL RANGE
- AHIAK CARIBOU FALL SEASONAL RANGE
- BASE DEVELOPMENTS
- PROJECT DEVELOPMENT
- RFD DEVELOPMENT
- PROVINCIAL/TERRITORIAL BOUNDARY
- WATER BODY

REFERENCE

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
DATUM: NAD 83 PROJECTION: CANADA LAMBERT CONFORMAL CONIC

90 0 90
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DEVELOPMENT IN THE SPRING AND FALL RANGES FOR THE AHIAK HERD

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PROJECT		1658927	FILE No.	
DESIGN	DC	29 Jun. 2017	SCALE AS SHOWN	REV. 0
GIS	JE	07 Jul. 2017		
CHECK	DC	07 Jul. 2017		
REVIEW	JV	07 Jul. 2017		

FIGURE 1

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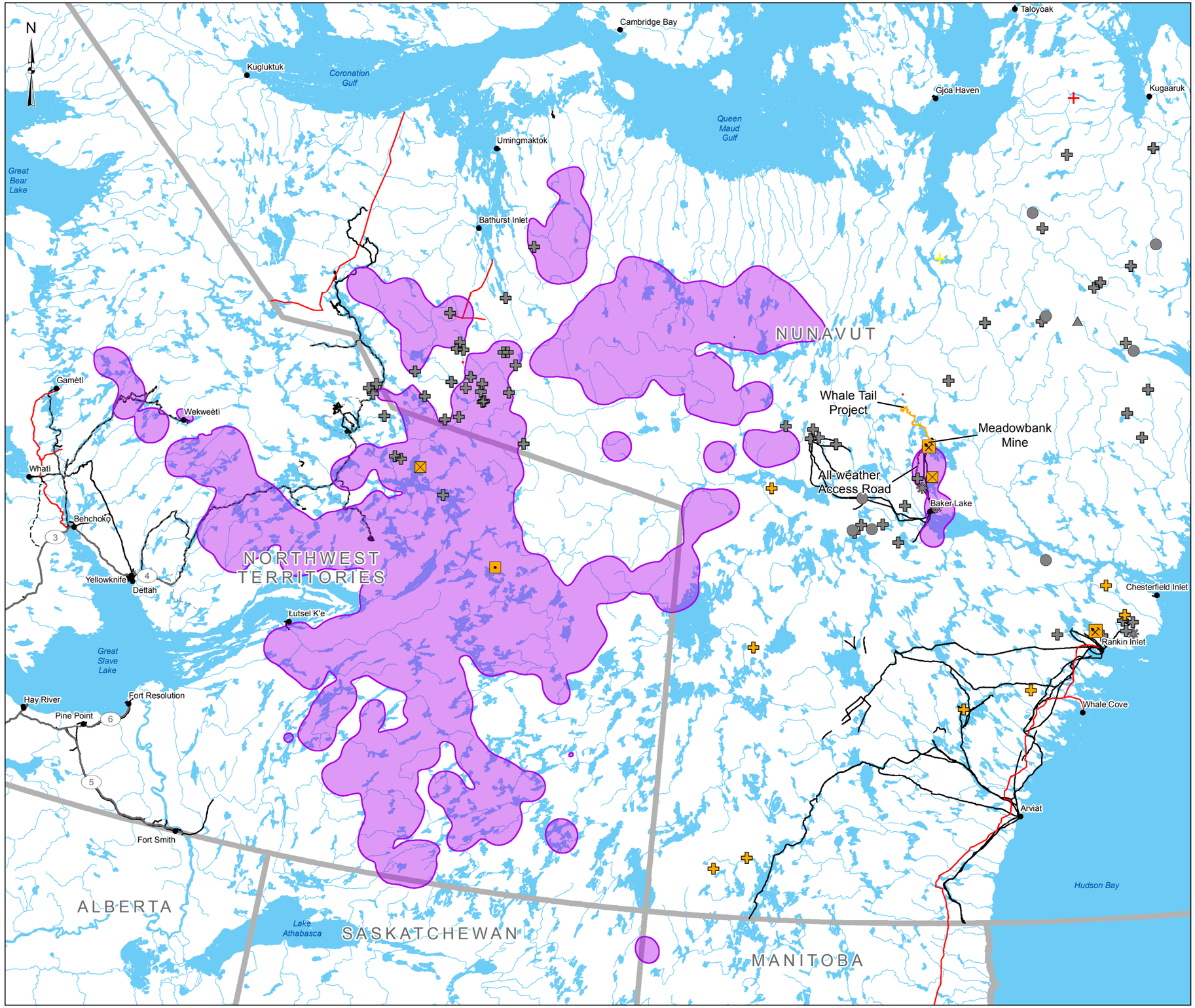

LEGEND

- POPULATED PLACE

PAST AND PRESENT DEVELOPMENTS

- CAMP, INACTIVE
- COMMUNITY
- CONTAMINATED SITE, HIGH
- CONTAMINATED SITE, MEDIUM
- FUEL STORAGE, INACTIVE
- MINE, ACTIVE
- MINE, INACTIVE
- MINERAL EXPLORATION, ACTIVE
- MINERAL EXPLORATION, INACTIVE
- MISCELLANEOUS, INACTIVE
- QUARRYING, INACTIVE
- TOURISM/CARIBOU HUNTING & FISHING, ACTIVE
- TOURISM/FISHING, ACTIVE
- ALL-WEATHER ACCESS ROAD
- ALL-SEASON ROAD
- WINTER ROAD
- WATERCOURSE
- AHIAK CARIBOU WINTER SEASONAL RANGE
- BASE DEVELOPMENTS
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FIGURE 2

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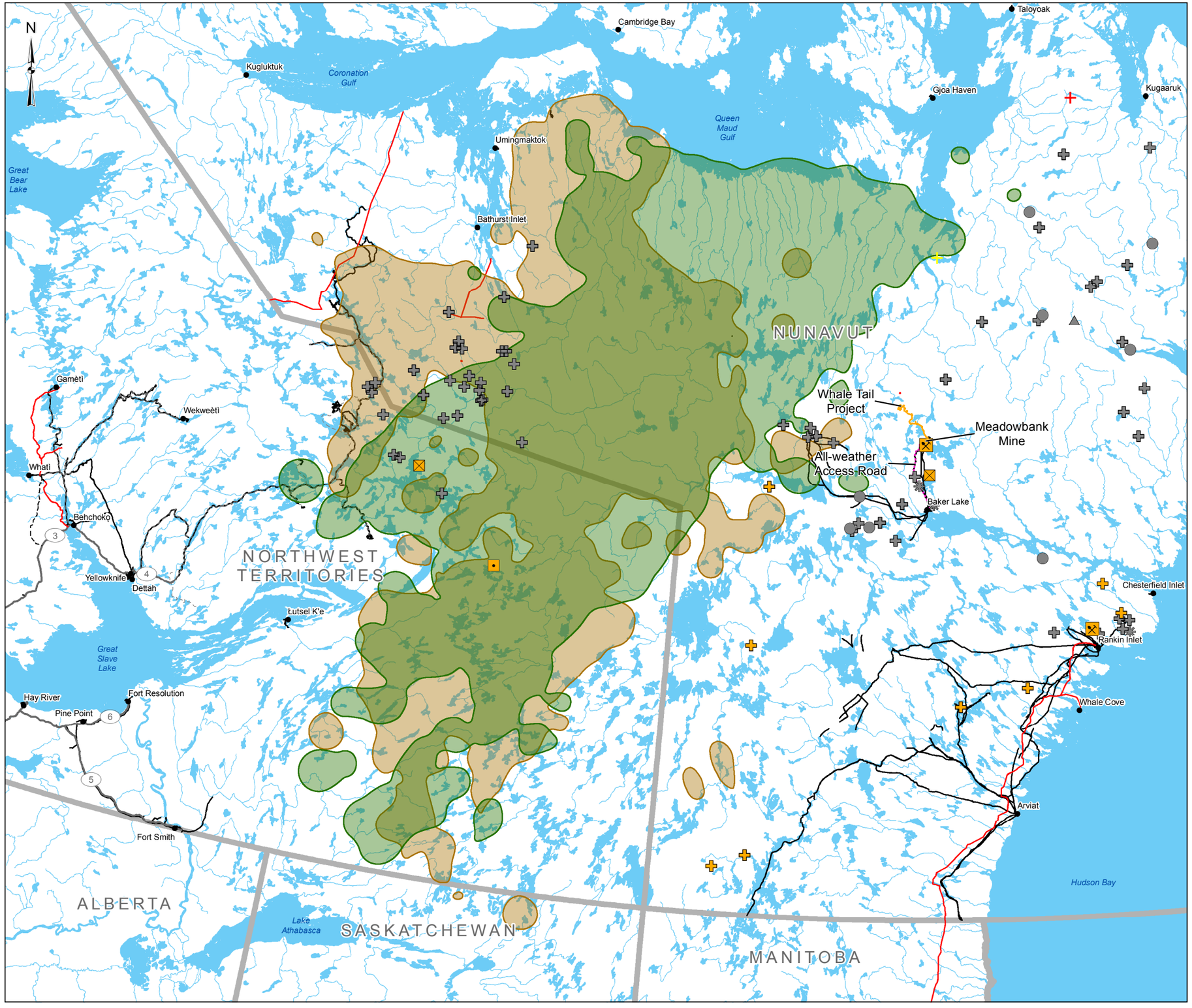

LEGEND

- POPULATED PLACE

PAST AND PRESENT DEVELOPMENTS

- CAMP, INACTIVE
- COMMUNITY
- CONTAMINATED SITE, HIGH
- CONTAMINATED SITE, MEDIUM
- FUEL STORAGE, INACTIVE
- MINE, ACTIVE
- MINE, INACTIVE
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- TOURISM/FISHING, ACTIVE
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- WATERCOURSE
- BEVERLY CARIBOU SPRING SEASONAL RANGE
- BEVERLY CARIBOU FALL SEASONAL RANGE
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DEVELOPMENT IN THE SPRING AND FALL RANGES FOR BEVERLY HERD

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DESIGN	DC	29 Jun. 2017	SCALE AS SHOWN	REV.	0
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FIGURE 3

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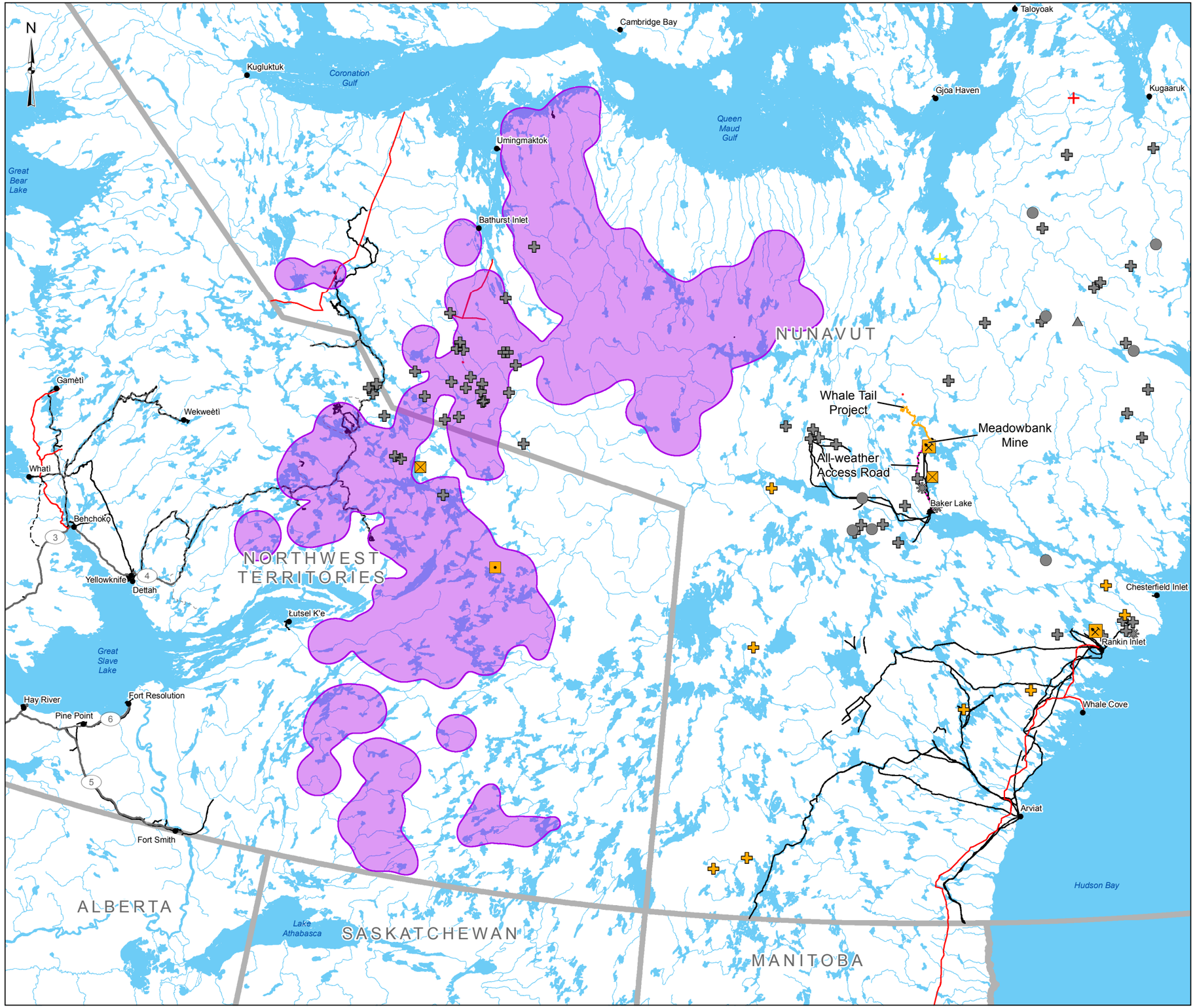

LEGEND

- POPULATED PLACE

PAST AND PRESENT DEVELOPMENTS

- CAMP, INACTIVE
- COMMUNITY
- CONTAMINATED SITE, HIGH
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FIGURE 4

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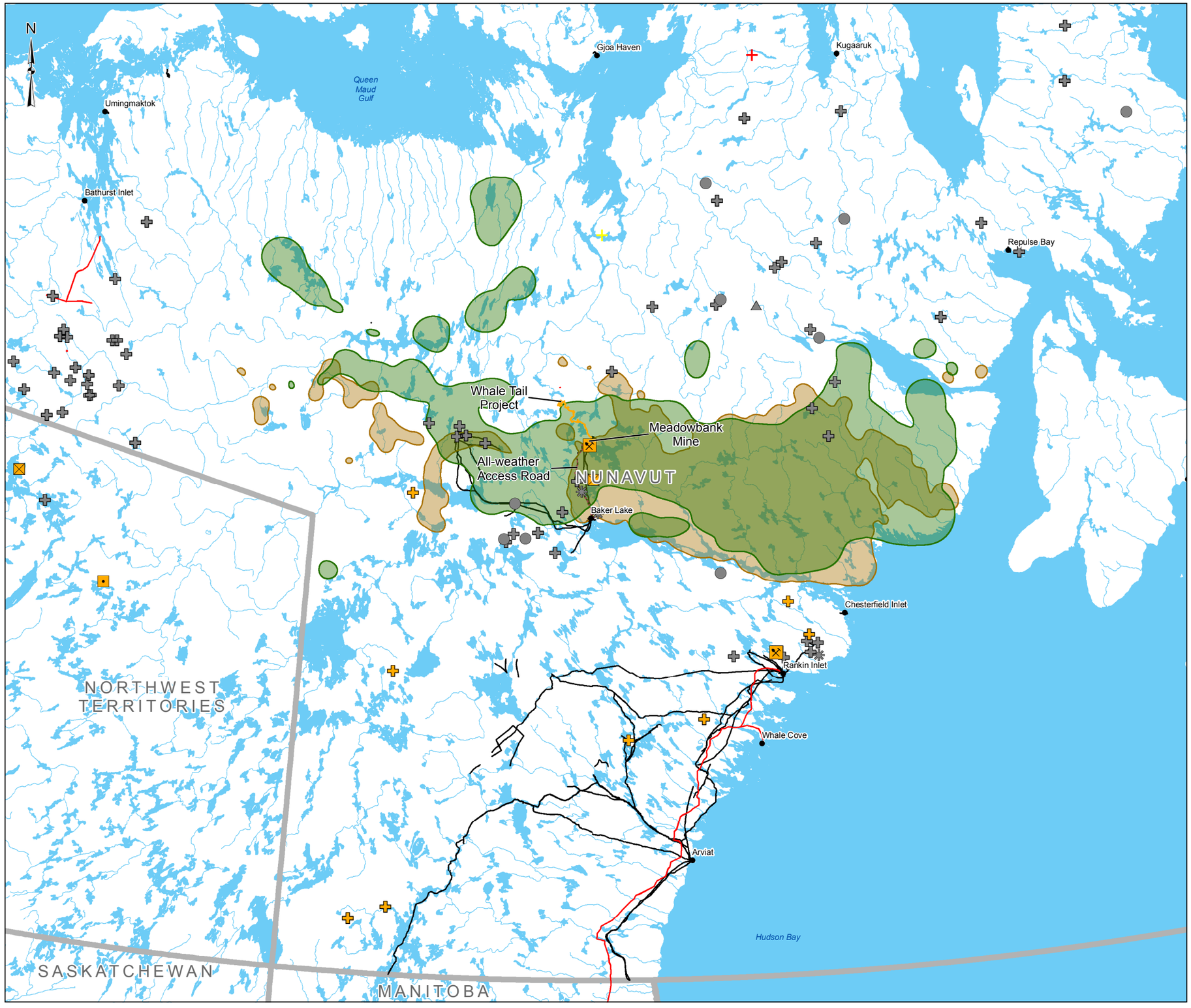

LEGEND

- POPULATED PLACE

PAST AND PRESENT DEVELOPMENTS

- CAMP, INACTIVE
- COMMUNITY
- CONTAMINATED SITE, HIGH
- CONTAMINATED SITE, MEDIUM
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- TOURISM/FISHING, ACTIVE
- ALL-WEATHER ACCESS ROAD
- ALL-SEASON ROAD
- WINTER ROAD
- WATERCOURSE
- LORILLARD CARIBOU SPRING SEASONAL RANGE
- LORILLARD CARIBOU FALL SEASONAL RANGE
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PROJECT		1658927	FILE No.	
DESIGN	DC	29 Jun. 2017	SCALE AS SHOWN	REV. 0
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REVIEW	JV	07 Jul. 2017		

FIGURE 5

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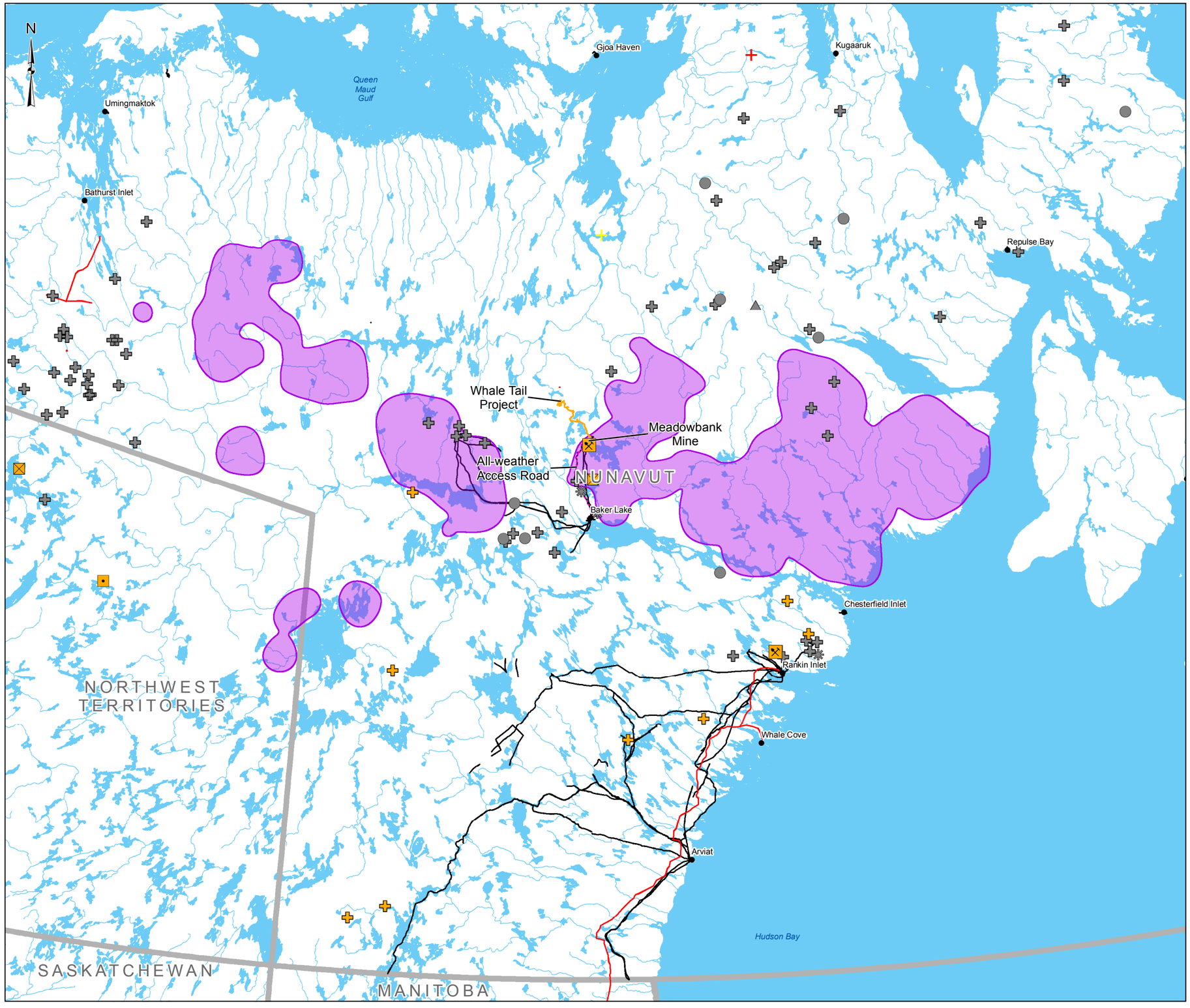

LEGEND

- POPULATED PLACE

PAST AND PRESENT DEVELOPMENTS

- CAMP, INACTIVE
- COMMUNITY
- CONTAMINATED SITE, HIGH
- CONTAMINATED SITE, MEDIUM
- FUEL STORAGE, INACTIVE
- MINE, ACTIVE
- MINE, INACTIVE
- MINERAL EXPLORATION, ACTIVE
- MINERAL EXPLORATION, INACTIVE
- MISCELLANEOUS, INACTIVE
- QUARRYING, INACTIVE
- TOURISM/CARIBOU HUNTING & FISHING, ACTIVE
- TOURISM/FISHING, ACTIVE
- ALL-WEATHER ACCESS ROAD
- ALL-SEASON ROAD
- WINTER ROAD
- WATERCOURSE
- LORILLARD CARIBOU WINTER SEASONAL RANGE
- BASE DEVELOPMENTS
- PROJECT DEVELOPMENT
- RFD DEVELOPMENT
- PROVINCIAL/TERRITORIAL BOUNDARY
- WATER BODY

REFERENCE

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
DATUM: NAD 83 PROJECTION: CANADA LAMBERT CONFORMAL CONIC

90 0 90
KILOMETRES

PROJECT
AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

DEVELOPMENT IN THE WINTER RANGE FOR THE LORILLARD HERD

Golder Associates

PROJECT		1658927	FILE No.	
DESIGN	DC	29 Jun. 2017	SCALE AS SHOWN	REV. 0
GIS	JE	07 Jul. 2017		
CHECK	DC	07 Jul. 2017		
REVIEW	JV	07 Jul. 2017		

FIGURE 6

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Cambridge Bay
Taloyoak
Igloolik
Hall Beach
Gjoa Haven
Kugaaruk
Queen Maud Gulf
Umingmaktok
Bathurst Inlet
Repulse Bay
NUNAVUT
Whale Tail Project
Meadowbank Mine
All-weather Access Road
Baker Lake
Coral Harbour
NORTHWEST TERRITORIES
Chesterfield Inlet
Rankin Inlet
Whale Cove

LEGEND

- POPULATED PLACE

PAST AND PRESENT DEVELOPMENTS

- CAMP, INACTIVE
- COMMUNITY
- CONTAMINATED SITE, HIGH
- CONTAMINATED SITE, MEDIUM
- FUEL STORAGE, INACTIVE
- MINE, ACTIVE
- MINE, INACTIVE
- MINERAL EXPLORATION, ACTIVE
- MINERAL EXPLORATION, INACTIVE
- MISCELLANEOUS, INACTIVE
- QUARRYING, INACTIVE
- TOURISM/CARIBOU HUNTING & FISHING, ACTIVE
- TOURISM/FISHING, ACTIVE
- ALL-WEATHER ACCESS ROAD
- ALL-SEASON ROAD
- WINTER ROAD
- WATERCOURSE
- WAGER BAY CARIBOU SPRING SEASONAL RANGE
- WAGER BAY CARIBOU FALL SEASONAL RANGE
- BASE DEVELOPMENTS
- PROJECT DEVELOPMENT
- RFD DEVELOPMENT
- PROVINCIAL/TERRITORIAL BOUNDARY
- WATER BODY

REFERENCE

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DATUM: NAD 83 PROJECTION: CANADA LAMBERT CONFORMAL CONIC

90 0 90
KILOMETRES

PROJECT
AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

DEVELOPMENT IN THE SPRING AND FALL RANGES FOR THE WAGER BAY HERD

Golder Associates

PROJECT		1658927	FILE No.	
DESIGN	DC	29 Jun. 2017	SCALE AS SHOWN	REV. 0
GIS	JE	07 Jul. 2017		
CHECK	DC	07 Jul. 2017	FIGURE 7	
REVIEW	JV	07 Jul. 2017		

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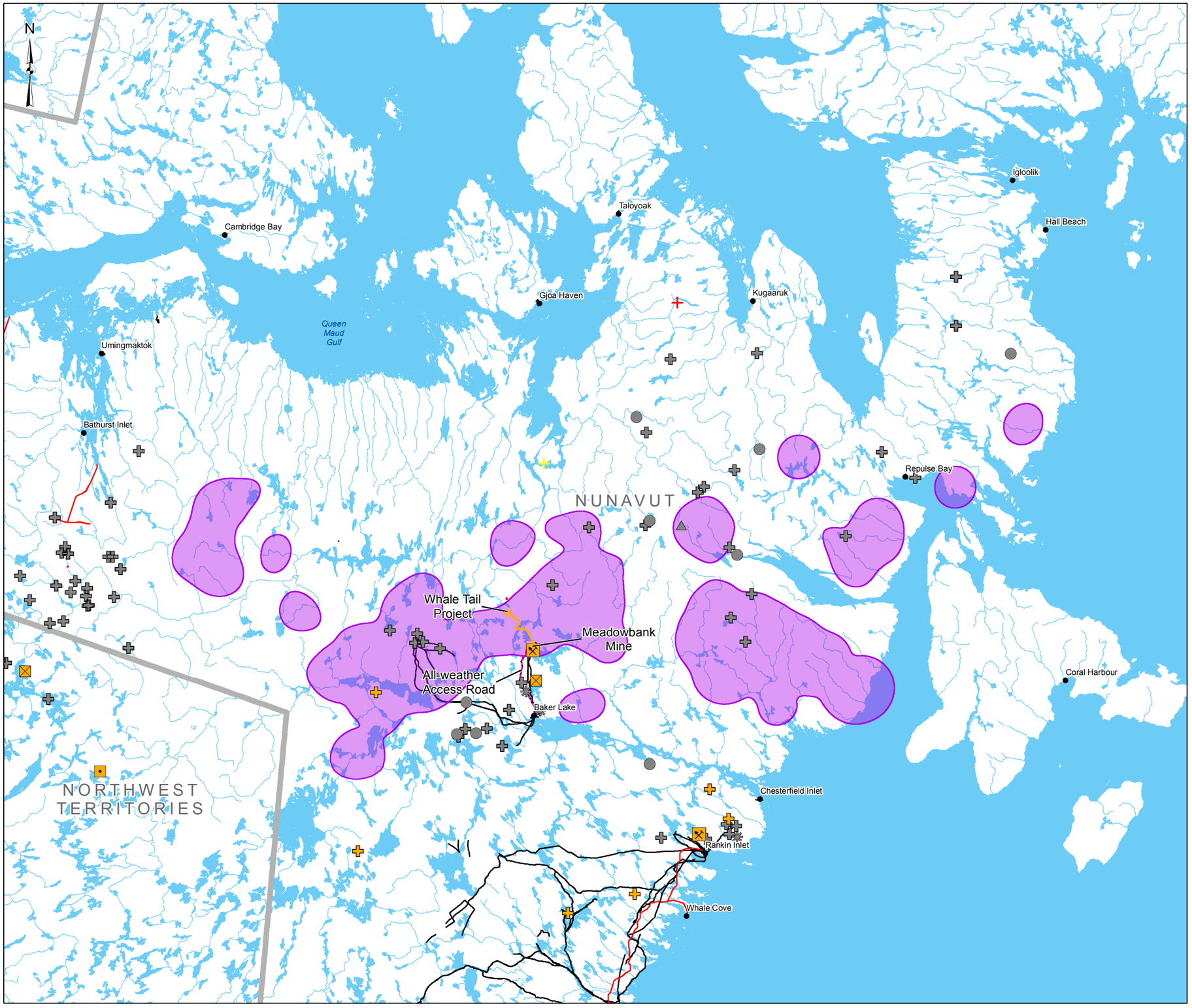

LEGEND

- POPULATED PLACE

PAST AND PRESENT DEVELOPMENTS

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- COMMUNITY
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- CONTAMINATED SITE, MEDIUM
- FUEL STORAGE, INACTIVE
- MINE, ACTIVE
- MINE, INACTIVE
- MINERAL EXPLORATION, ACTIVE
- MINERAL EXPLORATION, INACTIVE
- MISCELLANEOUS, INACTIVE
- QUARRYING, INACTIVE
- TOURISM/CARIBOU HUNTING & FISHING, ACTIVE
- TOURISM/FISHING, ACTIVE
- ALL-WEATHER ACCESS ROAD
- ALL-SEASON ROAD
- WINTER ROAD
- WATERCOURSE
- WAGER BAY CARIBOU WINTER SEASONAL RANGE
- BASE DEVELOPMENTS
- PROJECT DEVELOPMENT
- RFD DEVELOPMENT
- PROVINCIAL/TERRITORIAL BOUNDARY
- WATER BODY

REFERENCE

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DATUM: NAD 83 PROJECTION: CANADA LAMBERT CONFORMAL CONIC

90 0 90
KILOMETRES

PROJECT
AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:
MEADOWBANK DIVISION
WHALE TAIL PIT PROJECT

TITLE

DEVELOPMENT IN THE WINTER RANGE FOR THE WAGER BAY HERD

Golder Associates

PROJECT		1658927	FILE No.	
DESIGN	DC	29 Jun. 2017	SCALE AS SHOWN	REV. 0
GIS	JE	07 Jul. 2017		
CHECK	DC	07 Jul. 2017		
REVIEW	JV	07 Jul. 2017		

FIGURE 8

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Zone Of Influence Encounters and Residency Time

The movement paths of each collared caribou were combined with the development layer database and associated assumed ZOIs for different types of development (Table 3). The analysis was executed each year of the study so that a caribou movement path would only have the potential to intersect the ZOIs from developments that were determined to be present and active during a given year (e.g., active mine sites and exploration permits) from 1996 to 2017. The baseline included two scenarios representing previous and existing developments (Base Case) and the Meadowbank Case (Base Case+Meadowbank). The Meadowbank Mine and associated All-weather Access Road (AWAR) were isolated from the Base Case to determine the incremental encounters and residency times associated with these specific developments. In addition, movement paths from 1996 to 2017 were used to forecast the encounter rate and residency time for the Project Case (Meadowbank Case+Whale Tail Project) and RFD Case (Project Case+RFDs) for future projects not currently on the landscape. The temporal structure of these scenarios allows the incremental effects of the Meadowbank Mine and AWAR, and the Project to be determined from the relative difference between the Meadowbank and Base cases and the Project and Meadowbank cases, respectively.

The analysis was used to calculate the residency time of female caribou in ZOIs, and the encounter rates with ZOIs. Specifically, the percentage of days that caribou resided within ZOIs (i.e., residency time) of the total possible days during the exposure period (see Table 2 for seasonal exposure periods) was calculated for each individual female movement path. It was assumed that for each day in a ZOI, an animal was exposed to one disturbance event, regardless of how close it was to a development footprint or activity. To complement residency times, the number of animal encounters with ZOIs during the exposure period was also calculated for each female movement path. It was assumed that each time an animal entered a ZOI, the animal was exposed to one disturbance event (also independent of distance to disturbance). Where ZOIs of different developments overlapped they were not dissolved into a single ZOI. This meant that caribou interaction with both ZOIs were counted as two encounters as a conservatism to overestimate effects. This is a conservative approach in that the magnitude of effects in the ZOI would be expected to decrease with increasing distance from the footprint and/or activity.

3.0 RESULTS

3.1 Encounter Rates

3.1.1.1 Ahiak Herd

Spring Migration

Caribou paths monitored over 19 study years from 1996 to 2016 (no collar data from 1999 to 2000) were used to calculate the number of encounters with ZOIs. The number of collared individuals ranged from two caribou in 2004 and 2016 to 42 caribou in 2008. The number of paths ranged from 36 paths in 2004 to 4,364 paths in 2012 for a total of 20,305 in spring.

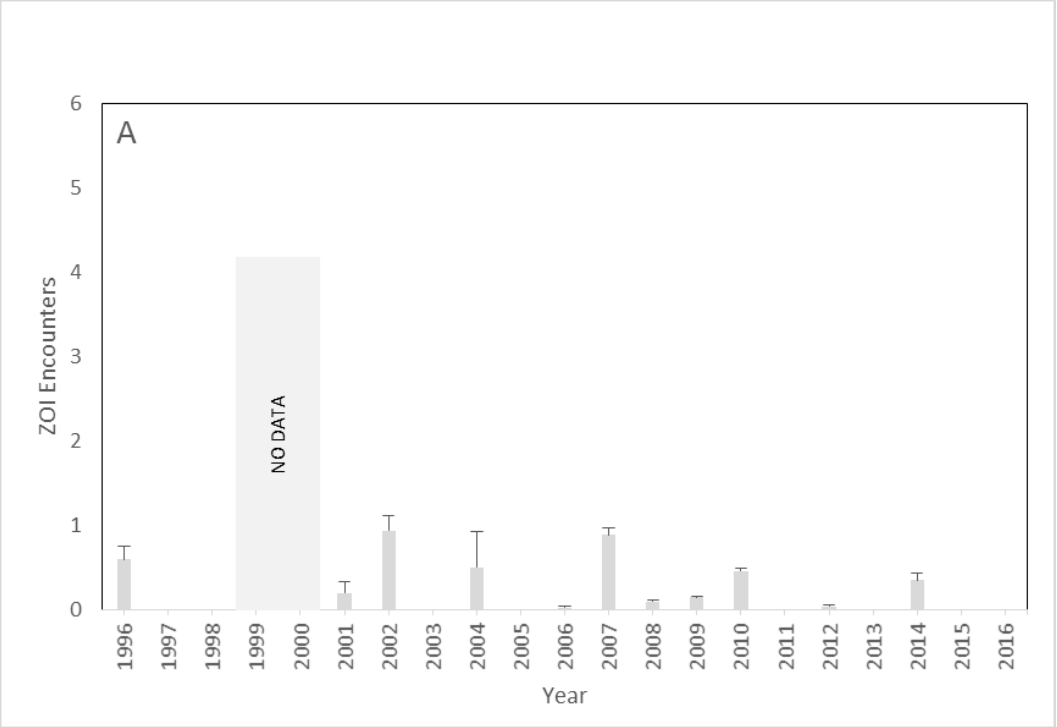
Caribou residency time (i.e., percent time in zones of influence) and encounter rates during spring migration were moderately positively correlated with each other (Pearson r = 0.69, P <0.01) (see Section 3.2.1.1). During Base Case conditions, annual mean encounter rates ranged from no encounters per 67 days for eight of the study years (1997, 1998, 2003, 2005, 2011, 2013, 2015, and 2016) to 0.9 encounters per 67 days in 2002 (Figure 9A). The mean annual encounter rate in the Base Case was low (mean = 0.2), and moderately variable (SD = 0.3), and encounter rates do not suggest a declining or decreasing trend over time.

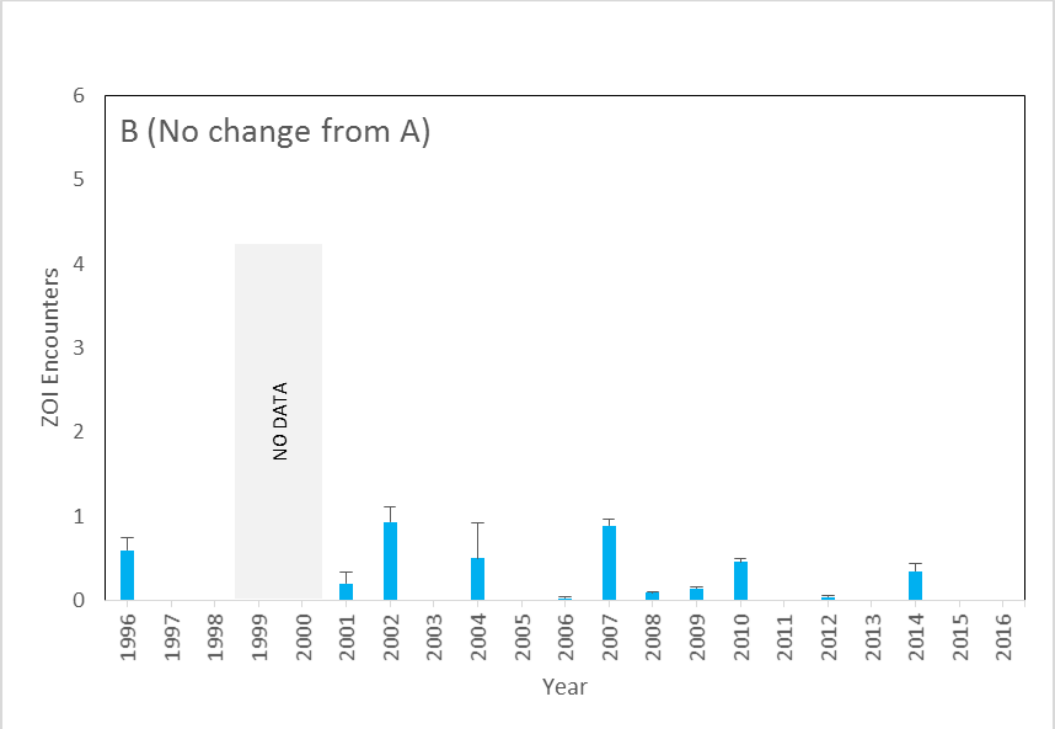
With the addition of the Meadowbank Mine and the AWAR to the spring range, there was no incremental change in encounter rates relative to the Base Case (Figure 9B).

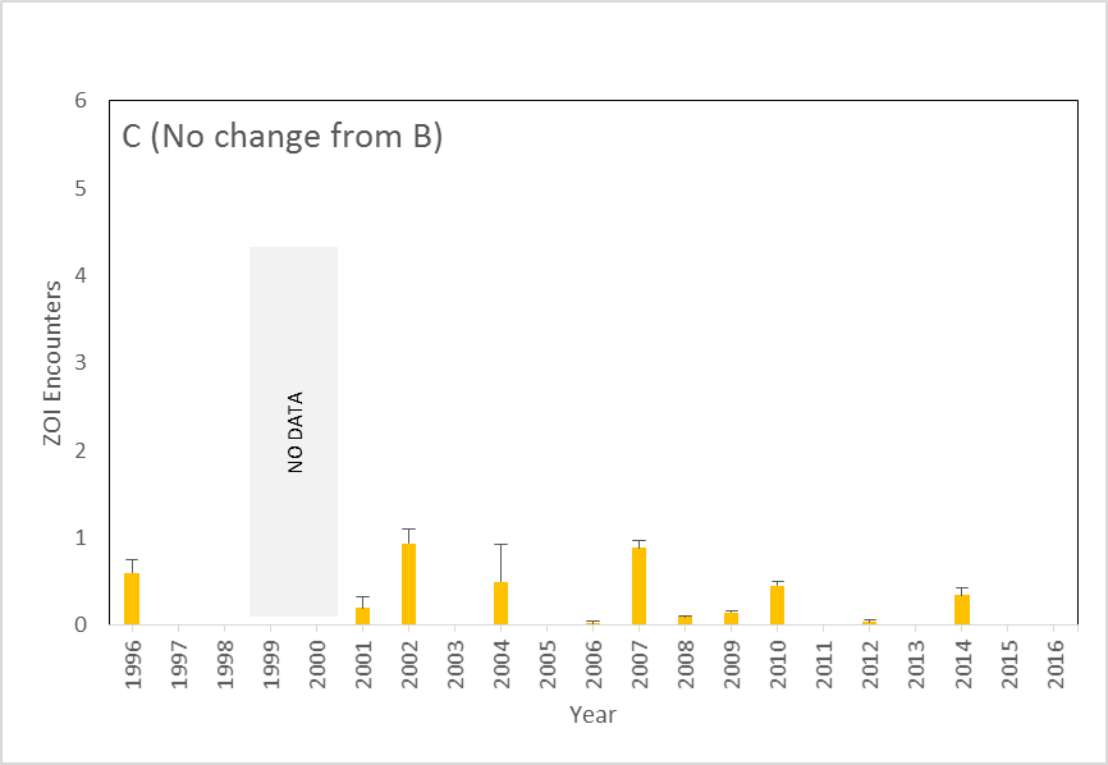
There was no incremental change in projected encounter rates for the Application Case relative to the Meadowbank Case (Figure 9C).

The projected cumulative encounter rate with ZOIs in spring through the RFD Case was higher than the Base, Meadowbank and Application cases. Using movement data from 1996 to 2016, the simulated number of annual mean encounters ranged from 0.04 to 2.0, and averaged 0.3 across study years (SD = 0.5) (Figure 9D). Annual mean encounter rates peaked in 2004 at 2.0 ZOI encounters.

Figure 9: Temporal Trend in Mean Encounter Rates (± 95% Upper Interval) During Spring migration with Zones of Influence for Female Caribou in the Ahiak Herd from 1996 to 2016 for the Base Case (A), Meadowbank Case (B) Application Case (C), and the Reasonably Foreseeable Development Case (D)



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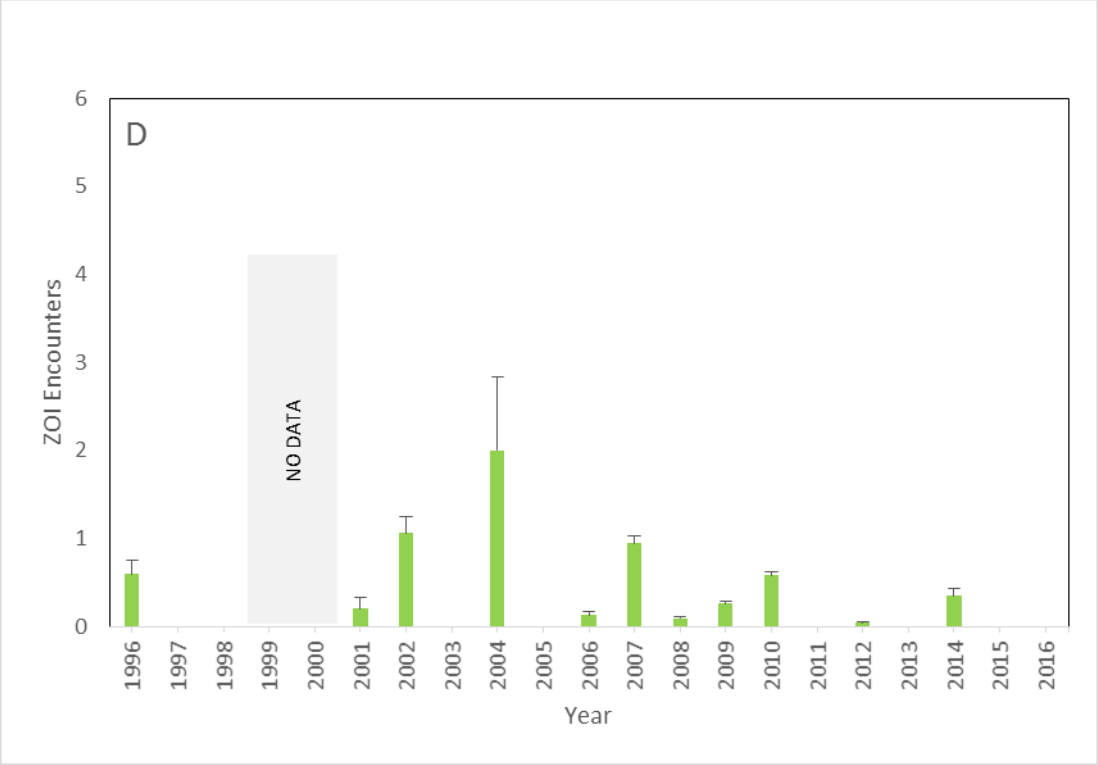
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Fall Migration

Caribou paths monitored over 19 study years from 1996 to 2016 (no collar data 1999 to 2000) were used to calculate the number of caribou encounters with ZOIs. The number of collared individuals ranged from two caribou in 2004 and 2016 to 42 caribou in 2003 and 2008. The number of paths ranged from 36 paths in 2004 to 4,364 paths in 2012 for a total of 20,305 in fall.

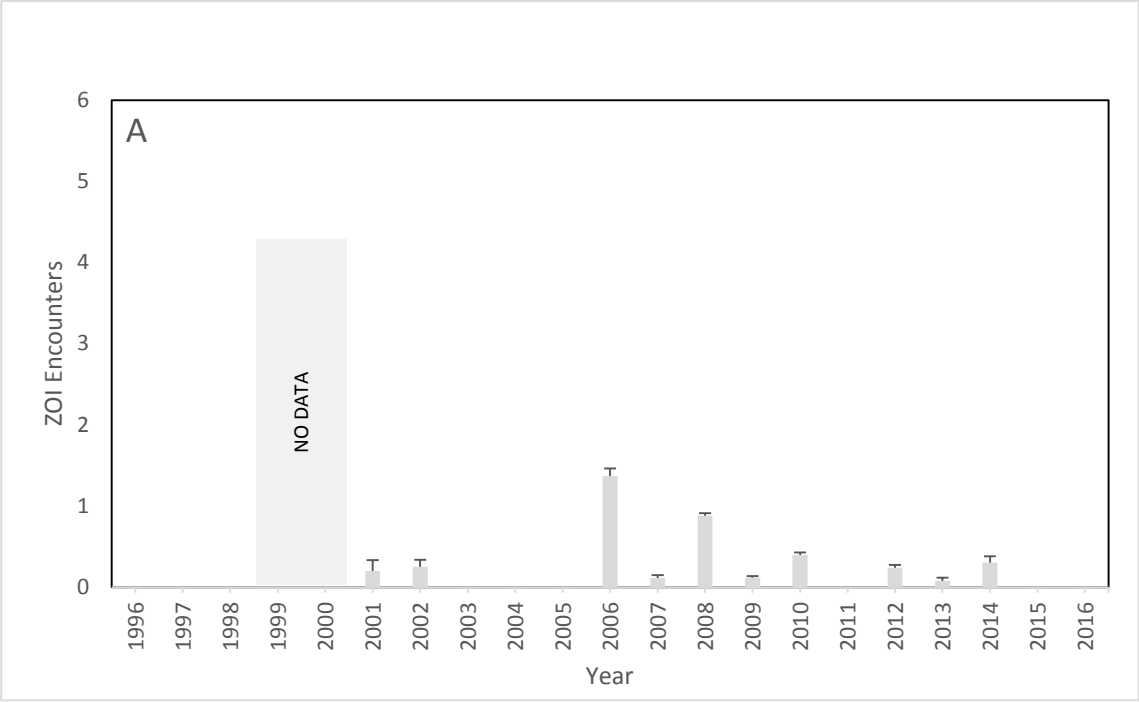
Caribou residency time (i.e., percent time in zones of influence) and encounter rates during fall migration were highly correlated with each other (Pearson r = 0.94, P <0.01) (see Section 3.2.1.1). During Base Case conditions, annual mean encounter rates ranged from no encounters per 115 days for nine of the study years (1996, 1997, 1998, 2003, 2004, 2005, 2011, 2015, and 2016) to 1.4 encounters per 115 days in 2006 (Figure 10A). The mean annual encounter rate in the Base Case was low (mean = 0.2), and moderately variable (SD = 0.4), and encounter rates do not suggest a declining or increasing temporal trend.

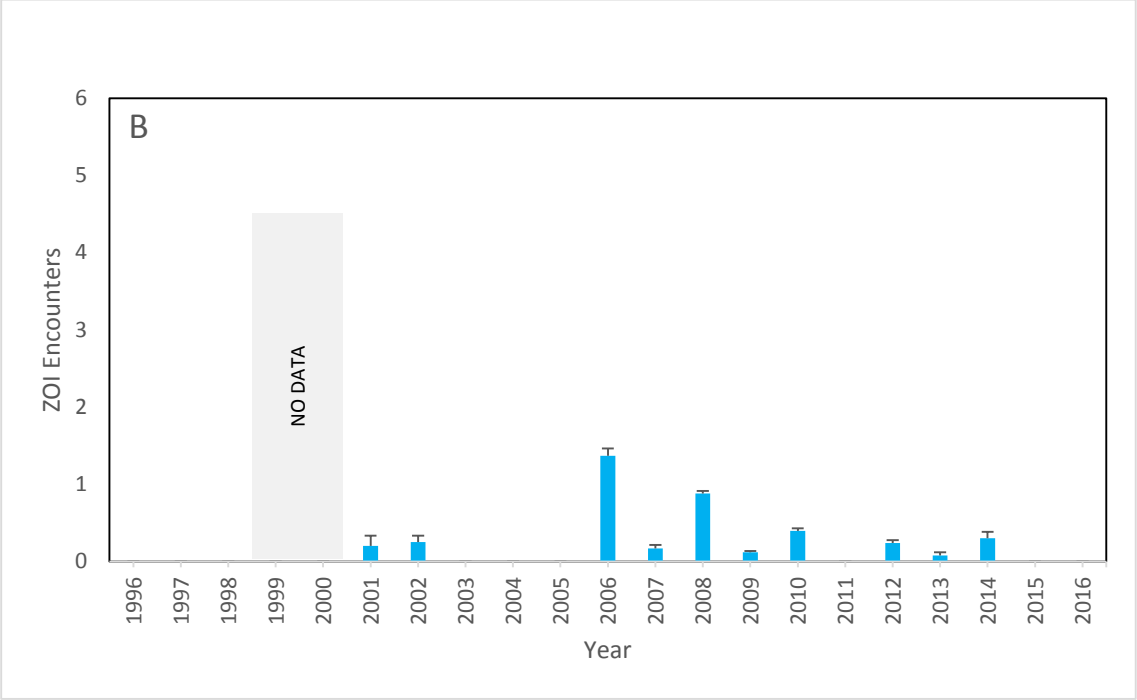
With the addition of the Meadowbank Mine and the AWAR to the fall migration range, there was no change in encounters for most study years with the exception of less than 0.1 additional encounters in 2007 relative to the Base Case (Figure 10B). Simulations for the fall migration indicated an overall annual average of less than 0.1 additional encounters per 115 days (SD < 0.1) relative to the Base Case.

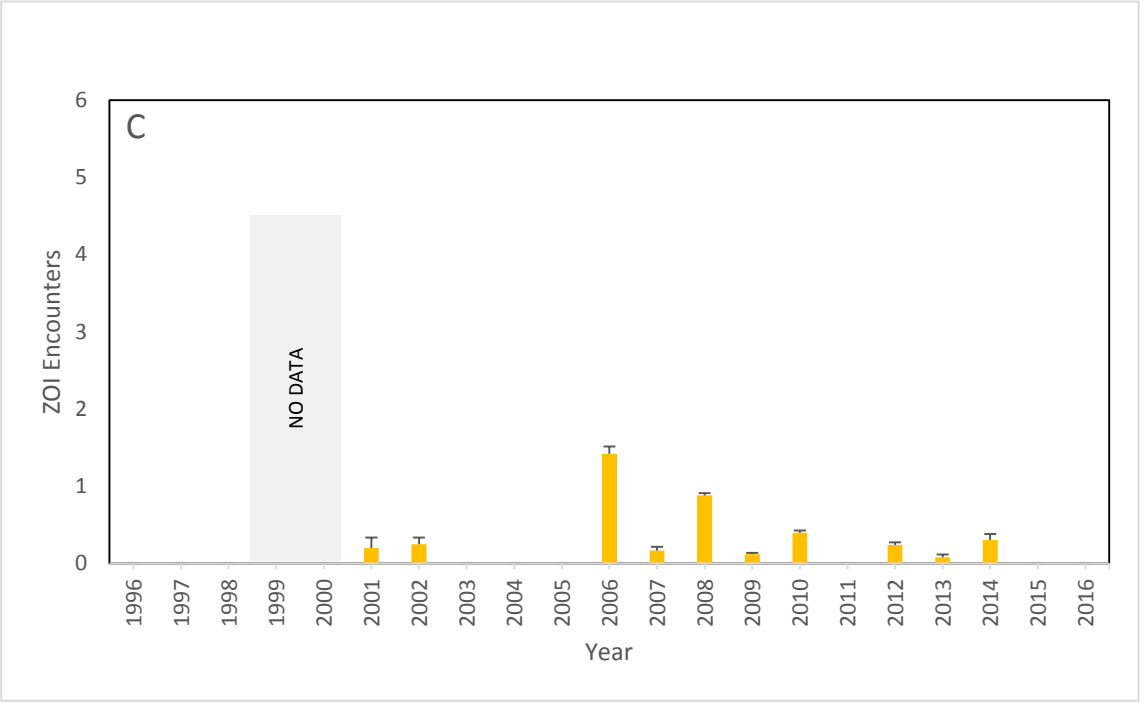
Under the Application Case for the fall migration range, there was no change in projected encounters for most study years with the exception of less than 0.1 additional encounters in 2006 relative to the Meadowbank Case (Figure 10C). Simulations projected an annual average of less than 0.1 additional encounters per 115 days (SD < 0.1) relative to the Meadowbank Case.

The projected cumulative encounter rate with ZOIs in fall migration through the RFD Case was higher than the Application Case. The simulated number of annual mean encounters ranged from 0.08 to 1.4, and averaged 0.3 (SD = 0.4) across study years (Figure 10D).

Figure 10: Temporal Trend in Mean Encounter Rates (± 95% Upper Interval) During Fall migration with Zones of Influence for Female Caribou in the Ahiak Herd from 1996 to 2016 for the Base Case (A), Meadowbank Case (B) Application Case (C), and the Reasonably Foreseeable Development Case (D)



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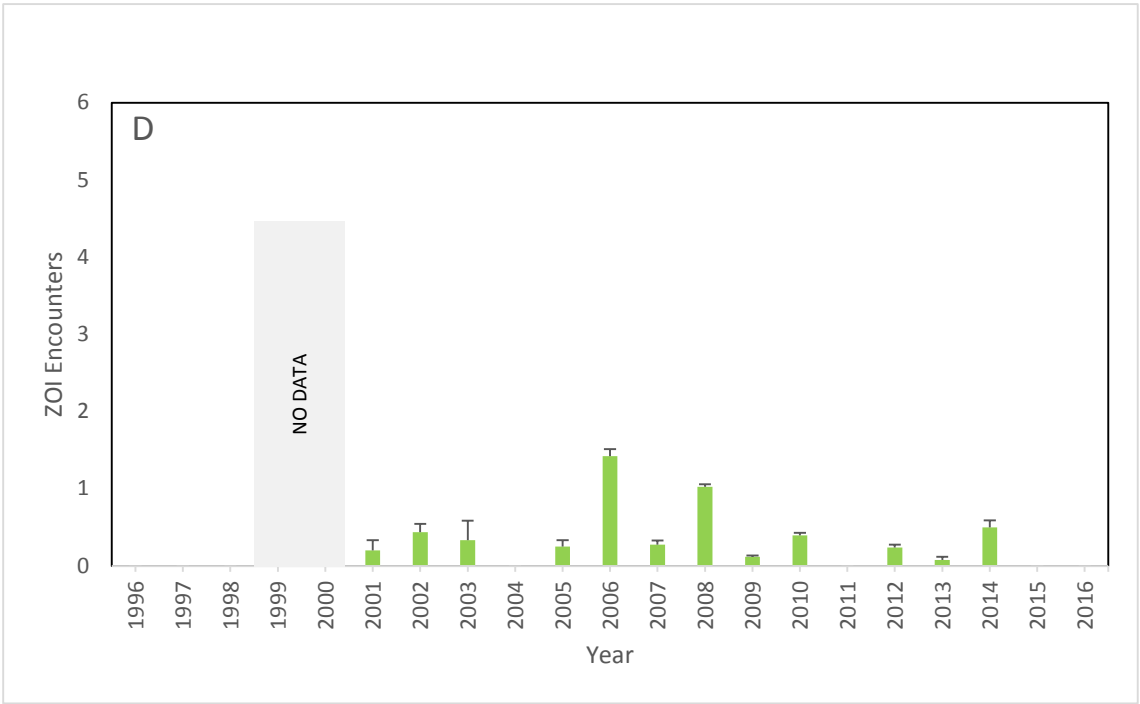
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Winter

Caribou paths monitored over 18 study years from 1997 to 2016 (no collar data 1999 to 2000) were used to calculate the number of caribou encounters with ZOIs. The number of collared individuals ranged from two caribou in 2004 and 2016 to 42 caribou in 2009. The number of paths ranged from 10 paths in 2001 to 4,928 paths in 2012 for a total of 25,881 in winter.

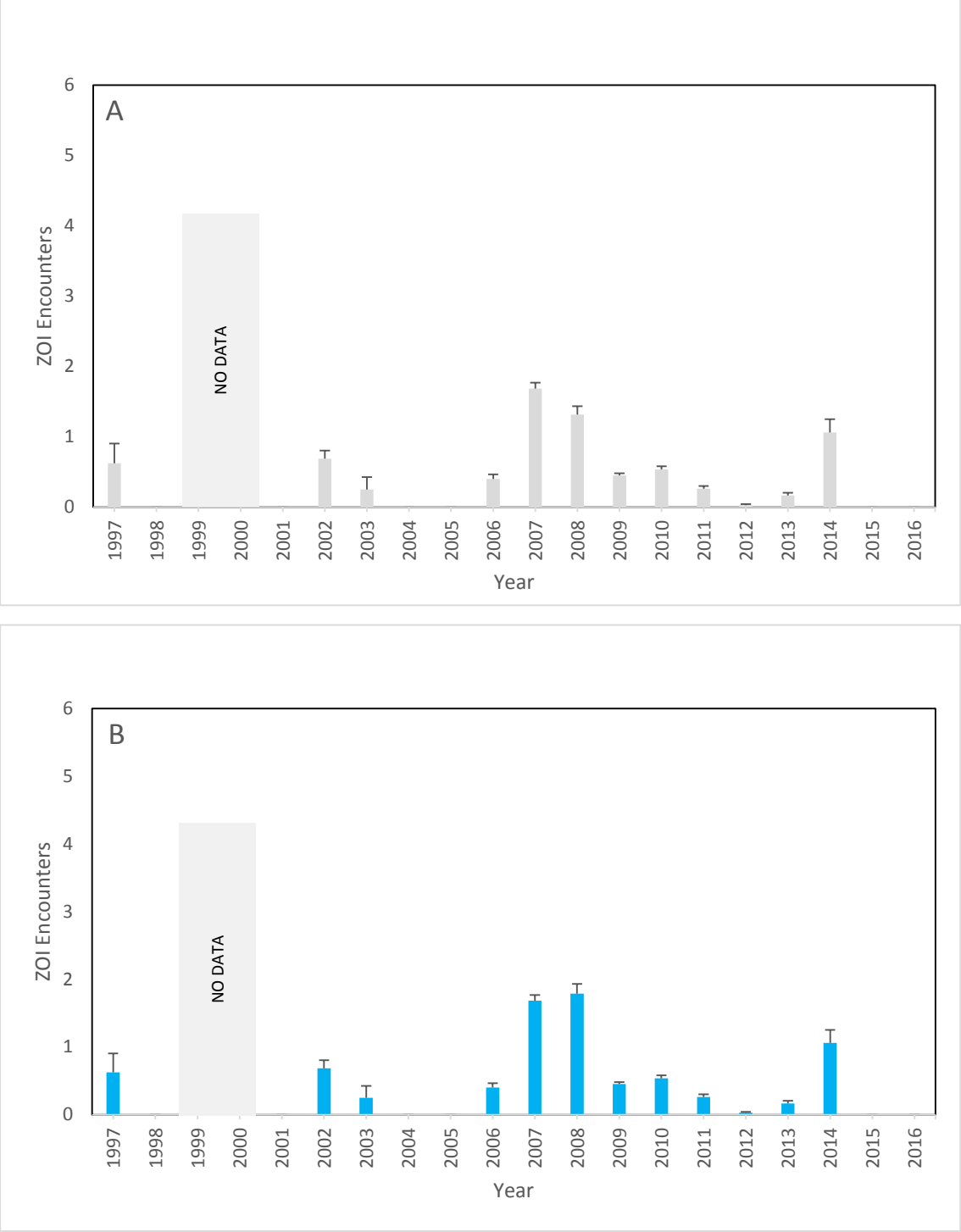
Caribou residency time (i.e., percent time in zones of influence) and encounter rates in winter were moderately positively correlated with each other (Pearson r = 0.55, P = 0.02) (see Section 3.2.1.1). During Base Case conditions, annual mean encounter rates ranged from no encounters per 110 days for six of the study years (1998, 2001, 2004, 2005, 2015, and 2016) to 1.7 encounters per 110 days in 2007 (Figure 11A). Overall mean encounter rate in the Base Case was low (mean = 0.4) and moderately variable (SD = 0.5), and encounter rates do not suggest a strong declining or increasing trend over time.

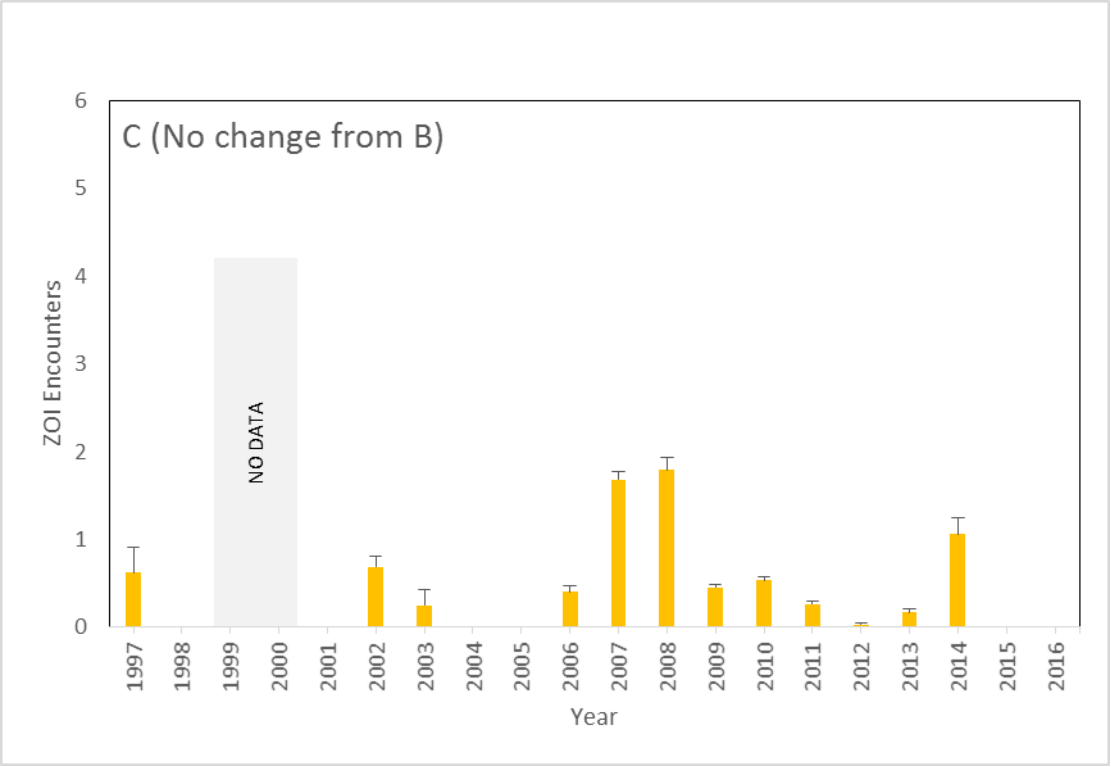
With the addition of the Meadowbank Mine and the AWAR to the winter range (Figure 11B), there were no new encounters for most study years with the exception of 0.5 additional encounters for 2008 per 110 days relative to the Base Case. Simulations indicated an overall annual average of less than 0.1 additional encounters per 115 days (SD = 0.1) relative to the Base Case.

Simulations for the Application Case projected no change in encounter rate per 110 days relative to the Meadowbank Case during winter (Figure 11C).

The projected cumulative encounter rate with ZOIs in winter through the RFD Case was higher than the Application Case. Using movement data from 1997 to 2016, the simulated number of annual mean encounters ranged from no encounters per 110 days for six of the study years (1998, 2001, 2004, 2005, 2015, and 2016) to 1.9 in 2008 and averaged 0. 5 across study years (SD=0.6) (Figure 11D). Annual mean encounter rate trends over time are similar to those described for the Base Case.

Figure 11: Temporal Trend in Mean Encounter Rates (± 95% Upper Interval) During Winter with Zones of Influence for Female Caribou in the Ahiak Herd from 1997 to 2016 for the Base Case (A), Meadowbank Case (B) Application Case (C), and the Reasonably Foreseeable Development Case (D)




C (No change from B)
ZOI Encounters
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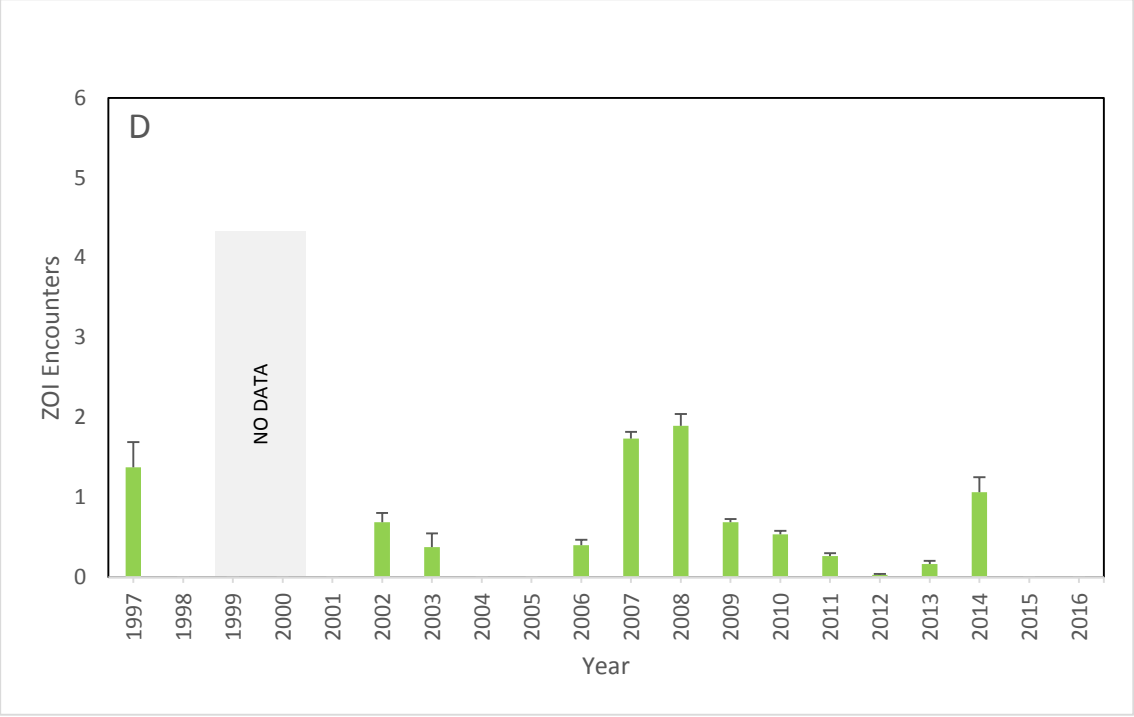
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3.1.1.2 Beverly Herd

Spring Migration

Caribou paths monitored over 14 study years from 2001 to 2017 (no collar data from 2011 to 2013) were used to calculate the number of caribou encounters with ZOIs. The number of collared individuals ranged from a single caribou in 2001 to 2005, 2007, and 2010 to 44 caribou in 2015. The number of paths ranged from 6 paths in 2004 to 6,653 paths in 2015 for a total of 21,153 in spring.

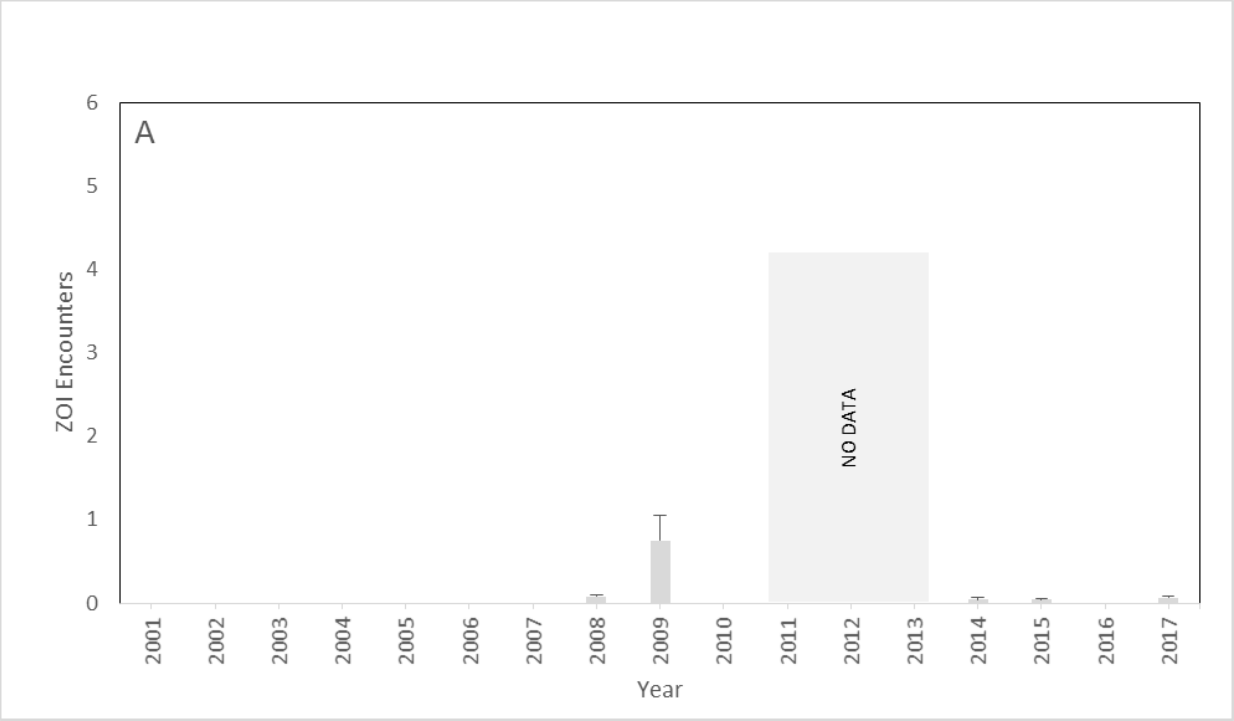
Caribou residency time (i.e., percent time in zones of influence) and encounter rates during spring migration were highly positively correlated with each other (Pearson r = 0.99, P <0.01) (see Section 3.2.1.2). During Base Case conditions, annual mean encounter rates ranged from no encounters per 56 days for nine of the study years (2001 to 2007, 2010, and 2016) to 0.8 encounters per 56 days in 2009 (Figure 12A). The mean annual encounter rate in the Base Case was low and moderately variable (mean = 0.1, SD = 0.2), and annual encounter rates do not suggest a declining or increasing trend over time.

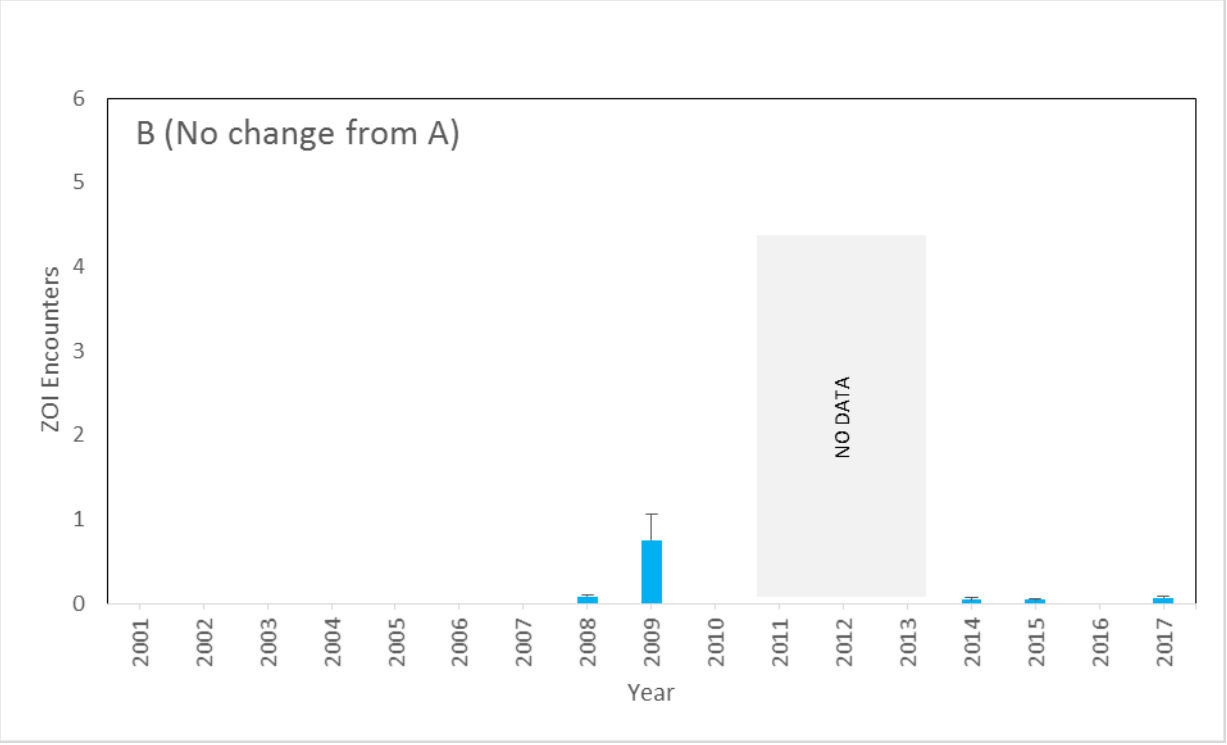
With the addition of the Meadowbank Mine and the AWAR to the spring range, there was no incremental change in encounter rates relative to the Base Case (Figure 12B).

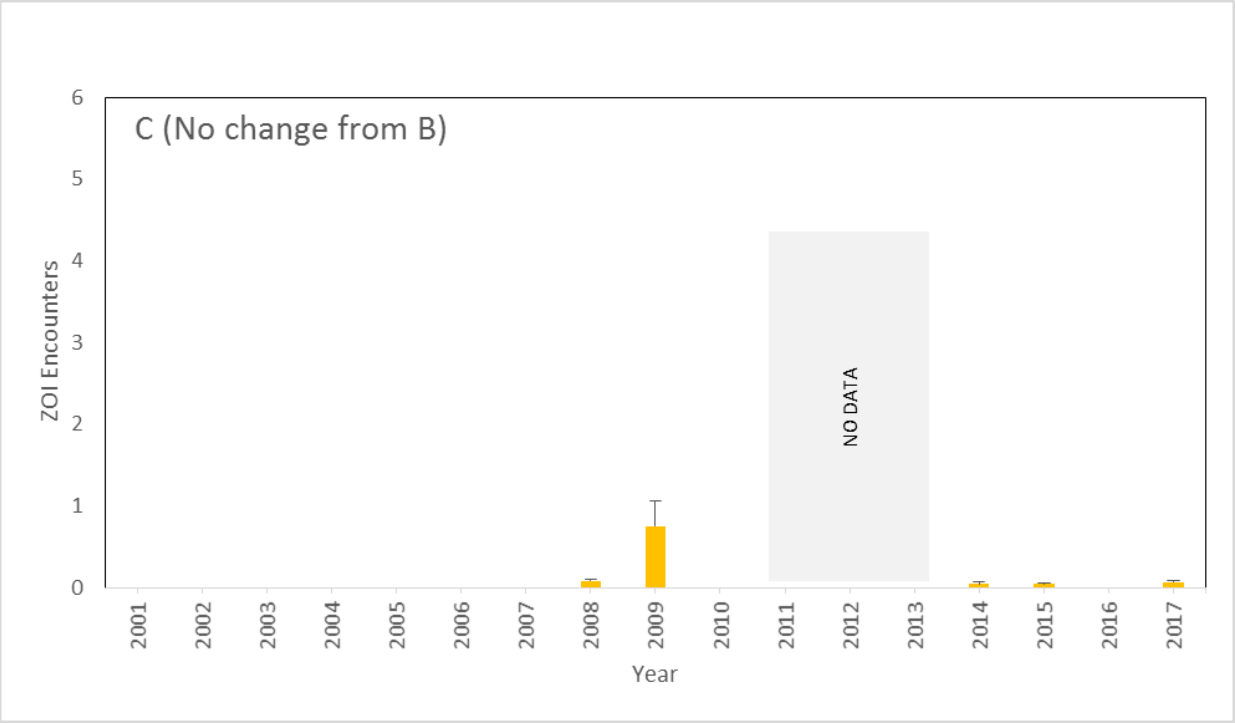
There was no incremental change in projected encounters for the Application Case relative to the Meadowbank or Base Case (Figure 12C).

The projected cumulative encounter rate with ZOIs in spring through the RFD Case was higher than the Base and Application cases. Using movement data from 2001 to 2017, the simulated number of mean annual encounters ranged from less than 0.1 to 0.8, and averaged 0.1 across study years (SD = 0.2) (Figure 12D).

Figure 12: Temporal Trend in Mean Encounter Rates (± 95% Upper Interval) During Spring migration with Zones of Influence for Female Caribou in the Beverly Herd from 2001 to 2017 for the Base Case (A), Meadowbank Case (B) Application Case (C), and the Reasonably Foreseeable Development Case (D)



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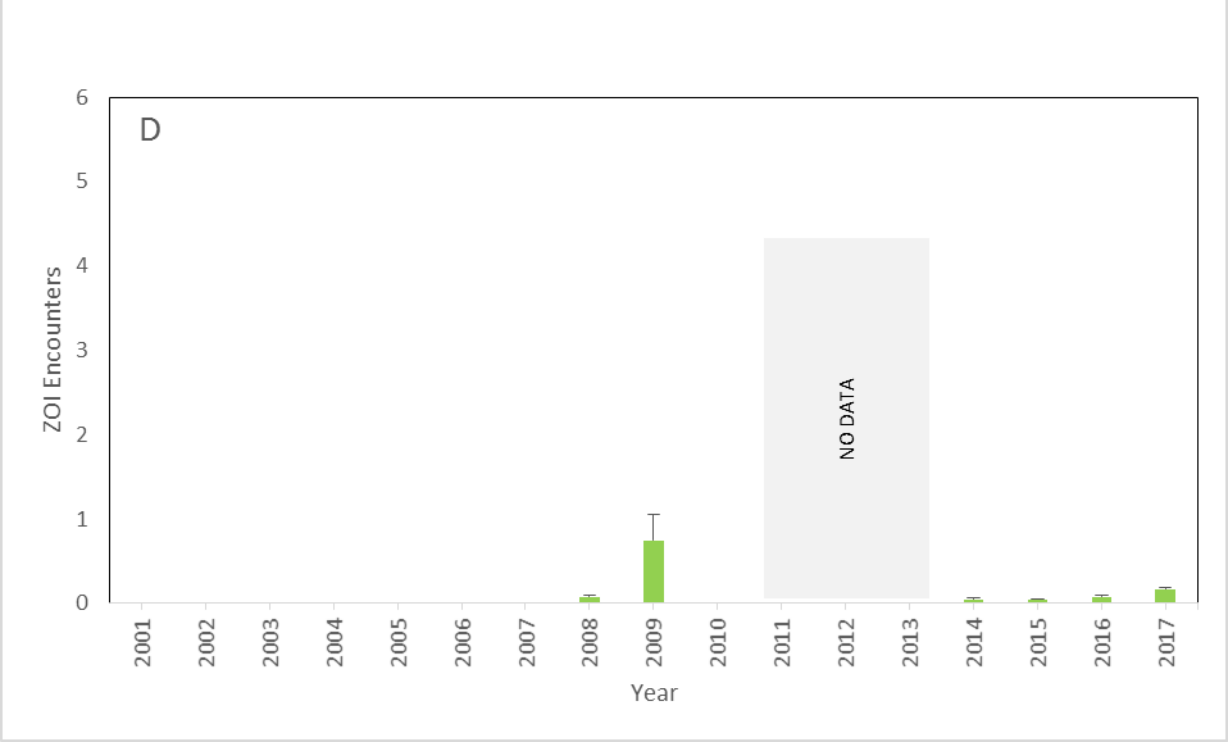
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Fall Migration

Caribou paths monitored over 11 study years from 2001 to 2016 (no collar data from 2005 and 2010 to 2013) were used to calculate the number of caribou encounters with ZOIs. The number of collared individuals ranged from a single caribou in 2001 to 2004 to 39 caribou in 2015. The number of paths ranged from 13 paths in 2001 and 2003 to 6,893 paths in 2015 for a total of 15,944 in fall.

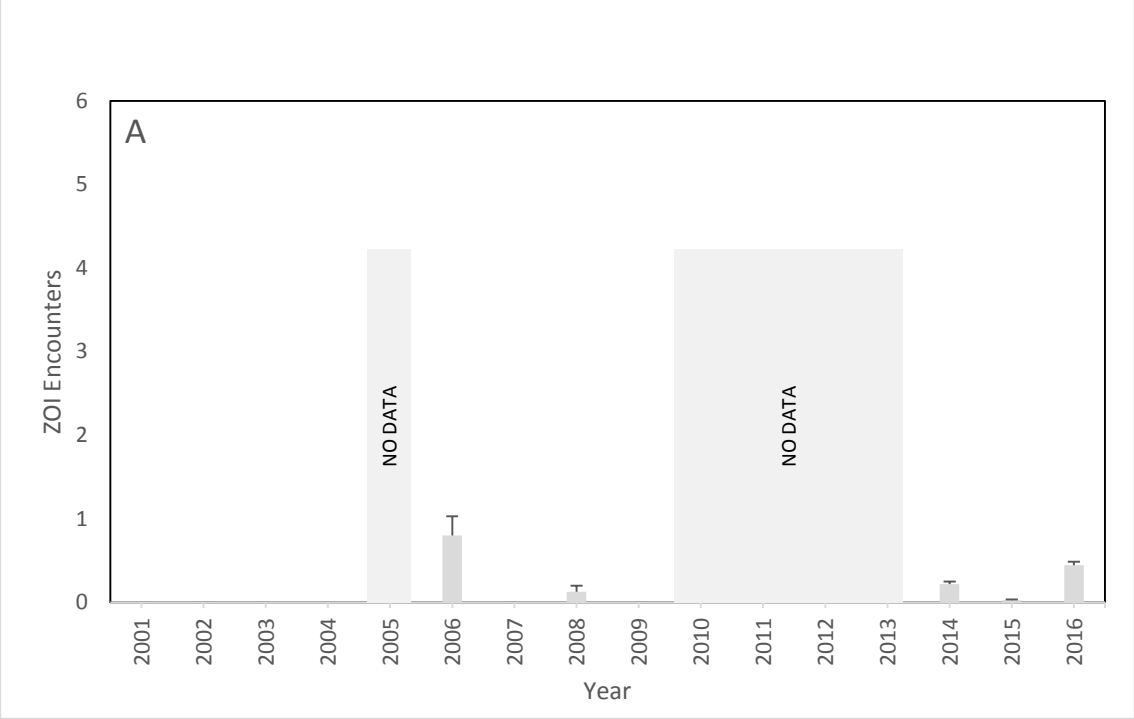
Caribou residency time (i.e., percent time in zones of influence) and encounter rates during spring migration were highly positively correlated with each other (Pearson r = 0.80, P <0.01) (see Section 3.2.1.2). During Base Case conditions, annual mean encounter rates ranged from no encounters per 125 days for six of the study years (2001 to 2004, 2007, and 2009) to 0.8 encounters per 125 days in 2006 (Figure 13A). The mean annual encounter rate in the Base Case was low and moderately variable (mean = 0.2, SD = 0.3), and do not suggest a strong declining or increasing trend over time.

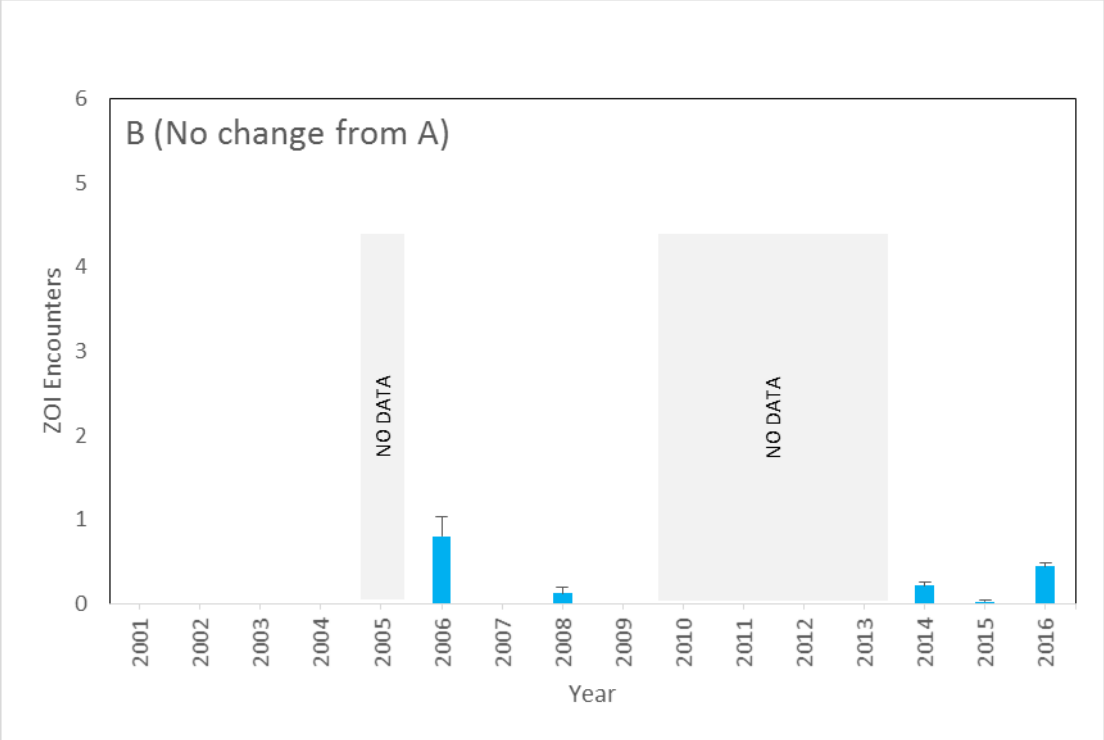
With the addition of the Meadowbank Mine and the AWAR to the fall range, there was no incremental change in encounter rates relative to the Base Case (Figure 13B).

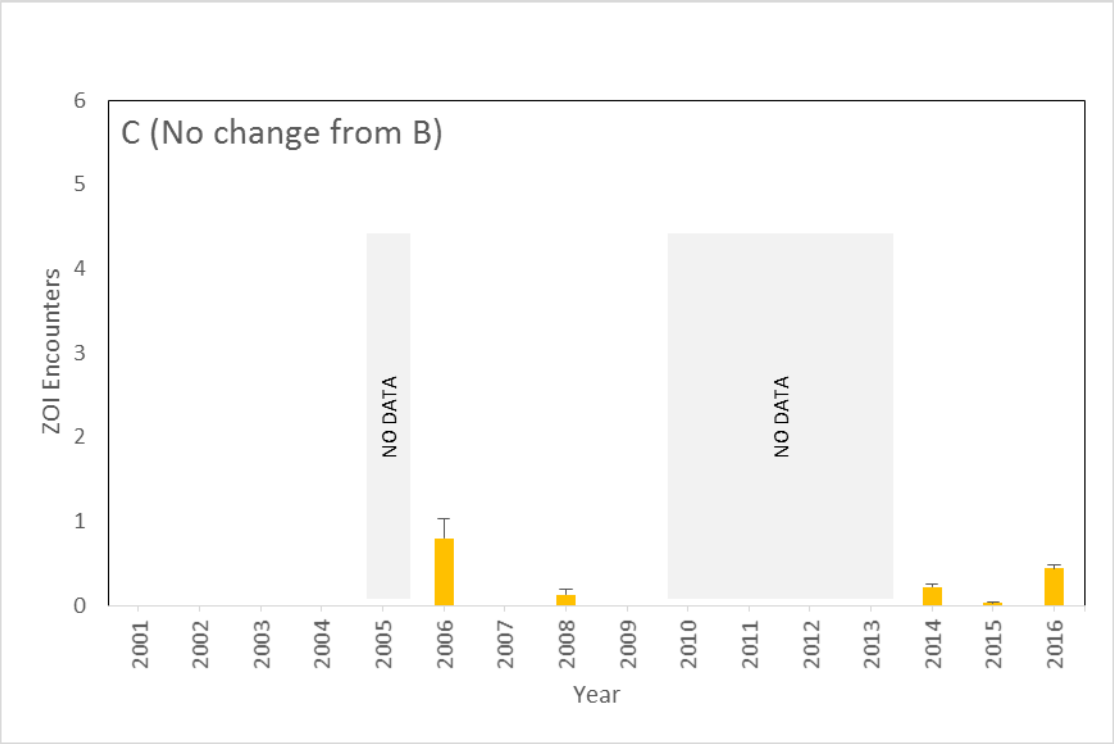
There was no incremental change in projected encounters for the Application Case relative to the Meadowbank or Base Case (Figure 13C).

The projected cumulative encounter rate with ZOIs in spring through the RFD Case was higher than the Base and Application cases. Using movement data from 2001 to 2016, the simulated number of annual mean encounters ranged from 0.1 to 1.6 and averaged 0.3 across study years (SD = 0.5) (Figure 13D). Annual encounter rates peaked in 2016 at 1.6 ZOI encounters.

Figure 13: Temporal Trend in Mean Encounter Rates (± 95% Upper Interval) During Fall migration with Zones of Influence for Female Caribou in the Beverly Herd from 2001 to 2016 for the Base Case (A), Meadowbank Case (B) Application Case (C), and the Reasonably Foreseeable Development Case (D)



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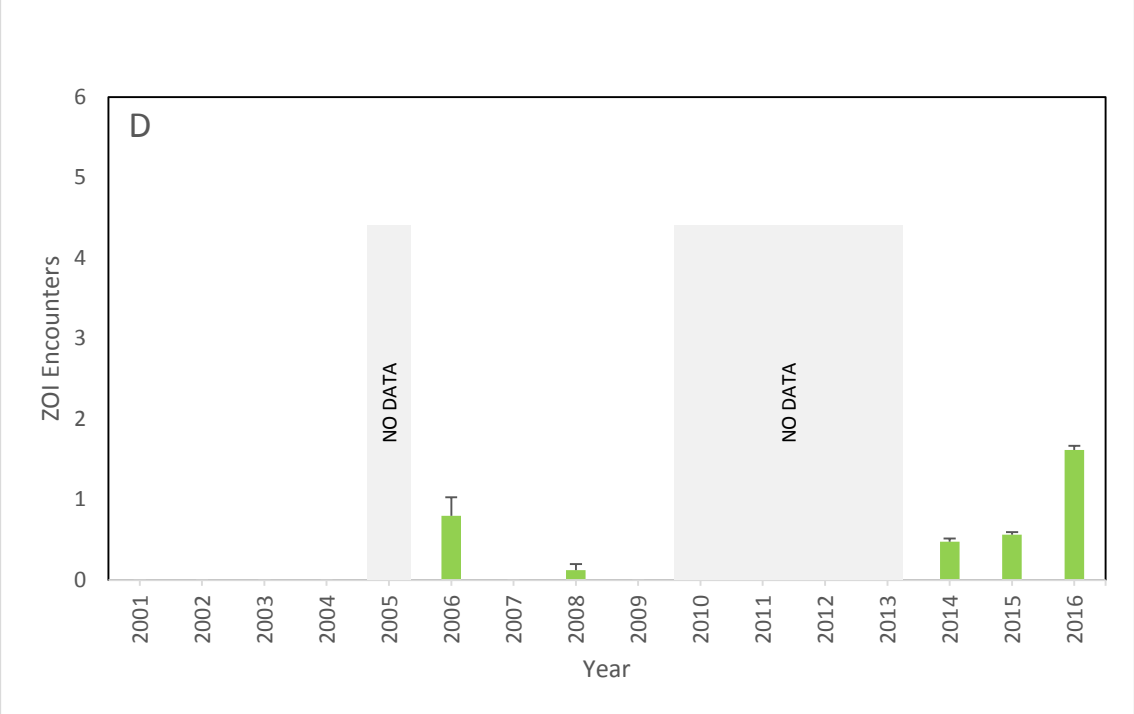
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Winter

Caribou paths monitored over 14 study years from 2001 to 2017 (no collar data from 2011 to 2013) were used to calculate the number of caribou encounters with ZOIs. The number of collared individuals ranged from a single caribou in 2001 to 2005 to 45 caribou in 2015. The number of paths ranged from 3 paths in 2001 to 7,648 paths in 2016 for a total of 24,072 in winter.

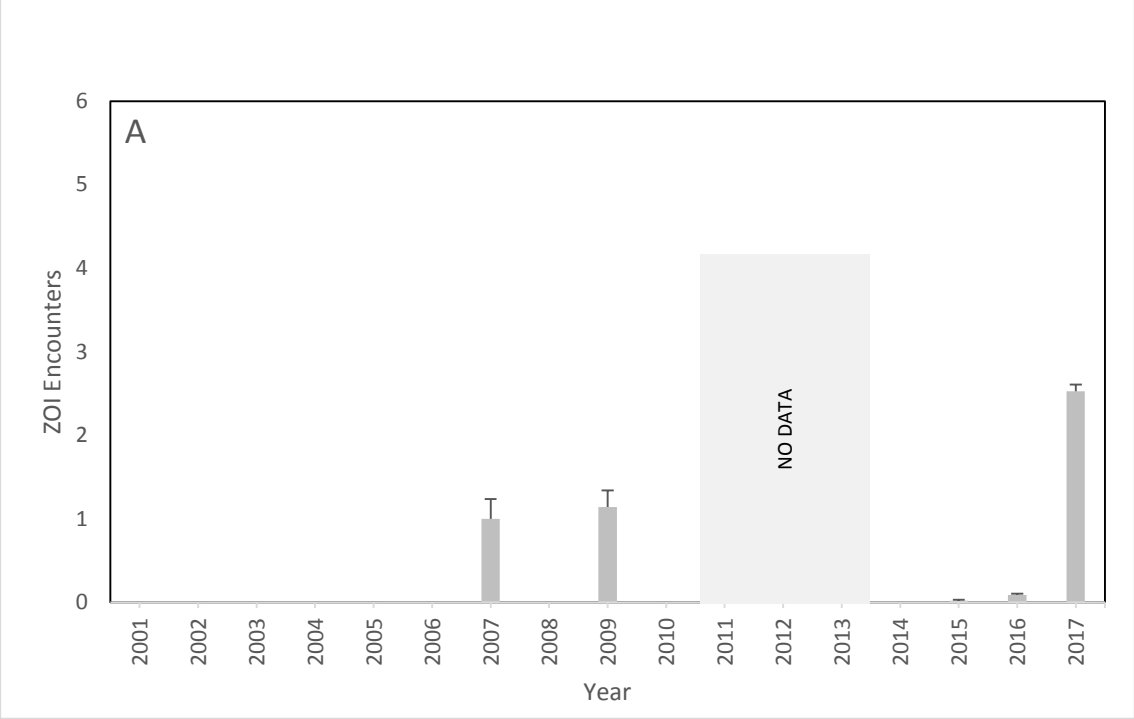
Caribou residency time (i.e., percent time in zones of influence) and encounter rates during winter were highly positively correlated with each other (Pearson r = 0.96, P < 0.01) (see Section 3.2.1.2). During Base Case conditions, annual mean encounter rates ranged from no encounters per 114 days for eight of the study years (2001 to 2005, 2008, 2010, and 2014) to 2.5 encounters per 114 days in 2017 (Figure 14A). The mean annual encounter rate in the Base Case was low and moderately variable (mean = 0.3, SD = 0.7), and do not suggest a strong declining or decreasing trend over time.

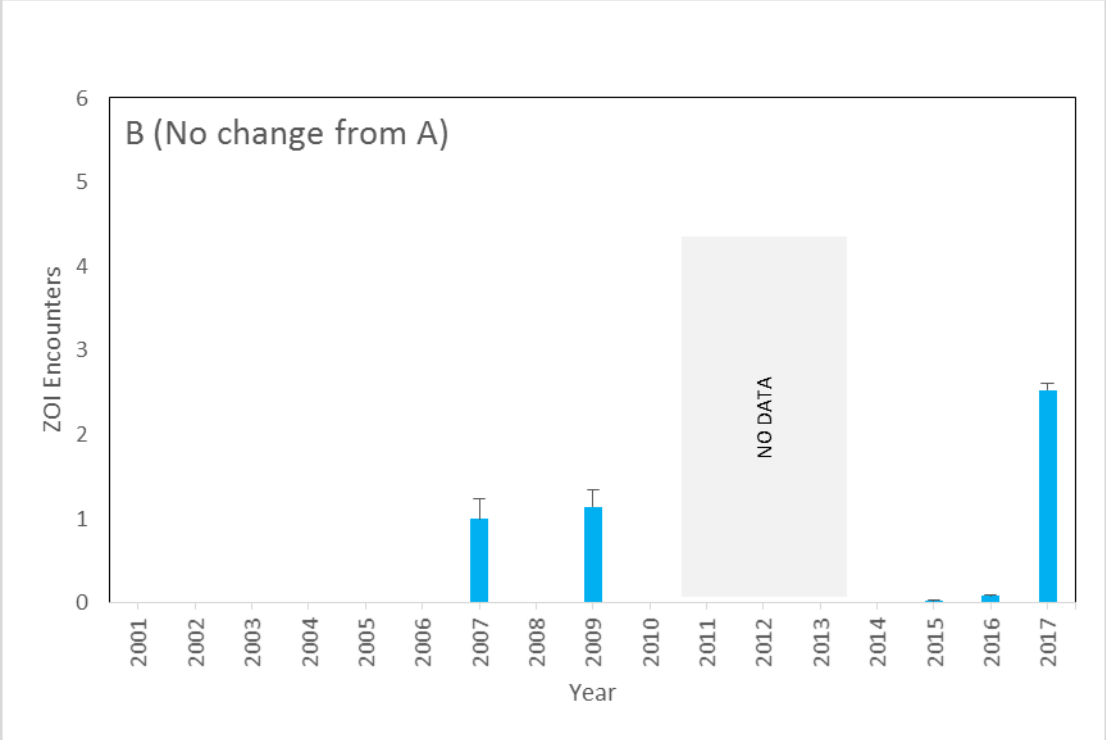
With the addition of the Meadowbank Mine and the AWAR to the winter range, there was no incremental change in encounter rates relative to the Base Case (Figure 14B).

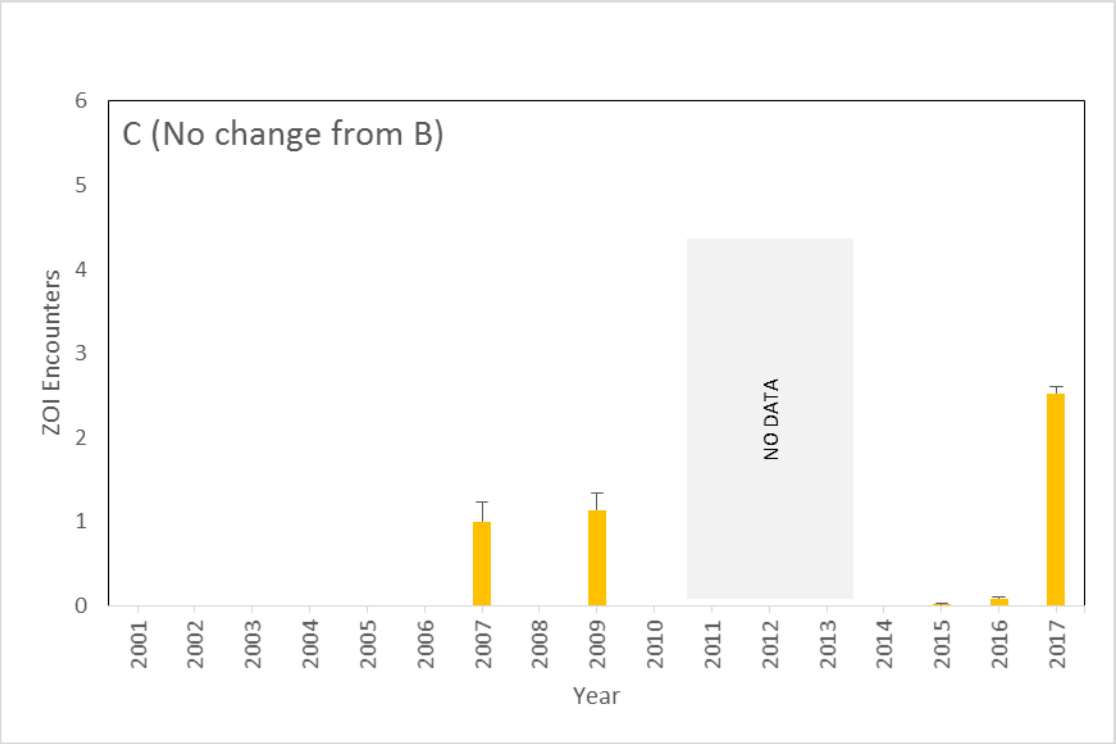
There was no incremental change in projected encounters for the Application Case relative to the Meadowbank or Base Case (Figure 14C).

The projected cumulative encounter rate with ZOIs in winter through the RFD Case was higher than the Base and Application cases. Using movement data from 2001 to 2017, the simulated number of annual mean encounters ranged from 0.02 to 3.0 and averaged 0.5 across study years (SD = 1.0) (Figure 14D). Annual encounter rates peaked in 2017 at 3.0 ZOI encounters.

Figure 14: Temporal Trend in Mean Encounter Rates (± 95% Upper Interval) During Winter with Zones of Influence for Female Caribou in the Beverly Herd from 2001 to 2017 for the Base Case (A), Meadowbank Case (B) Application Case (C), and the Reasonably Foreseeable Development Case (D)



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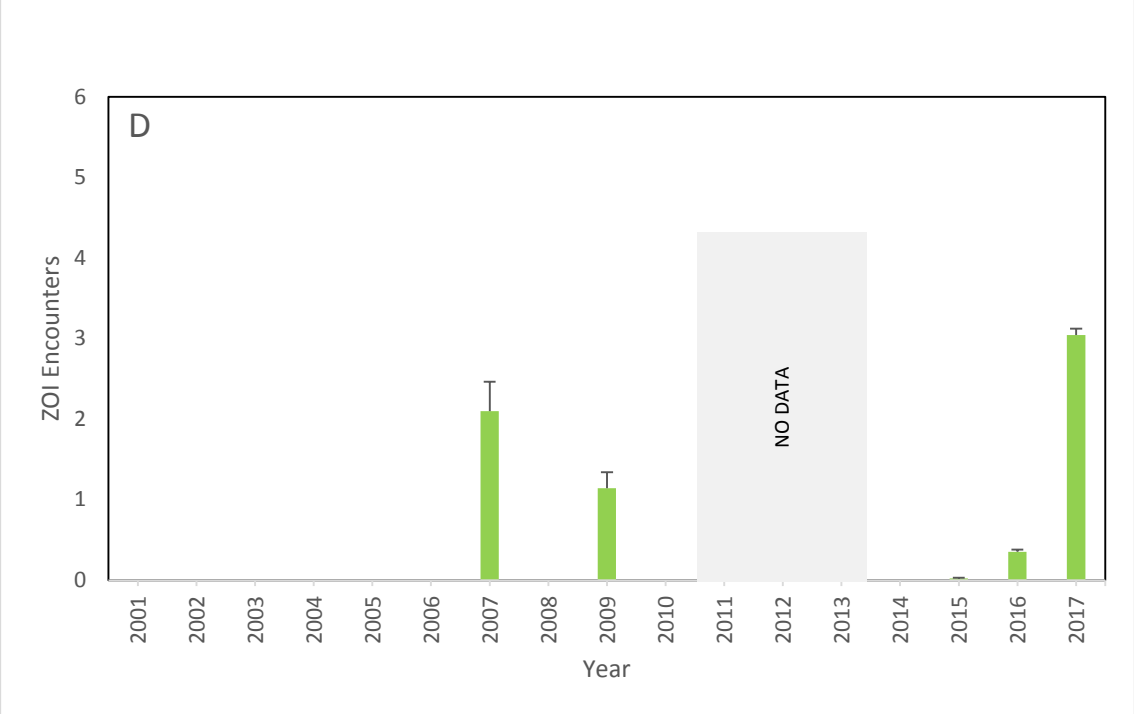
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3.1.1.3 Lorillard Herd

Spring Migration

Caribou paths monitored over 17 study years from 1998 to 2017 (no collar data from 2007 to 2010) were used to calculate the number of caribou encounters with ZOIs. The number of collared individuals ranged from two caribou in 1998 and 2006 to 15 caribou in 2016. The number of paths ranged from 17 paths in 1998 to 2,870 paths in 2016 for a total of 7,174 in spring.

Caribou residency times (i.e., percent time in zones of influence) and encounter rates during spring migration were highly correlated with each other (Pearson r = 0.90, P <0.01) (see Section 3.2.1.3). During Base Case conditions, annual mean encounter rates ranged from no encounters per 53 days for 10 of the study years (1998 to 2002, 2012 to 2014, 2016, and 2017) to 0.5 encounters per 53 days in 2006 (Figure 15A). Mean annual encounter rates in the Base Case were low and moderately variable (mean = <0.1, SD = 0.1), and do not suggest a declining or increasing temporal trend.

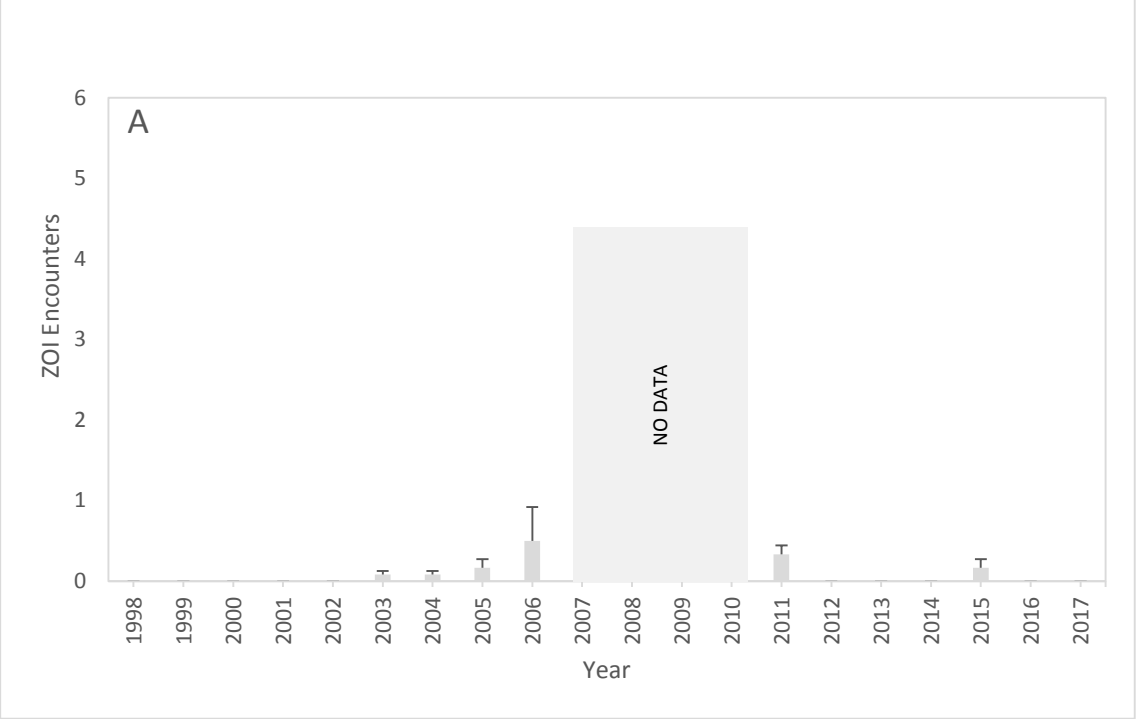
With the addition of the Meadowbank Mine and the AWAR to the spring range, the number of additional encounters ranged from no change for 1998 to 2006, and for 2017, to an increase of 1.4 encounters in 2011 per 53 days relative to the Base Case (Figure 15B). Simulations indicated an overall annual average of 0.3 additional encounters per 115 days (SD = 0.5) relative to the Base Case

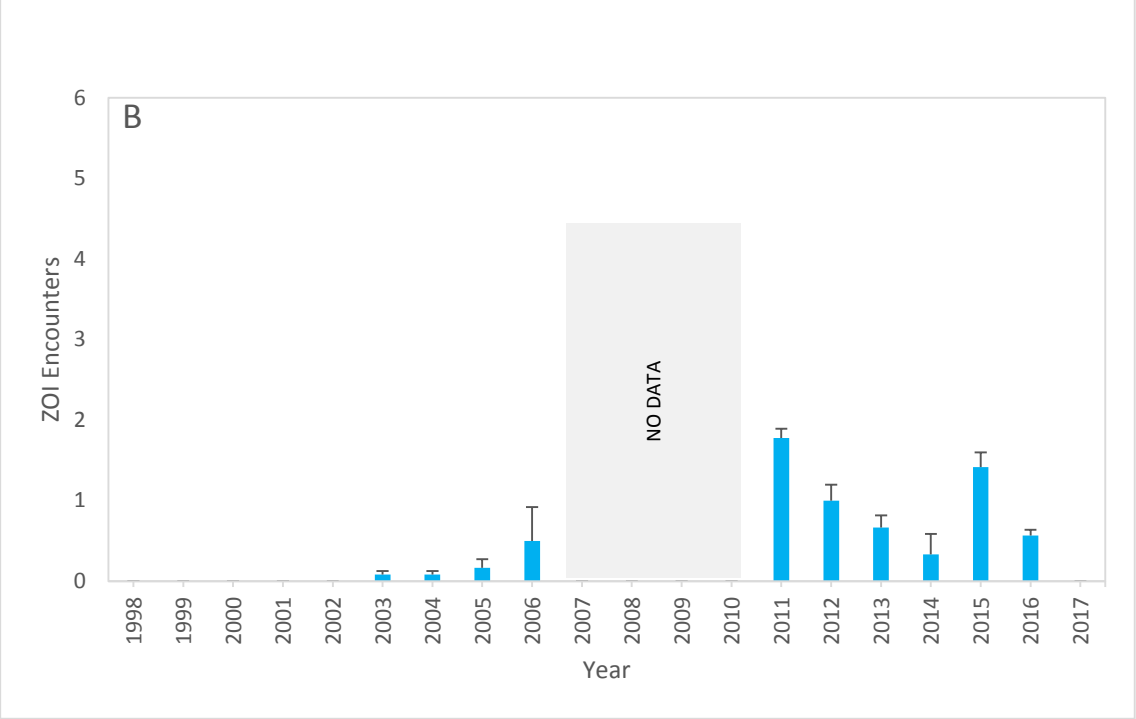
Under the Application Case for the spring range, the number of additional encounters ranged from no change for 1996 to 2004, 2006, and 2017, to an increase of 1.2 encounters in 2012 relative to the Base Case (Figure 15C). Simulations for the Application Case in spring projected an annual average of 0.3 additional encounters per 53 days (SD = 0.4) relative to the Meadowbank Case.

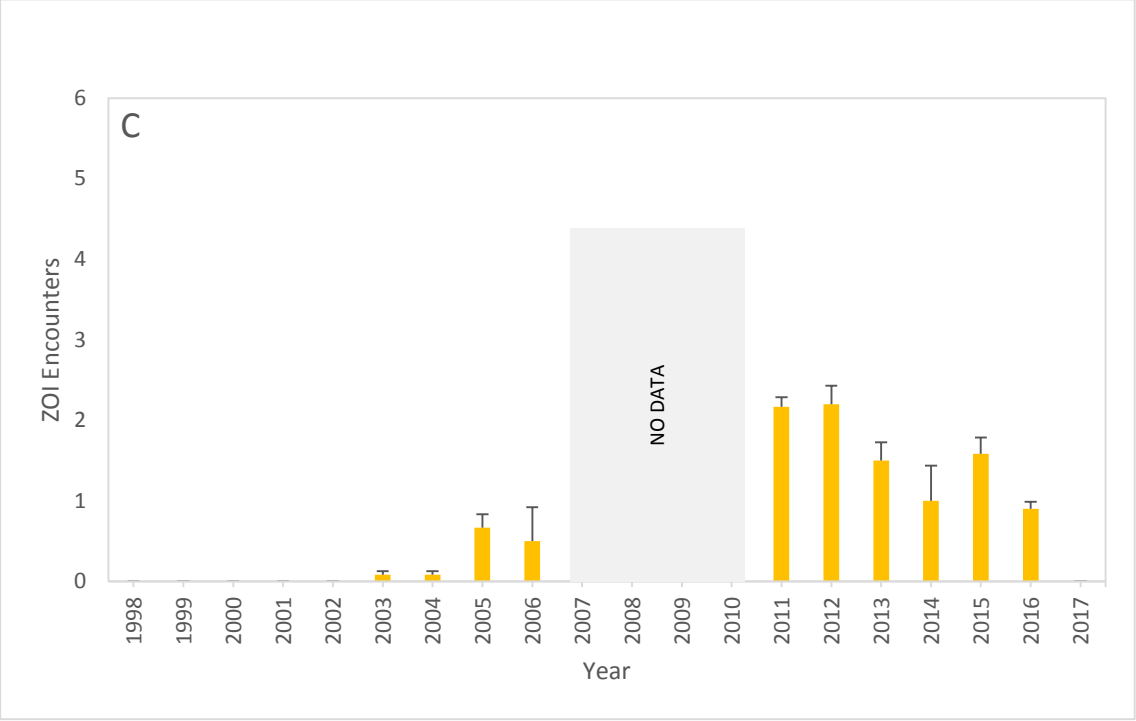
Annual encounter rates for the spring migration increased over time under conditions for the Meadowbank, and Application cases (Figure 15B and Figure 15C). For example, under the Application Case, higher encounters were noted for the period of 2011 to 2017 (mean = 1.3) versus the period of 1998 to 2006 (mean = 0.15).

The projected cumulative encounter rate with ZOIs in spring through the RFD Case was higher than the Base and Application cases. Using movement data from 1998 to 2017, the simulated number of annual mean encounters ranged from 0.1 to 2.3, and averaged 0.7 (SD = 0.8) across study years (Figure 15D).

Figure 15: Temporal Trend in Mean Encounter Rates (± 95% Upper Interval) During Spring migration with Zones of Influence for Female Caribou in the Lorillard Herd from 1998 to 2017 for the Base Case (A), Meadowbank Case (B) Application Case (C), and the Reasonably Foreseeable Development Case (D)



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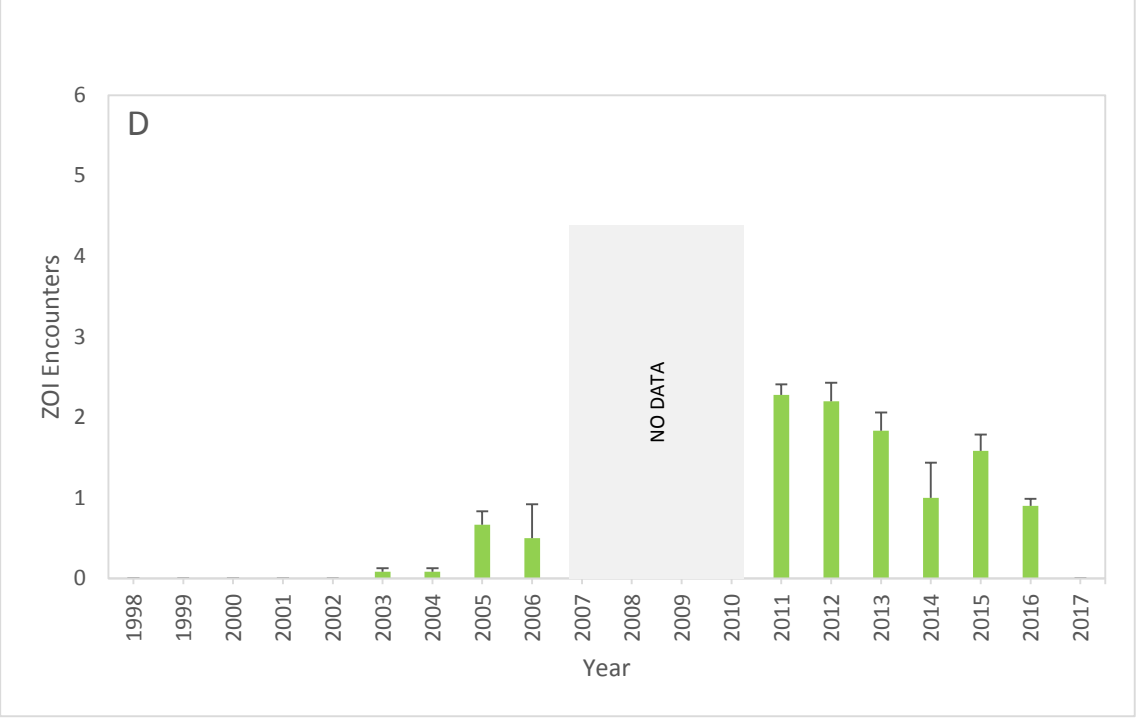
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Fall Migration

Caribou paths monitored over 14 study years from 1998 to 2016 (no collar data 2006 to 2010) were used to calculate the number of caribou encounters with ZOIs. The number of collared individuals ranged from two caribou in 1998 and 2014 to 12 caribou in 2003 and 2016. The number of paths ranged from 34 paths in 1998 to 5,620 paths in 2016 for a total of 10,988 in fall.

Caribou residency time (i.e., percent time in zones of influence) and encounter rates during fall migration were highly correlated with each other (Pearson r = 0.97, P <0.01) (see Section 3.2.1.3). During Base Case conditions, annual mean encounter rates ranged from no encounters per 115 days for eight of the study years (1998 to 2002, 2005, 2013, and 2014) to 1.6 encounters per 115 days in 2012 (Figure 16A). The mean annual encounter rate in the Base Case was low and highly variable (mean < 0.1, SD = 0.4), and do not suggest a strong declining or increasing temporal trend.

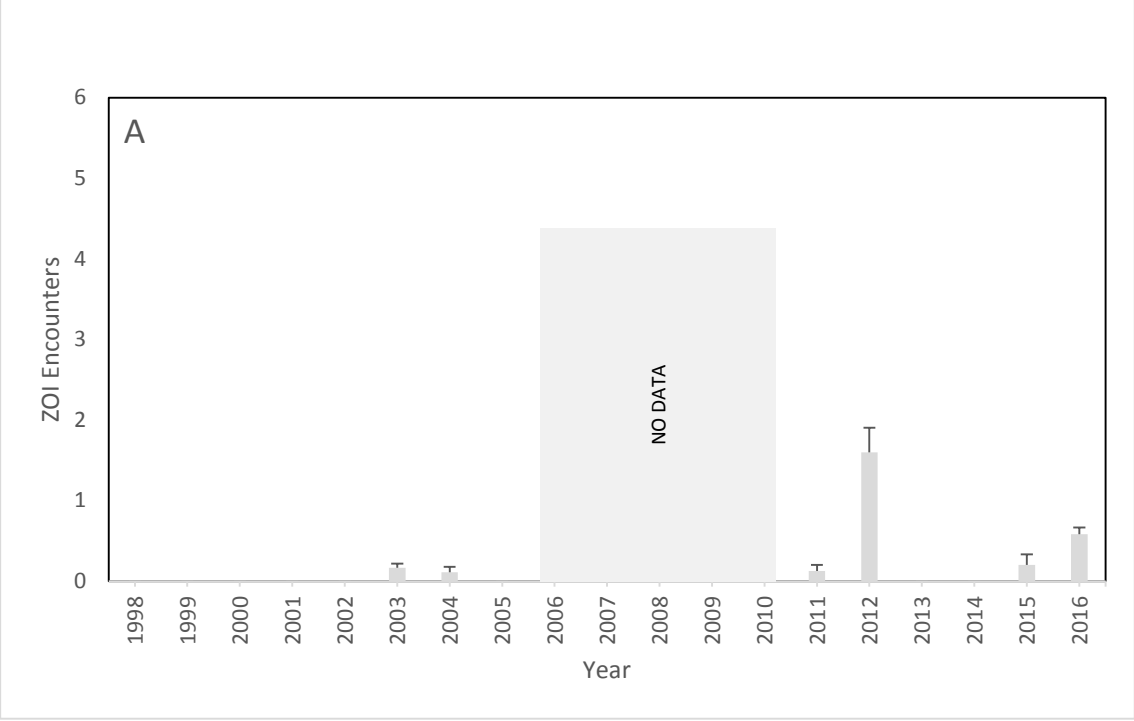
With the addition of the Meadowbank Mine and the AWAR to the fall migration range, additional encounters ranged from no change for 1998 to 2005 to an increase of 2.2 encounters in 2012 per 115 days relative to the Base Case (Figure 9B). Simulations for the Meadowbank Case indicated an annual average of 0.4 additional encounters per 115 days (SD = 0.6) relative to the Base Case.

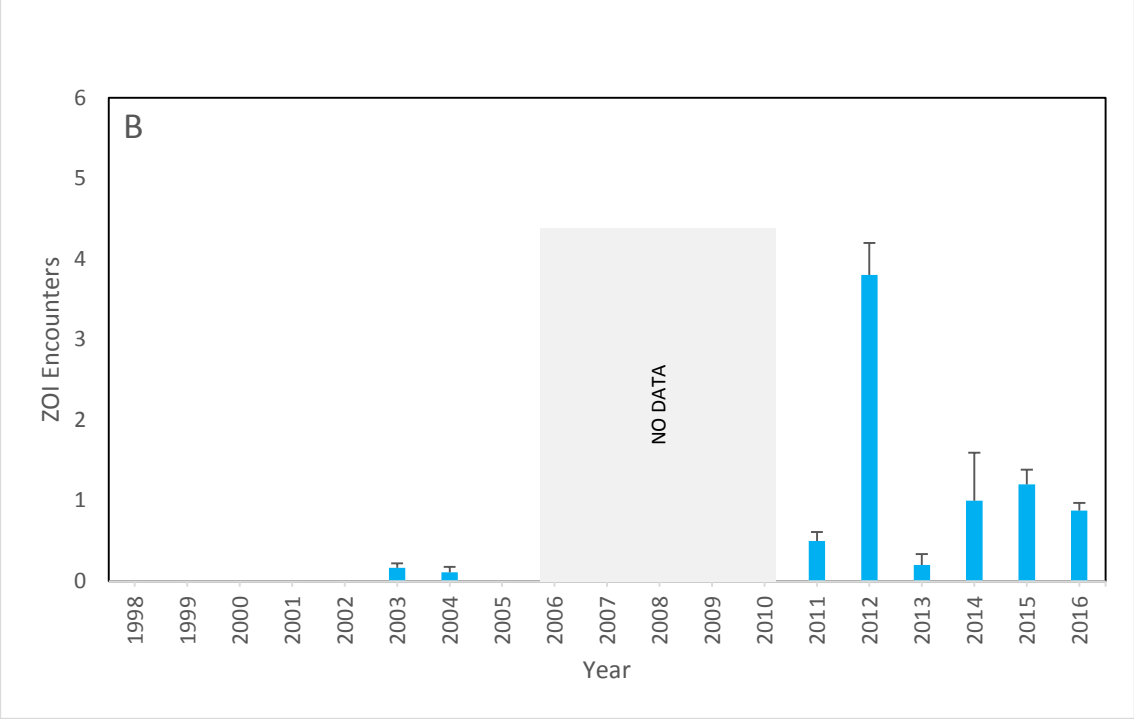
Under conditions of the Application Case, additional encounters ranged from no change for 1998 to 2002, 2005, 2012, 2015, and 2016 to an increase of 1.3 encounters in 2004 per 115 days relative to the Meadowbank Case (Figure 16C). Simulations for the Application Case projected an annual average of 0.3 additional encounters per 115 days (SD = 0.4) relative to the Meadowbank Case.

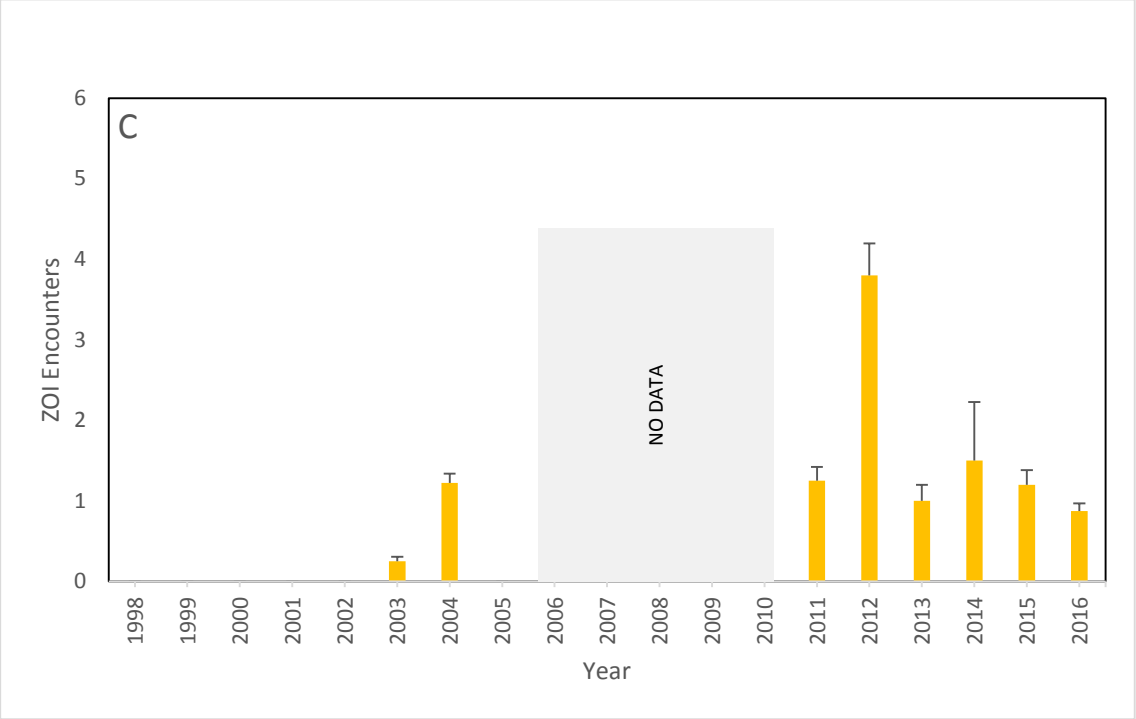
Annual encounter rates for the fall migration increased over time under conditions for the Meadowbank and Application cases (Figure 16B and Figure 16C). For example, under the Application Case, higher encounters were noted for the period of 2011 to 2017 (mean = 1.6) versus the period of 1998 to 2005 (mean = 0.2)

The projected cumulative encounter rate with ZOIs in fall migration through the RFD Case was higher than the Base and Application cases. The simulated number of annual mean encounters ranged from 0.3 to 4.4 using movement data from 1998 to 2016, and averaged 1.0 (SD = 1.2) across study years (Figure 16D). Annual encounter rates peaked in 2012 at 4.4 ZOI encounters.

Figure 16: Temporal Trend in Mean Encounter Rates (± 95% Upper Interval) During Fall migration with Zones of Influence for Female Caribou in the Lorillard Herd from 1998 to 2016 for the Base Case (A), Meadowbank Case (B) Application Case (C), and the Reasonably Foreseeable Development Case (D)



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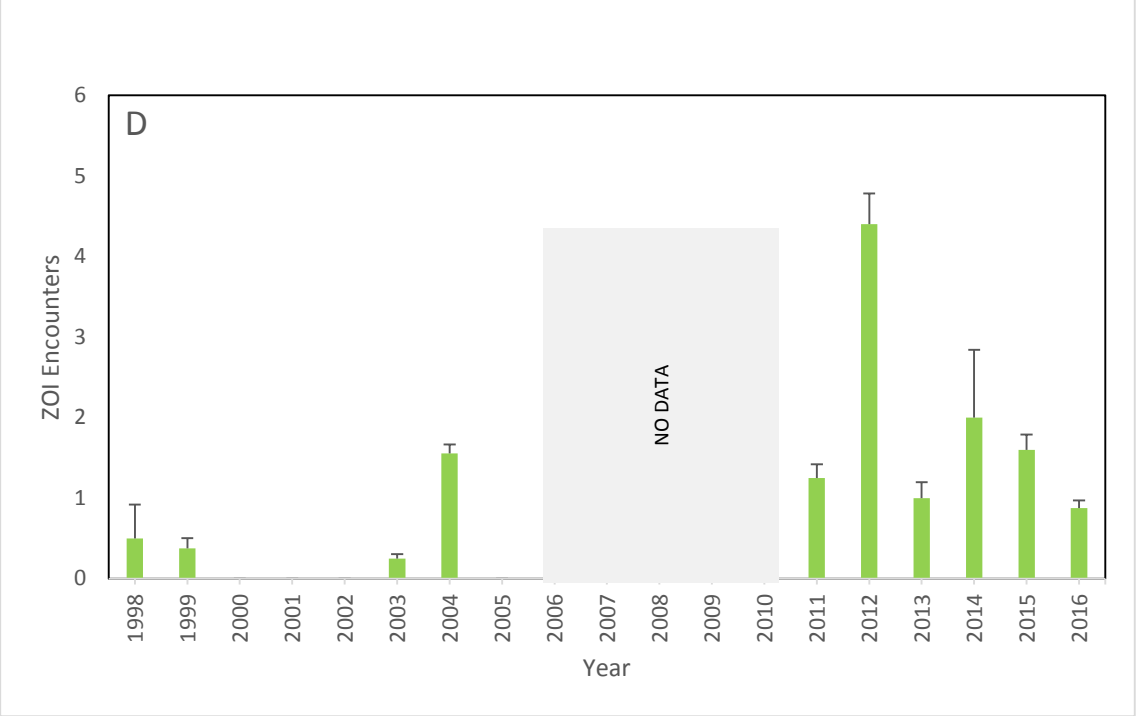
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Winter

Caribou paths monitored over 15 years from 1998 to 2017 (no collar data 2007 to 2011) were used to calculate the number of caribou encounters with ZOIs. The number of collared individuals ranged from a single caribou in 1998, to 12 caribou in 2004 and 2017. The number of paths ranged from 2 paths in 1998 to 2,840 paths in 2016 for a total of 12,830 in winter.

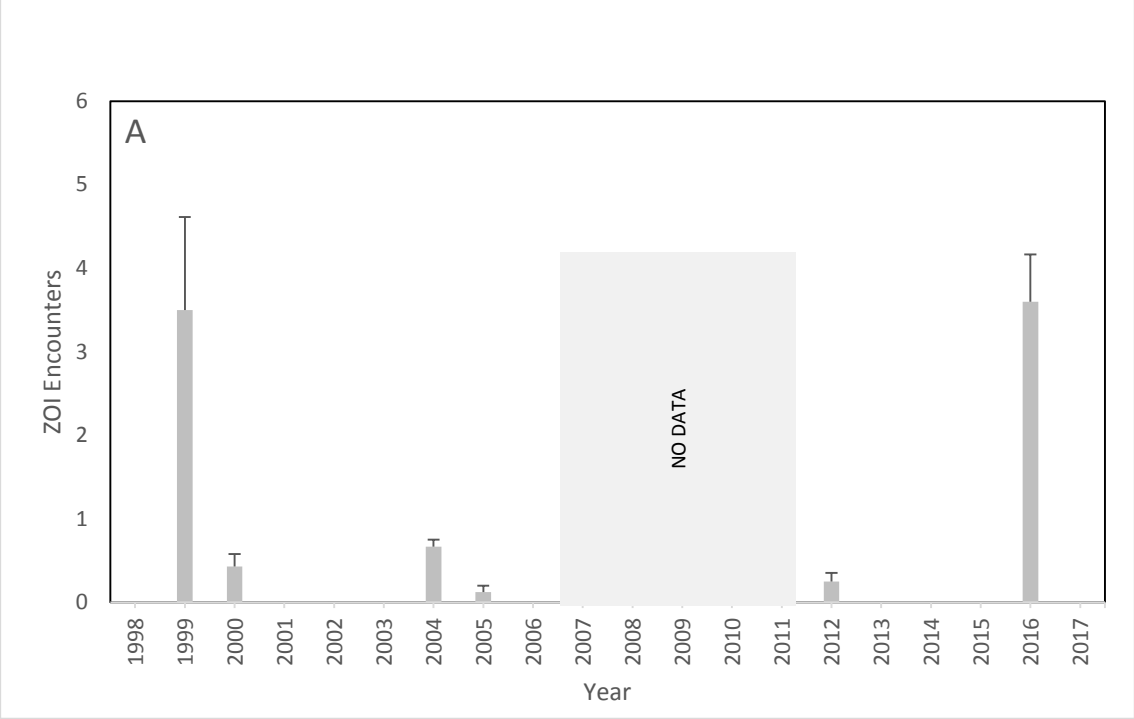
Caribou residency time (i.e., percent time in zones of influence) and encounter rates in winter were highly correlated with each other (Pearson r = 0.97, P <0.01) (see Section 3.2.1.3). During Base Case conditions, annual mean encounter rates ranged from no encounters per 109 days in nine of the study years (1998, 2001 to 2003, 2006, 2013 to 2015, and 2017) to 3.6 encounters per 109 days in 2016 (Figure 17A). The mean annual encounter rate in the Base Case was generally low and variable (mean = 0.6, SD = 1.2), and there was no evidence of a declining or increasing temporal trend in annual encounter rates.

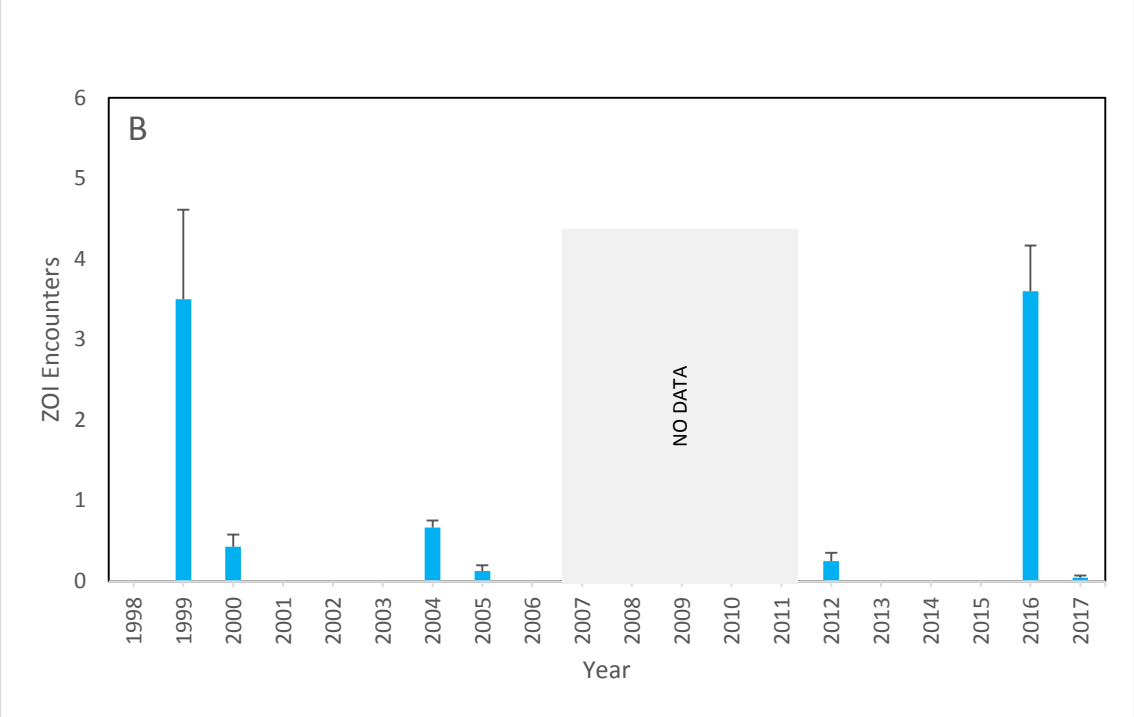
With the addition of the Meadowbank Mine and the AWAR to the winter range, the average number of additional encounters per year ranged from no change for 1998 to 2006, and for 2012 to 2016 to less than 0.1 additional encounters in 2015 per 109 days relative to the Base Case (Figure 17B). Simulations for the winter indicated an overall annual average of less than 0.1 additional encounters per 115 days (SD < 0.1) relative to the Base Case.

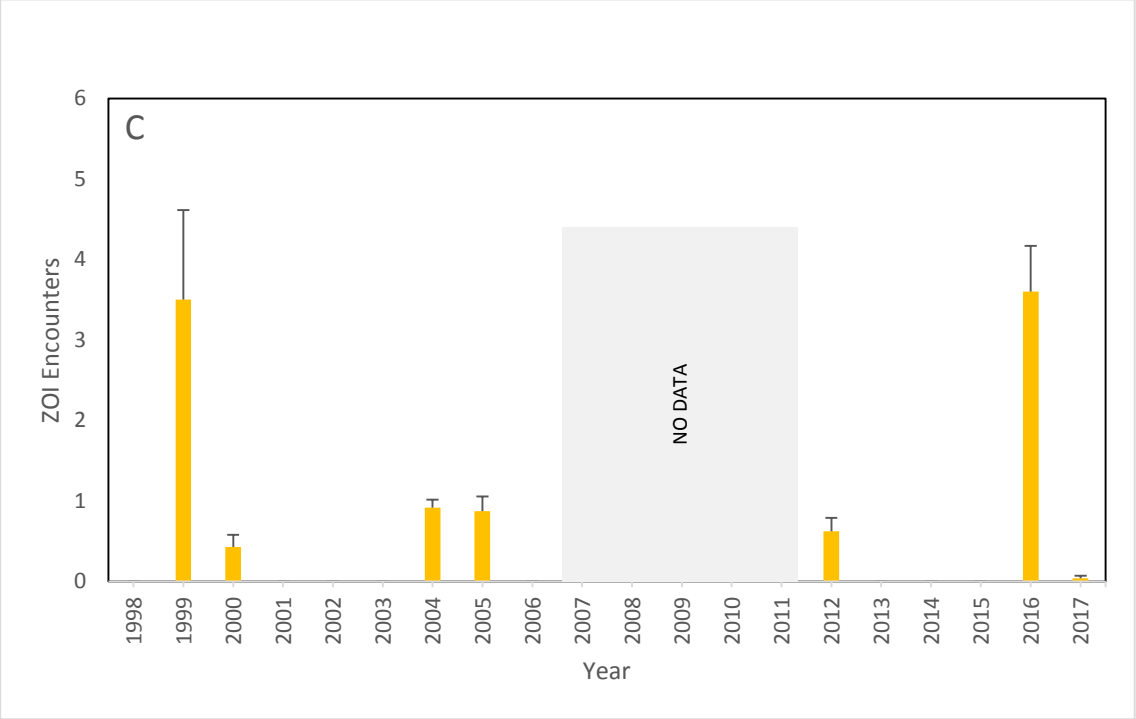
Under the Application Case for the winter range, the number of additional encounters per year ranged from no change for 1998 to 2003, 2006, and 2013 to 2017, to 0.8 additional encounters in 2005 per 109 days relative to the Meadowbank Case (Figure 17C). Application Case simulations for the winter range projected an annual average of 0.1 additional encounters per 109 days (SD = 0.2) relative to the Meadowbank Case.

The projected cumulative encounter rate with ZOIs in winter through the RFD Case was higher than the Base and Application cases. Using movement data from 1998 to 2017, the simulated number of annual mean encounters ranged from less than 0.1 to 3.6, and averaged 0.7 (SD = 1.2) across years (Figure 17D). Annual encounter rates peaked in 2016 at 3.6 ZOI encounters.

Figure 17: Temporal Trend in Mean Encounter Rates (± 95% Upper Interval) During Winter with Zones of Influence for Female Caribou in the Lorillard Herd from 1998 to 2017 for the Base Case (A), Meadowbank Case (B) Application Case (C), and the Reasonably Foreseeable Development Case (D)



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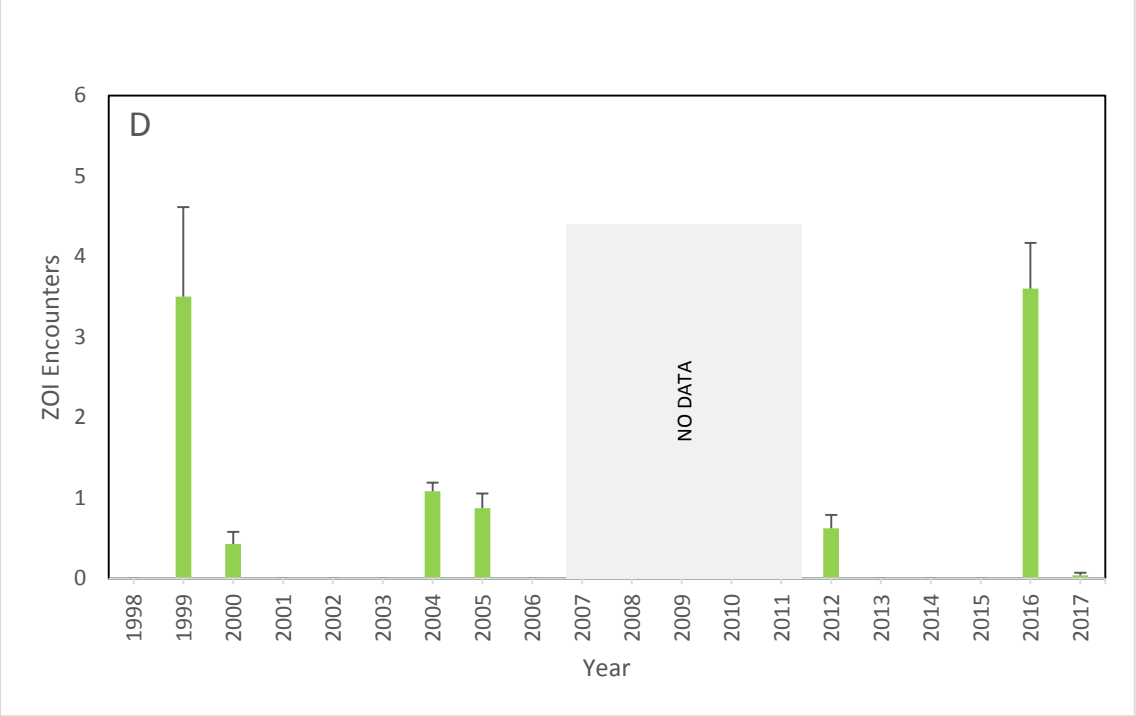
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3.1.1.4 Wager Bay Herd

Spring Migration

Caribou paths monitored over 14 study years from 1999 to 2017 (no collar data 2007 to 2009, 2013 and 2014) were used to calculate the number of caribou encounters with ZOIs. The number of collared individuals ranged from a single caribou in 1999, 2010, and 2012 to 12 caribou in 2003. The number of paths ranged from 8 paths in 1999 to 1,312 paths in 2016 for a total of 2,874 in spring.

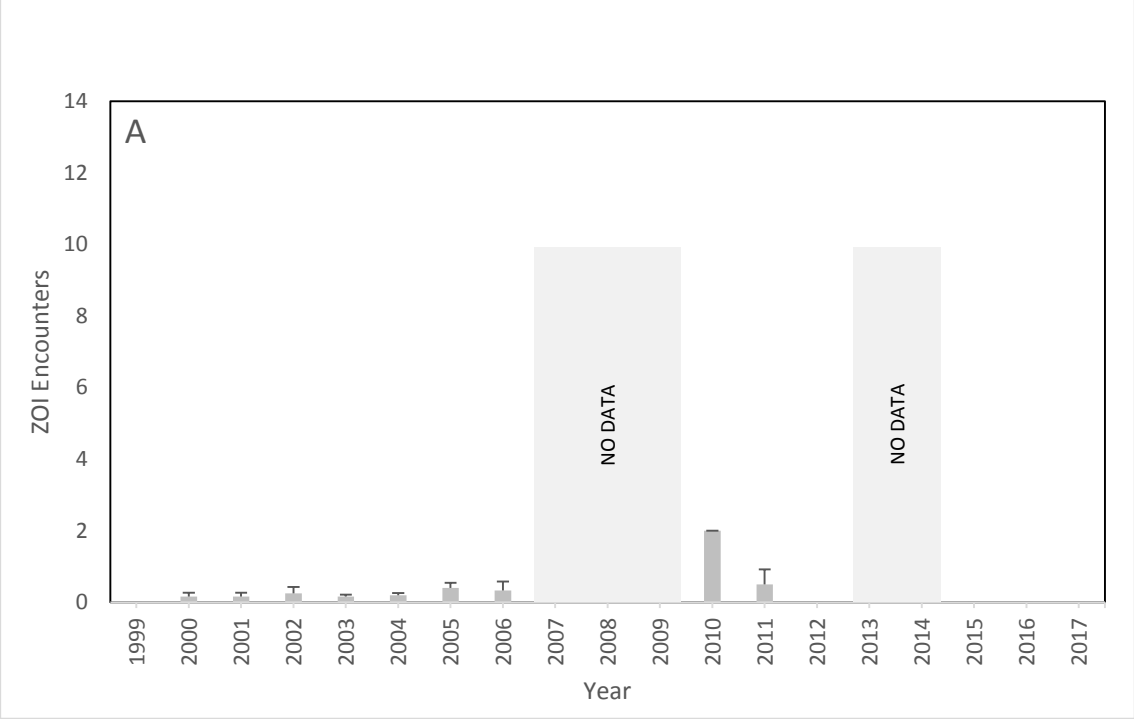
Caribou residency time (i.e., percent time in zones of influence) and encounter rates during spring migration were highly correlated with each other (Pearson r = 0.73, P <0.01) (Section 3.2.1.4). During Base Case conditions, annual mean encounter rates ranged from no encounters per 58 days in five of the study years (1999, 2012, and 2015 to 2017) to 2.0 encounters per 58 days in 2010 (Figure 18A). The mean annual encounter rate was very low (mean = 0.3), and moderately variable (SD=0.5), and there was no evidence of a declining or increasing temporal trend.

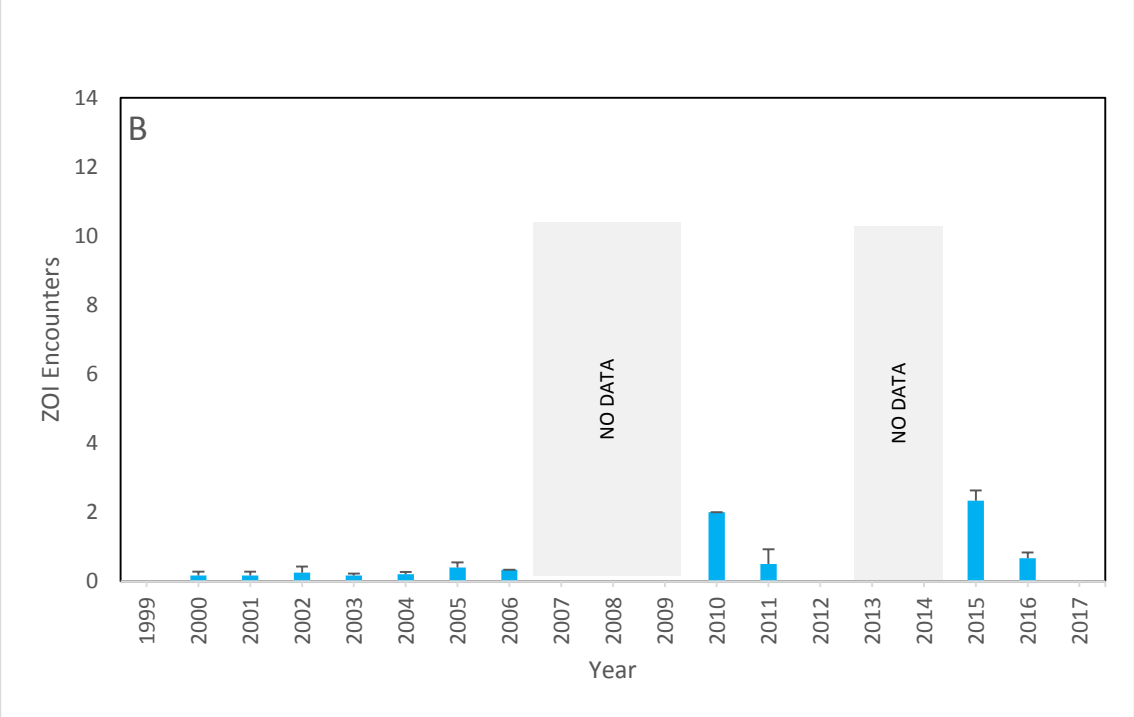
With the addition of the Meadowbank Mine and the AWAR to the spring range, the annual average number of additional encounters in spring ranged from no change for study years between 1999 to 2012, and for 2017, to an increase of 2.3 encounters in 2015 per 58 days (SD = 0.6) relative to the Base Case (Figure 18B). Simulations for encounters under the Meadowbank Case in spring indicated an annual average of 0.2 additional encounters per 58 days (SD = 0.6) relative to the Base Case.

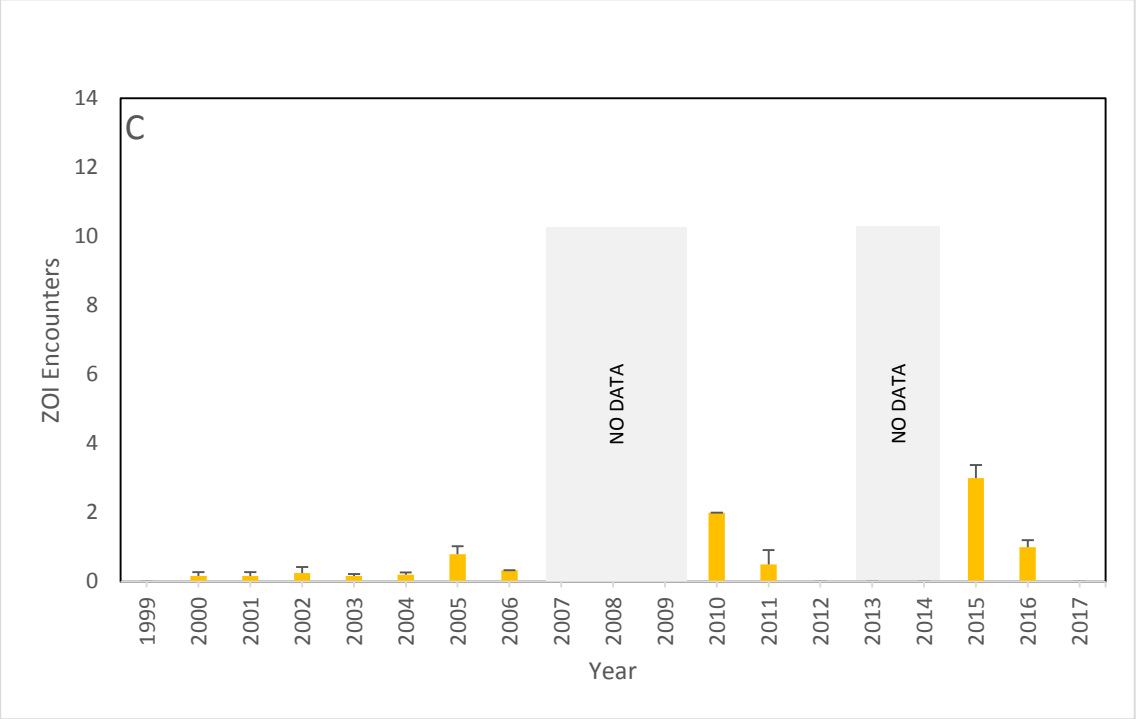
Under the Application Case for the spring range, the annual average number of additional encounters in spring ranged from no change for 1999 to 2004, 2006, 2010 to 2012, and 2017 to an increase of 0.7 encounters in 2015 per 58 days (SD = 0.2) relative to the Meadowbank Case (Figure 18C). Simulations for the Application Case in spring projected an annual average of 0.1 additional encounters per 58 days (SD = 0.2) relative to the Meadowbank Case.

The projected cumulative encounter rate with ZOIs in spring through the RFD Case was higher than the Base Case but unchanged in comparison to the Application case. Using movement data from 1999 to 2017, the simulated number of mean annual encounters ranged from 0.2 to 3.0, and averaged 0.6 (SD = 0.9) across study years (Figure 18D). Annual encounter peaked in 2015 at 3.0 encounters.

Figure 18: Temporal Trend in Mean Encounter Rates (± 95% Upper Interval) During Spring migration with Zones of Influence for Female Caribou in the Wager Bay Herd from 1999 to 2017 for the Base Case (A), Meadowbank Case (B) Application Case (C), and the Reasonably Foreseeable Development Case (D)



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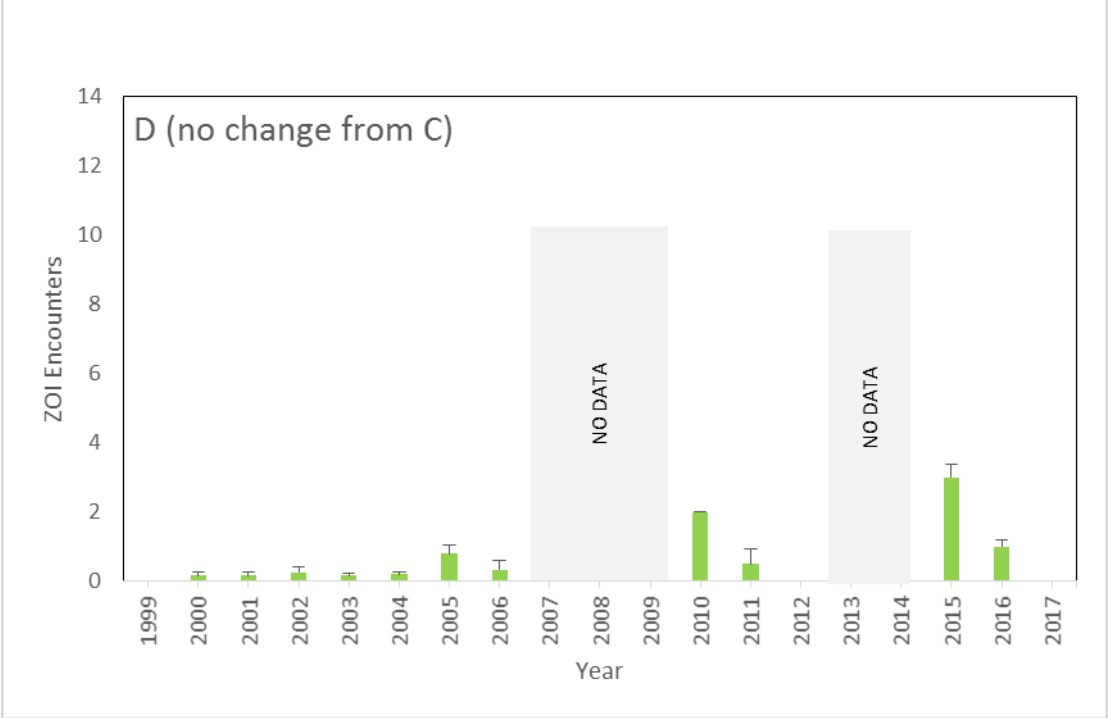
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Fall Migration

Caribou paths monitored over 14 study years from 1999 to 2016 (no collar data 2007, 2008, 2013, and 2014) were used to calculate the number of caribou encounters with ZOIs. The number of collared individuals ranged from a single caribou in 1999, 2000, 2009, 2010, and 2012 to 12 caribou in 2003. The number of paths ranged from 17 paths in 1999 to 2,834 paths in 2012 for a total of 4,824 in fall.

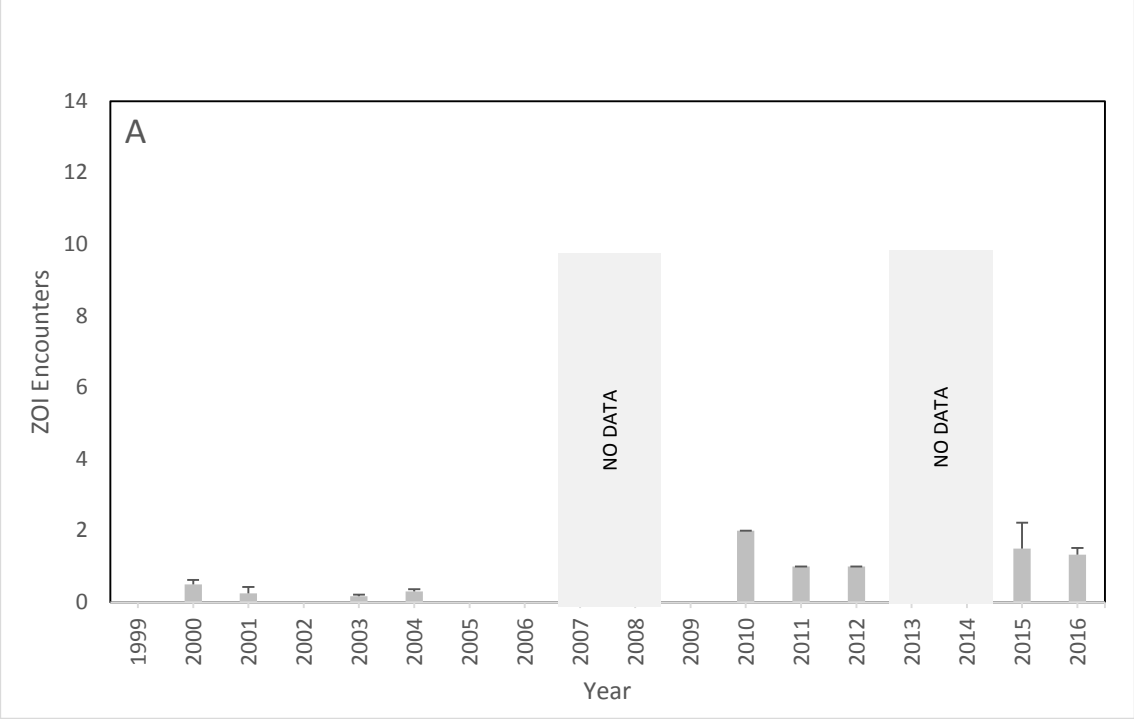
Caribou residency time (i.e., percent time in zones of influence) and encounter rates during fall migration were highly correlated with each other (Pearson r = 0.96, P <0.01) (see Section 3.2.1.4). During Base Case conditions, annual mean encounter rates ranged from no encounters per 115 days for five of the study years (1999, 2002, 2005, 2006, and 2009) to 2.0 encounters per 115 days in 2010 (Figure 19A). The mean annual encounter rate was low and moderately variable (mean = 0.6, SD = 0.7), and there was no evidence of a strong declining or increasing temporal trend.

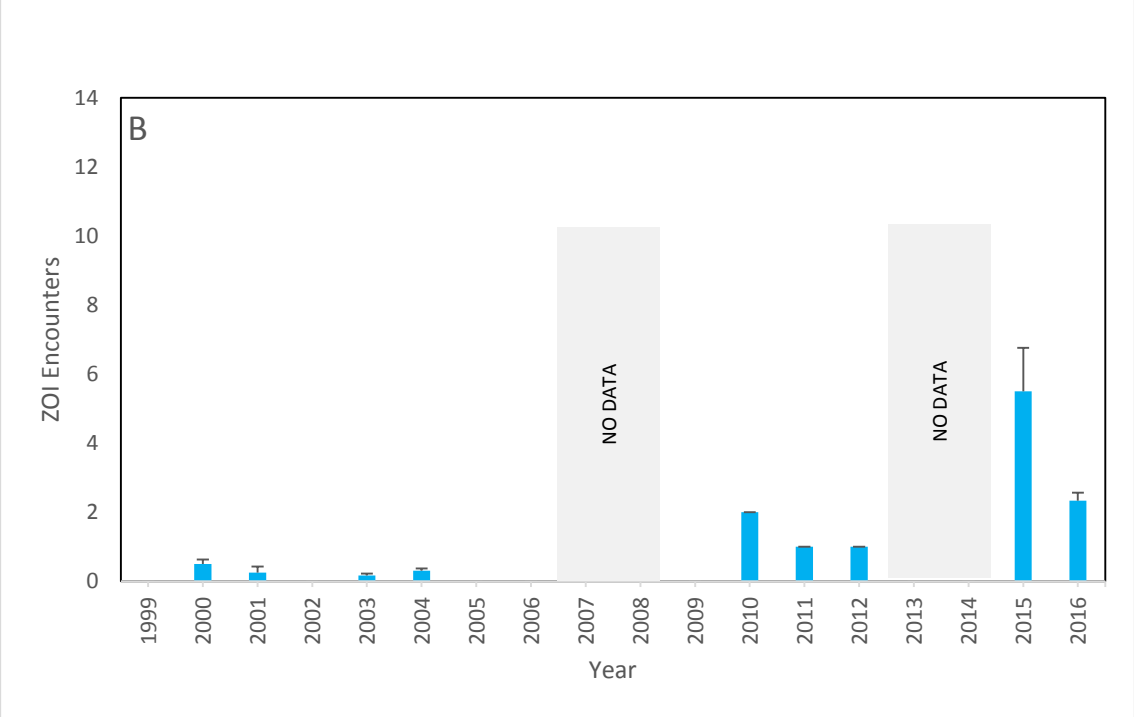
With the addition of the Meadowbank Mine and the AWAR to the fall migration range, analysis of the average number of additional encounters resulted in no change for all study years between 1999 and 2011 to an increase of 4.0 encounters in 2015 relative to the Base Case (Figure 19B). Simulations for the Meadowbank Case in fall migration indicated an annual average of 0.4 additional encounters per 115 days (SD = 1.1) relative to the Base Case.

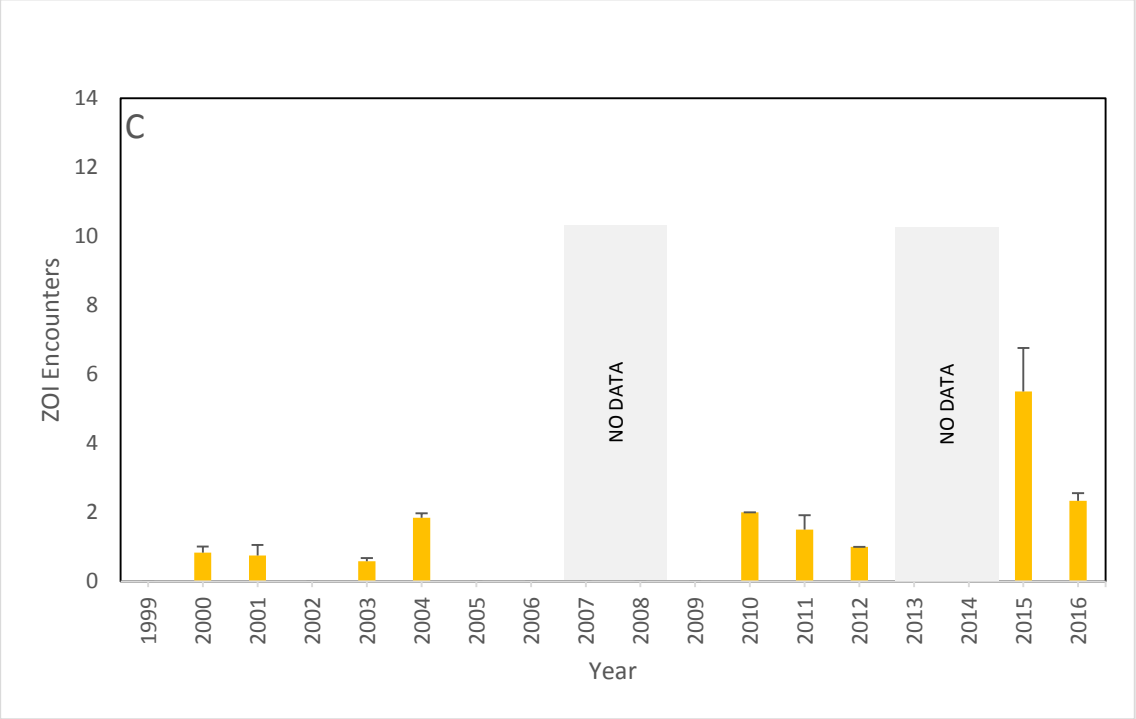
Under the Application Case for the fall migration range, analysis of the average number of additional encounters resulted in no projected change for 1999, 2002, 2005, 2006, 2009, 2010, 2012, 2015, and 2016 to an increase of 1.6 encounters in 2004 relative to the Meadowbank Case (Figure 19C). Application Case simulations for the fall migration projected an annual average of 0.2 additional encounters per 115 days (SD = 0.4) relative to the Meadowbank Case.

The projected cumulative encounter rate with ZOIs in fall migration through the RFD Case was higher than the Base and Application cases. Using movement data from 2000 to 2016, the simulated number of annual mean encounters ranged from 0.6 to 6.0 and averaged 1.3 (SD = 1.6) across study years (Figure 19D). Annual encounter peaked in 2015 at 6.0 encounters.

Figure 19: Temporal Trend in Mean Encounter Rates (± 95% Upper Interval) During Fall migration with Zones of Influence for Female Caribou in the Wager Bay Herd from 1999 to 2016 for the Base Case (A), Meadowbank Case (B) Application Case (C), and the Reasonably Foreseeable Development Case (D)






C
ZOI Encounters
Year
NO DATA
NO DATA
0
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4
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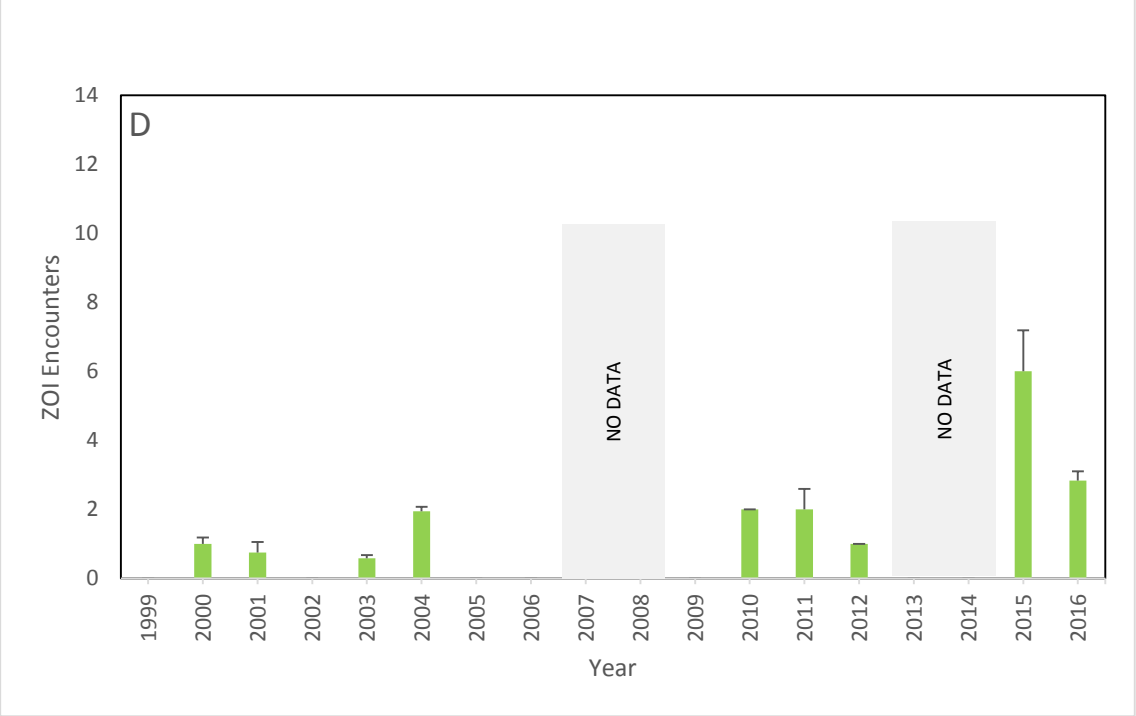
2016


D
ZOI Encounters
Year
NO DATA
NO DATA
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Winter

Caribou paths monitored over 14 study years from 2000 to 2017 (no collar data 2008, 2009, 2014, and 2015) were used to calculate the number of caribou encounters with ZOIs. The number of collared individuals ranged from a single caribou in 2000, 2007, 2010, 2011, and 2013 and 2006 to 11 caribou in 2004. The number of paths ranged from 2 paths in 2013 to 2,317 paths in 2017 for a total of 4,611 in winter.

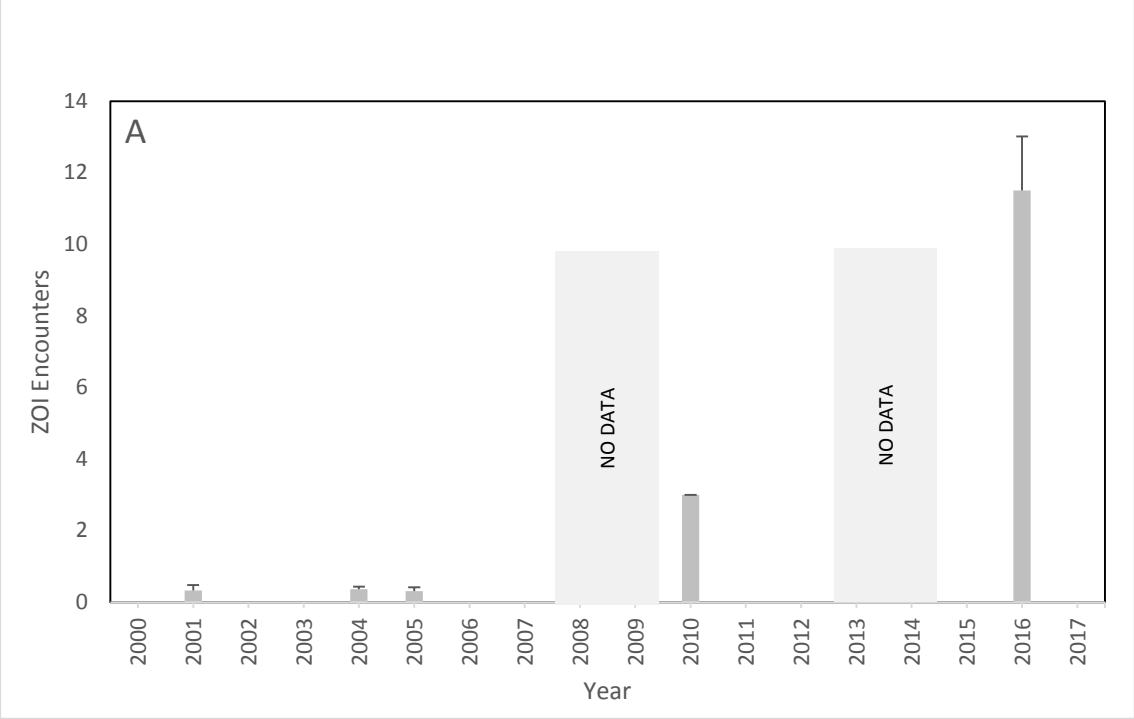
Caribou residency time (i.e., percent time in zones of influence) and encounter rates in winter were highly correlated with each other (Pearson r = 0.99, P <0.01) (see Section 3.2.1.4). During Base Case conditions, annual mean encounter rates ranged from no encounters per 105 days for nine of the study years (2000, 2002, 2003, 2006, 2007, 2011 to 2013, and 2017) to 11.5 encounters per 105 days in 2016 (Figure 20A). The mean annual encounter rate in the Base Case was moderate in magnitude and highly variable (mean = 1.1, SD =3.1). There was a relatively high encounter rate (11.5) estimated for 2016.

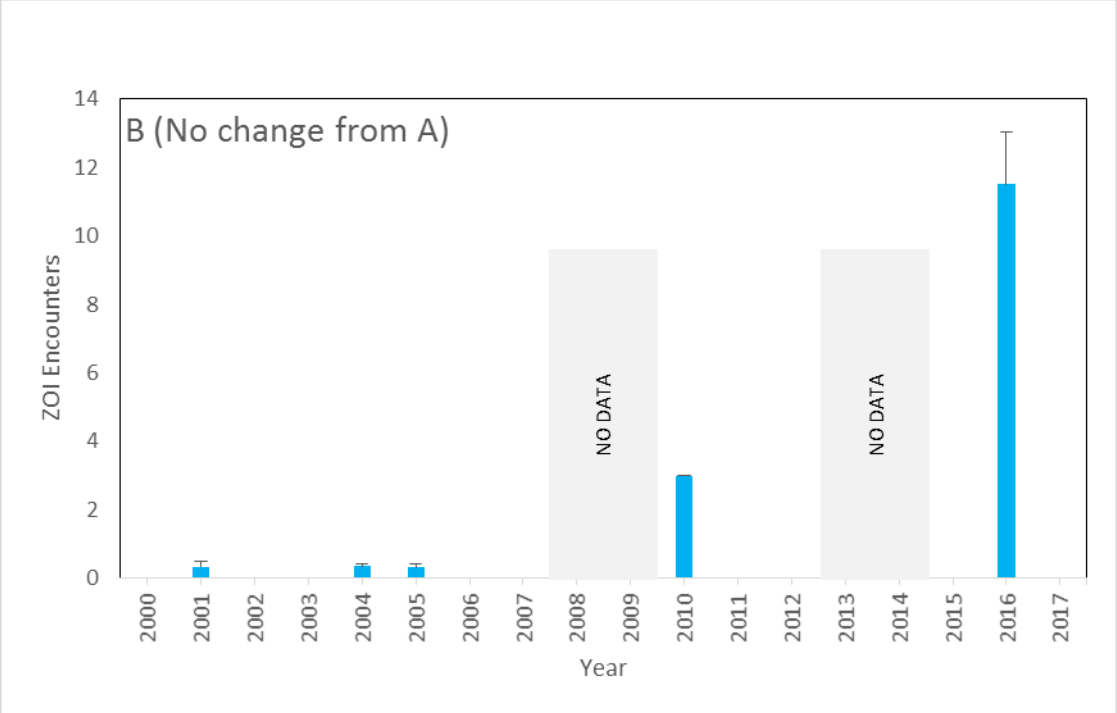
With the addition of the Meadowbank Mine and the AWAR to the winter range, there was no change in encounter rates relative to the Base Case (Figure 20B).

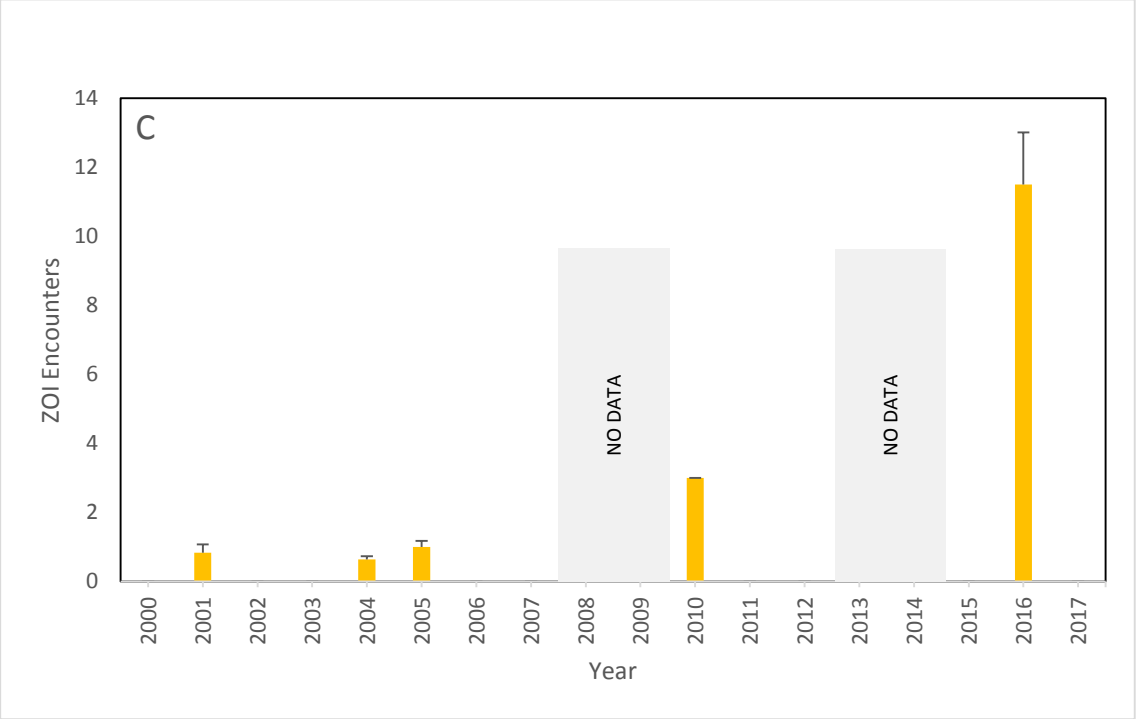
Under the Application Case for the winter range, analysis of additional encounters relative to the Meadowbank Case resulted in a range of no change for 2000, 2002, 2003, 2006, 2007, 2010 to 2013, 2016, and 2017, to an increase of 0.7 encounters in 2005 (Figure 20C). Application Case simulations projected an annual average of 0.1 additional encounters per 105 days (SD = 0.2) relative to the Meadowbank Case.

The projected cumulative encounter rate with ZOIs in winter through the RFD Case was higher than the Base and Application cases. Using movement data from 2000 to 2017, the simulated number of annual mean encounters ranged from 0.8 to 11.5, and averaged 1.4 (SD = 3.0) across study years (Figure 20D).

Figure 20: Temporal Trend in Mean Encounter Rates (± 95% Upper Interval) During Winter with Zones of Influence for Female Caribou in the Wager Bay Herd from 2000 to 2017 for the Base Case (A), Meadowbank Case (B) Application Case (C), and the Reasonably Foreseeable Development Case (D)






C
ZOI Encounters
Year
NO DATA
NO DATA
0
2
4
6
8
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12
14
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
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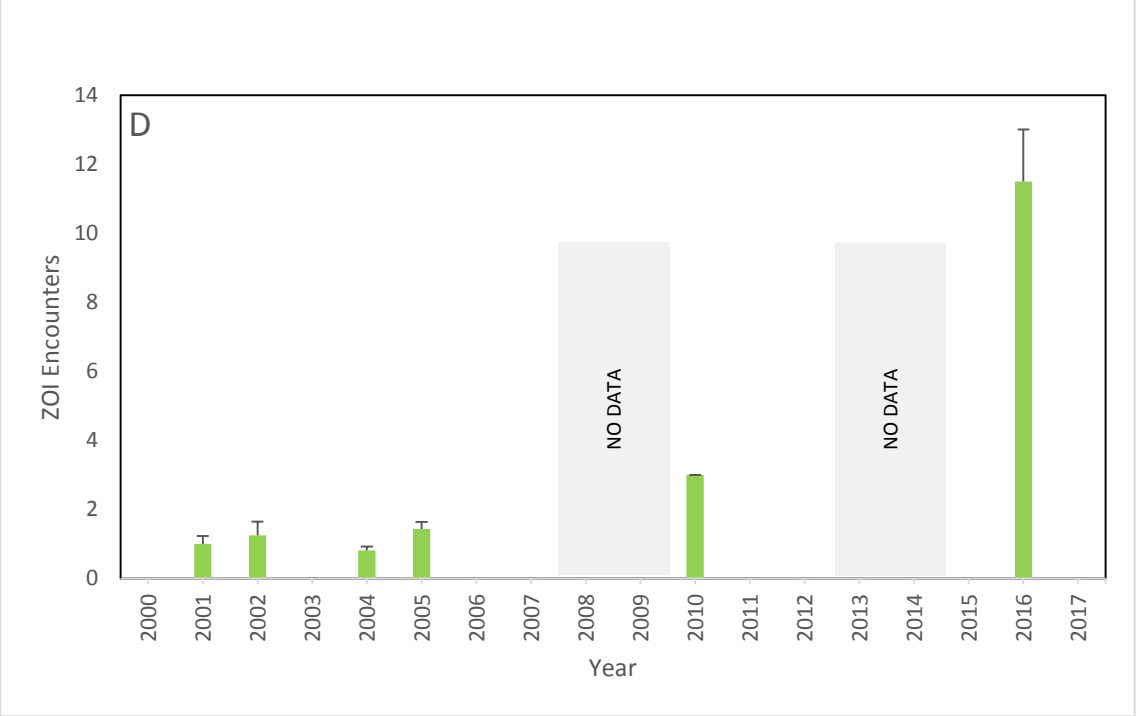
2014
2015
2016
2017


D
ZOI Encounters
Year
NO DATA
NO DATA
0
2
4
6
8
10
12
14
2000
2001
2002
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2004
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2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017

3.2 Residency Time

3.2.1.1 Ahiak Herd

Spring Migration

Caribou paths monitored over 19 study years from 1996 to 2016 (no collar data 1999 and 2000) were used to calculate the residency time within ZOIs. The number of collared individuals ranged from two caribou in 2004 and 2016 to 42 caribou in 2008.

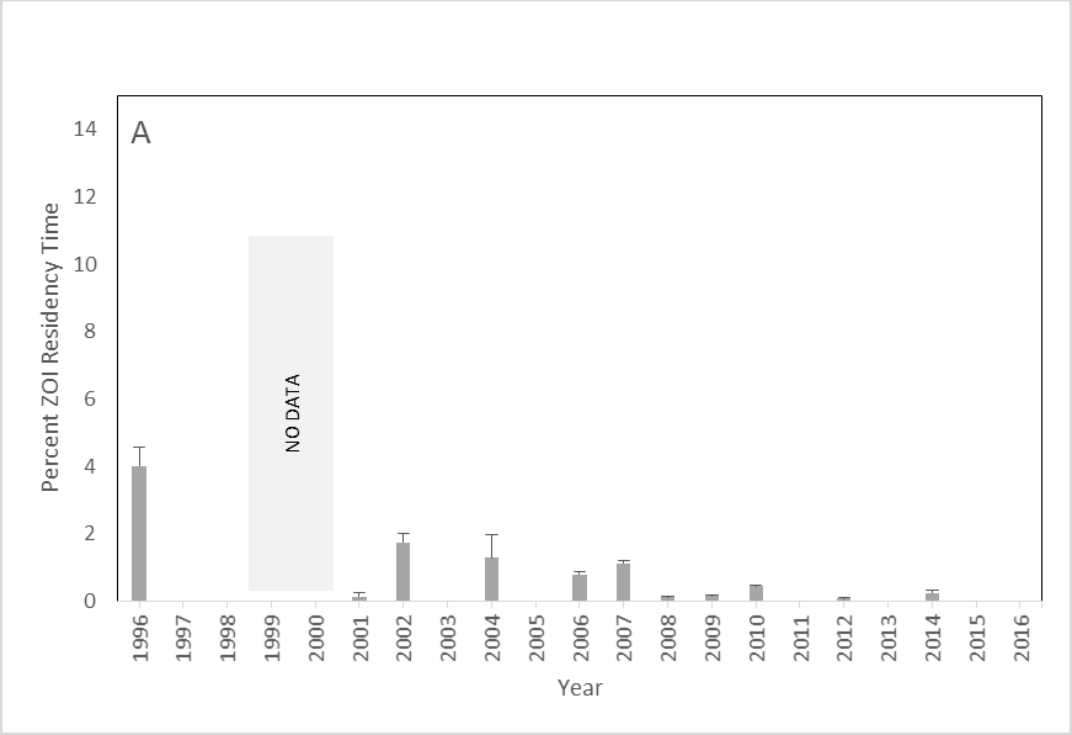
From 1996 to 2016 (Base Case), Ahiak caribou resided in ZOIs for an average of 0.4 days (SD = 1.0 days) or 0.5% of their time during the spring migration period (n = 245 paths). No time was spent by female caribou in ZOIs during eight of the study years (1997, 1998, 2003, 2005, 2011, 2013, 2015, and 2016). When there was interaction with a ZOI, the amount of time spent by female caribou in ZOIs ranged from less than 0.1% in 2012 to 4.0% in 1996 (Figure 21A). There was no evidence of a strong declining or increasing temporal trend, although residency time was highest in 1996.

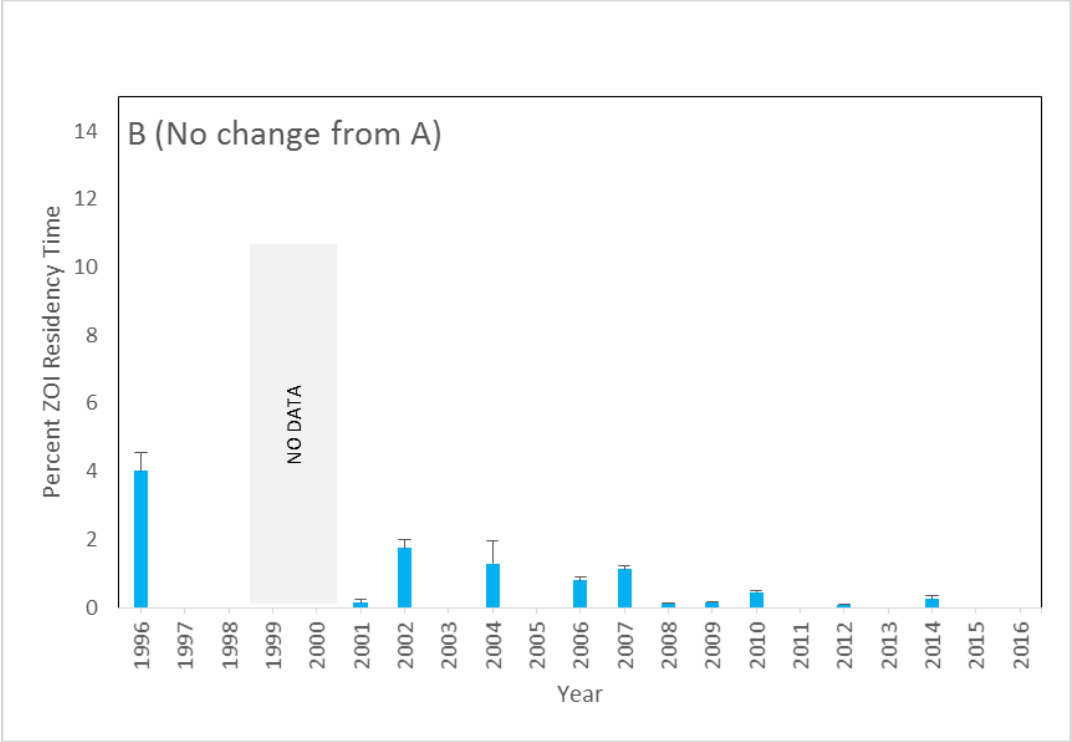
With the addition of the Meadowbank Mine and the AWAR to the spring range, the amount of time spent in ZOIs did not change relative to the Base Case (Figure 21B).

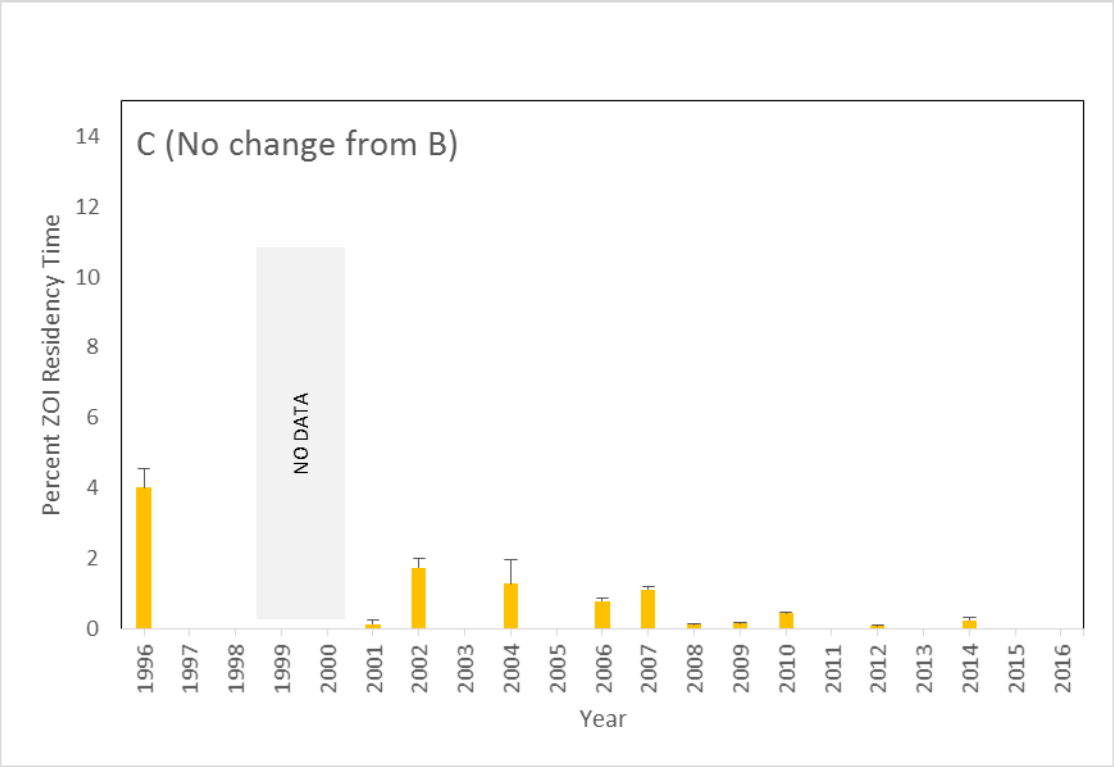
There was no change in projected residency time for the Application Case relative to the Meadowbank Case (Figure 21C).

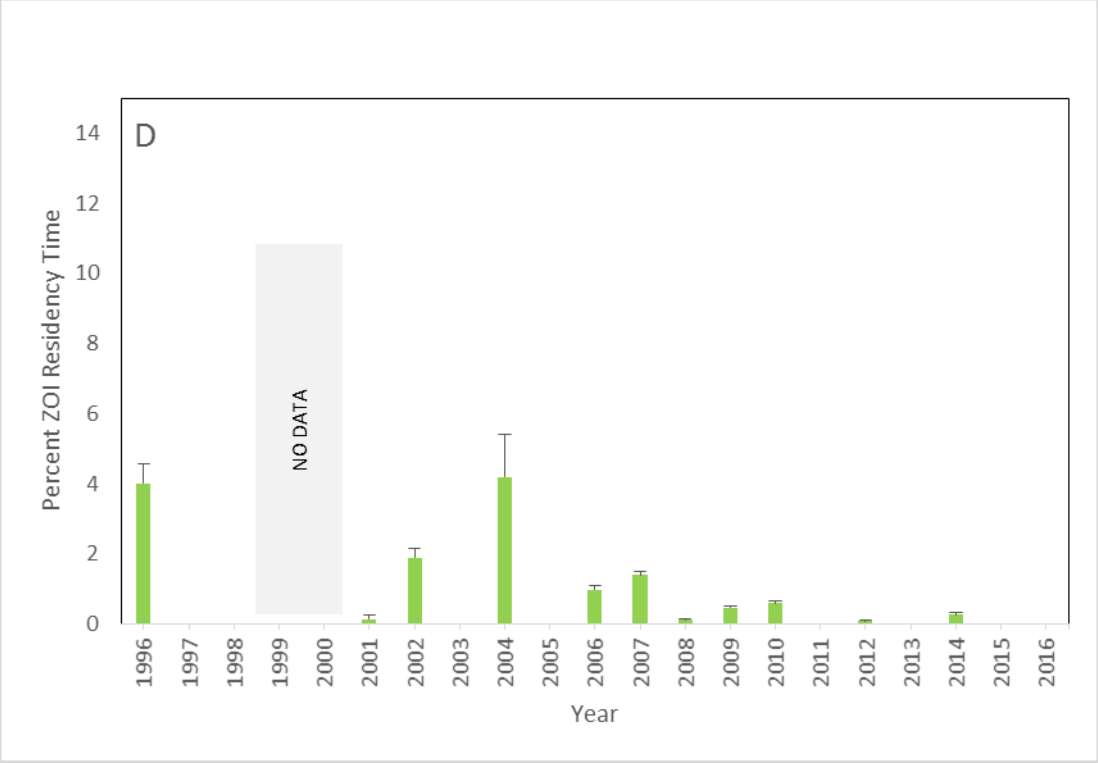
Simulations with the RFD Case projected that caribou reside in ZOIs for an average of 0.5 days (SD = 1.3) or 0.7% of their time during the spring migration period. Residency time in ZOIs ranged from 0.1% in 2012 to 4.2% in 2004 of the spring migration period (Figure 21D). No time was spent by female caribou in ZOIs per 67 days in eight of the study years: 1997, 1998, 2003, 2005, 2011, 2013, 2015, and 2016.

Figure 21: Temporal Trend in Mean Encounter Rates (± 95% Upper Interval) During Spring migration with Zones of Influence for Female Caribou in the Ahiak Herd from 1996 to 2016 for the Base Case (A), Meadowbank Case (B) Application Case (C), and the Reasonably Foreseeable Development Case (D)






C (No change from B)
Percent ZOI Residency Time
NO DATA
Year
0
2
4
6
8
10
12
14
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016


D
Percent ZOI Residency Time
NO DATA
Year
0
2
4
6
8
10
12
14
1996
1997
1998
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2002
2003
2004
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2016

Fall Migration

Caribou paths monitored over 19 study years from 1996 to 2016 (no collar data 1999 and 2000) were used to calculate the residency time within ZOIs. The number of collared individuals ranged from two caribou in 2004 and 2016 to 42 caribou in 2008.

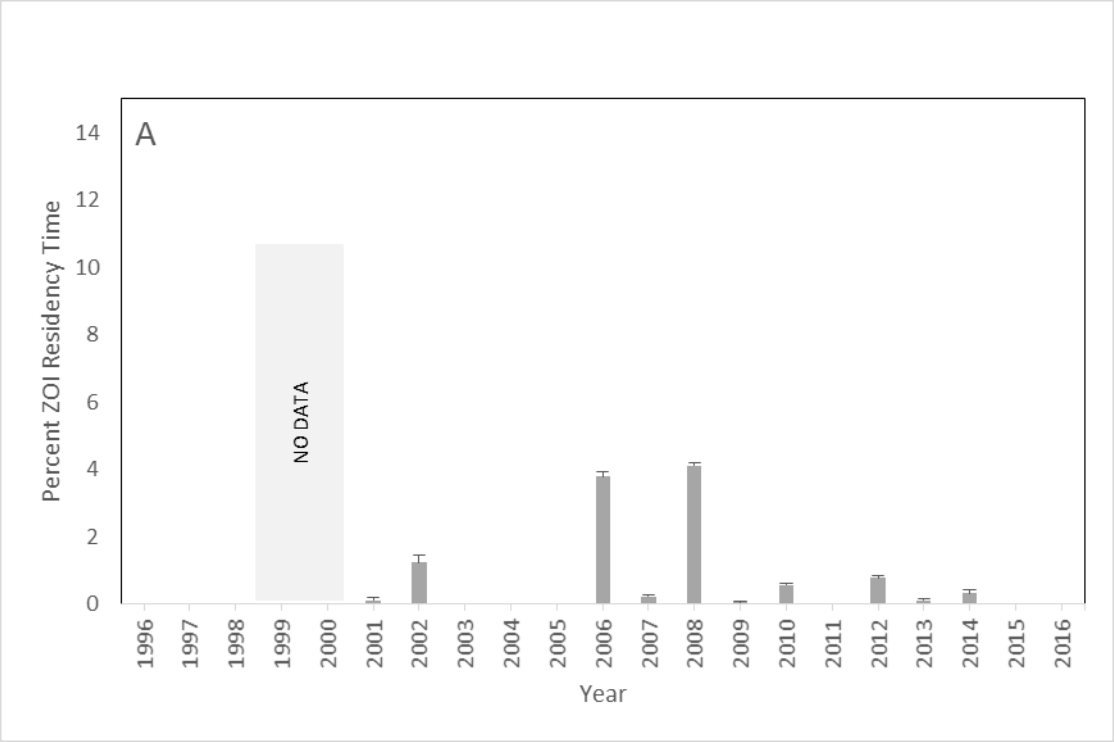
From 1996 to 2016 (Base Case), Ahiak caribou resided in ZOIs for an average of 0.7 days (SD = 1.2 days) or 0.6% of their time during the fall migration period (n = 245 paths). No time was spent by female caribou in ZOIs during 1996 to 1998, 2003 to 2005, 2011, and 2015 to 2016. When there was an interaction with a ZOI, the amount of time spent by female caribou in ZOIs ranged from 0.1% in 2001 and 2013 to 4.1% in 2008 (Figure 22A). There was no evidence of a strong declining or increasing temporal trend.

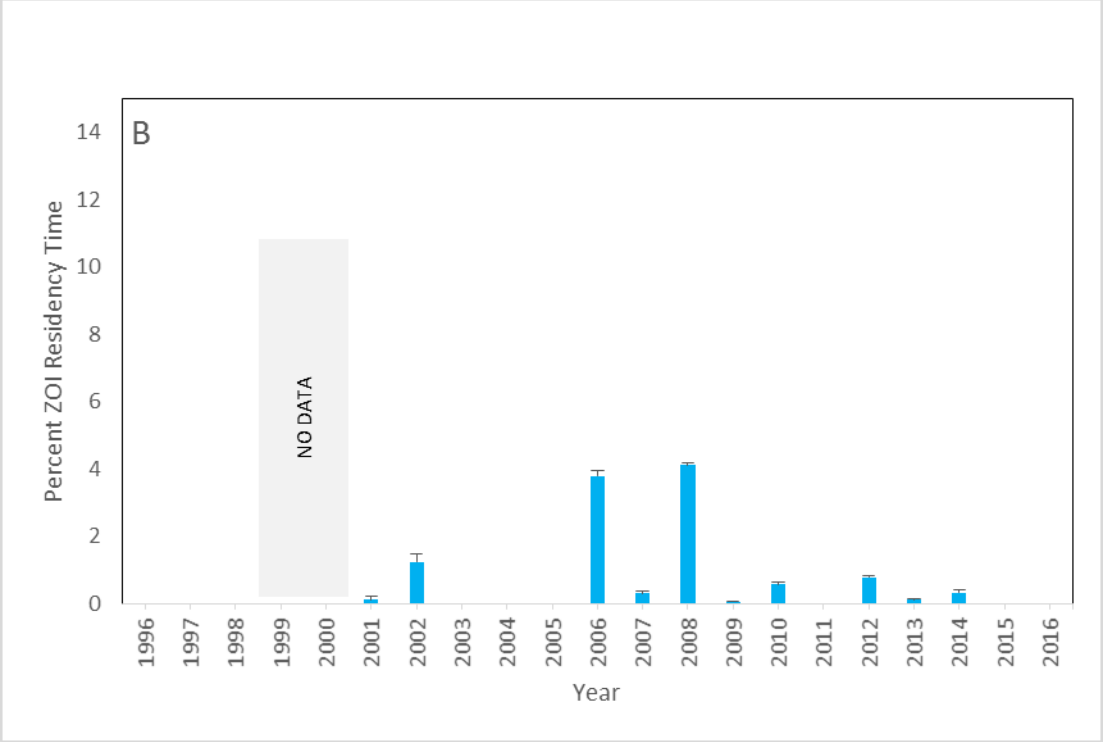
With the addition of the Meadowbank Mine and the AWAR to the winter range, the amount of additional time spent in ZOIs included no days for most study years with the exception of 2007 when residency time increased by 0.1 days per 115 days relative to the Base Case (Figure 22B). The mean incremental increase in residency time was less than 0.1 % (<0.1 days) for the Meadowbank Case.

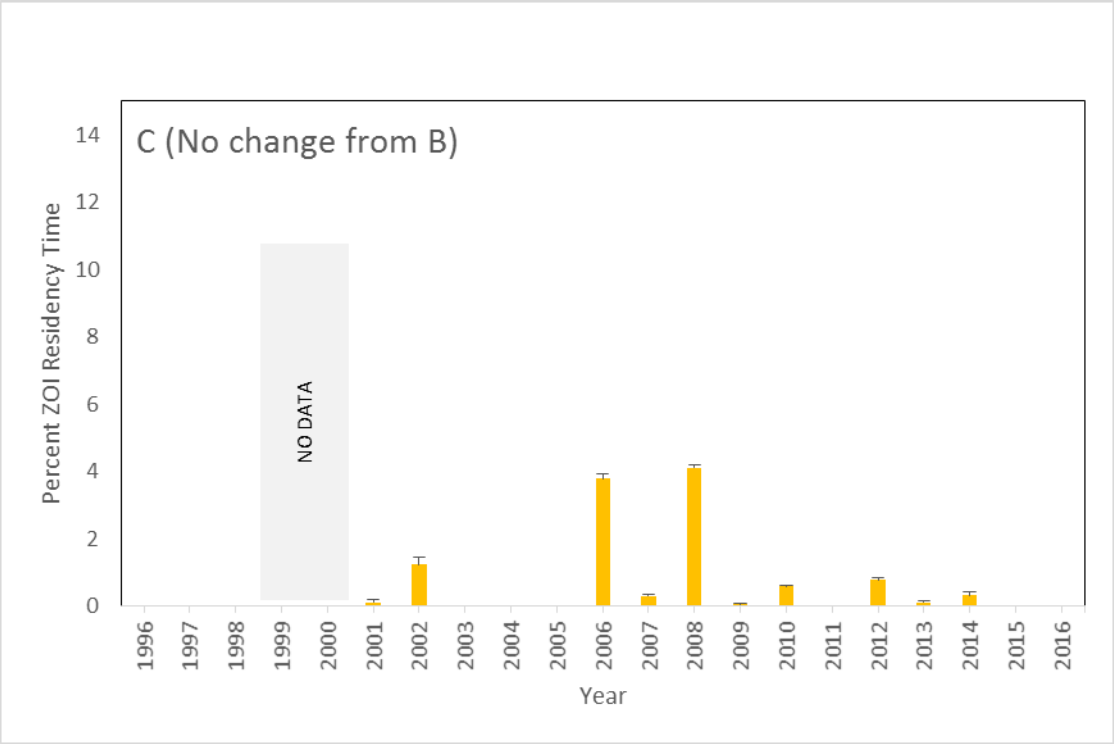
Relative to the Meadowbank Case, the projected average amount of time female caribou spend in ZOIs does not change for the Application Case (Figure 22C).

Simulations with the RFD Case projected that caribou reside in ZOIs for an average of 0.8 days (SD = 1.3) or 0.7% of their time during the fall migration period. No time was spent by female caribou in ZOIs per 115 days in 1996 to 1998, 2004, 2011, 2015, and 2016. When there was interaction with ZOIs, residency time in ZOIs ranged from 0.1% in 2001 and 2013 to 4.8% in 2008 of the fall migration period (Figure 22D).

Figure 22: Temporal Trend in Mean Encounter Rates (± 95% Upper Interval) During Fall migration with Zones of Influence for Female Caribou in the Ahiak Herd from 1996 to 2016 for the Base Case (A), Meadowbank Case (B) Application Case (C), and the Reasonably Foreseeable Development Case (D)






C (No change from B)
Percent ZOI Residency Time
NO DATA
Year
0
2
4
6
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12
14
1996
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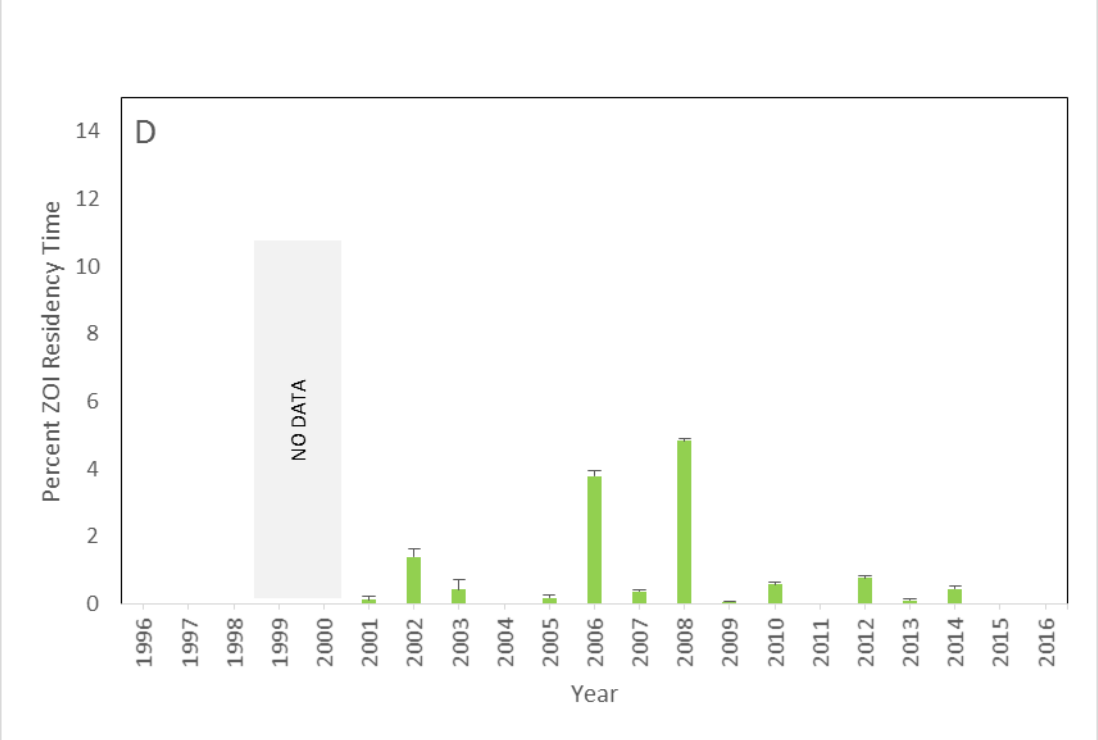
D
Percent ZOI Residency Time
NO DATA
Year
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1996
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Winter

Caribou paths monitored over 18 study years from 1997 to 2016 (no collar data 1999 to 2000) were used to calculate the residency time with ZOIs. The number of collared individuals ranged from two caribou in 2004 and 2016, to 42 caribou in 2009.

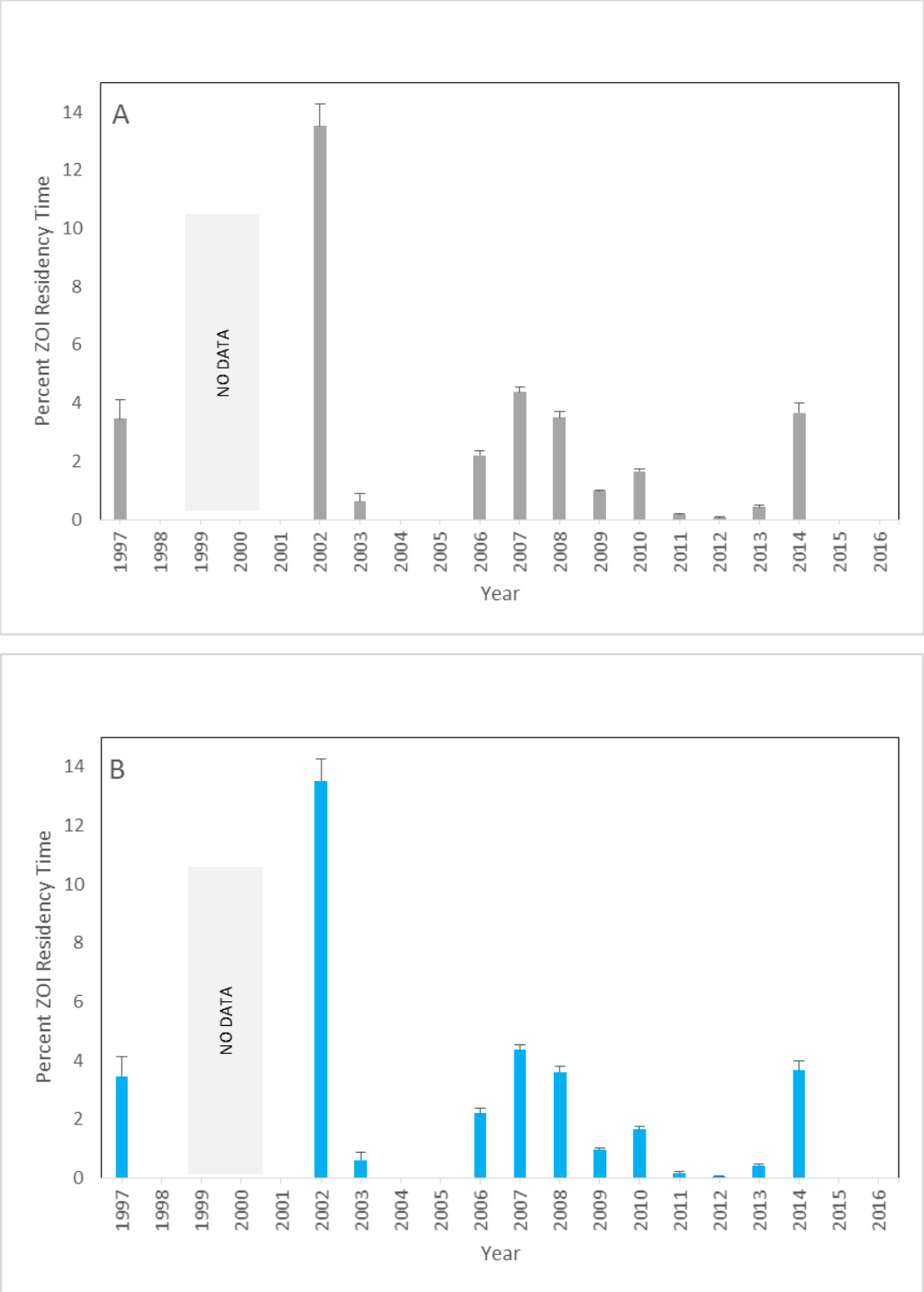
From 1997 to 2016 (Base Case), Ahiak caribou resided in ZOIs for an average of 2.1 days (SD = 3.3 days) or 1.9% of their time during the winter period (n = 248 paths). No time was spent by female caribou in ZOIs during 1998, 2001 to 20045, and during 2015 and 2016. When there was interaction, the amount of time spent by female caribou in ZOIs ranged from 0.2% in 2011 to 13.5% in 2002 (Figure 23A). There was no evidence of a strong declining or increasing temporal trend.

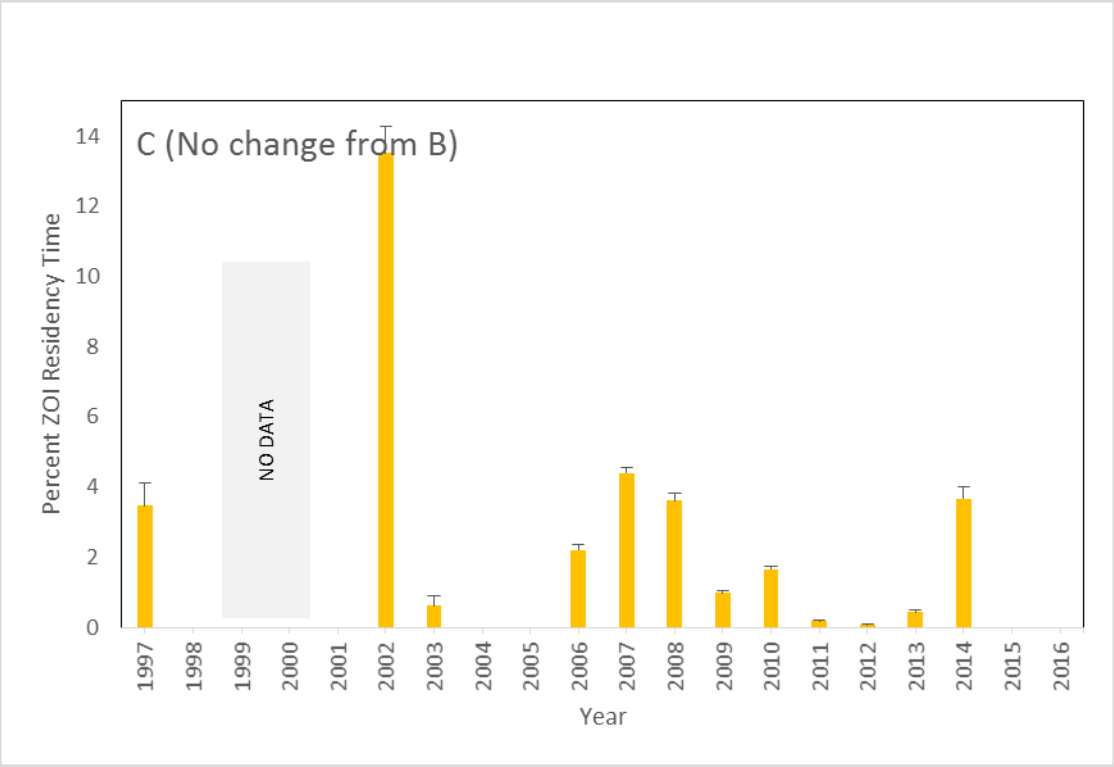
With the addition of the Meadowbank Mine and the AWAR to the winter range, there was no additional time spent in ZOIs for most study years with the exception of 2008 when residency time increased by 0.1 days (or 0.1%) relative to the Base Case (Figure 23B). The overall mean incremental change in residency time was less than 0.1 days (or <0.1%).

Relative to the Meadowbank Case, the average amount of time female caribou spend in ZOIs for the Application Case is projected to not change during the winter period (Figure 23C).

Simulations with the RFD Case projected that caribou reside in ZOIs for an average of 2.4 days (SD = 3.4) or 2.1% of their time during the winter period. No time was spent by female caribou in ZOIs per 110 days in 1998, 2001 to 2005, 2015, and 2016. When there was interaction, residency time in ZOIs ranged from 0.4% in 2012 to 13.5% in 2002 (Figure 23D).

Figure 23: Temporal Trend in Mean Encounter Rates (± 95% Upper Interval) During Winter with Zones of Influence for Female Caribou in the Ahiak Herd from 1997 to 2016 for the Base Case (A), Meadowbank Case (B) Application Case (C), and the Reasonably Foreseeable Development Case (D)




C (No change from B)
Percent ZOI Residency Time
NO DATA
Year
0
2
4
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10
12
14
1997
1998
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2000
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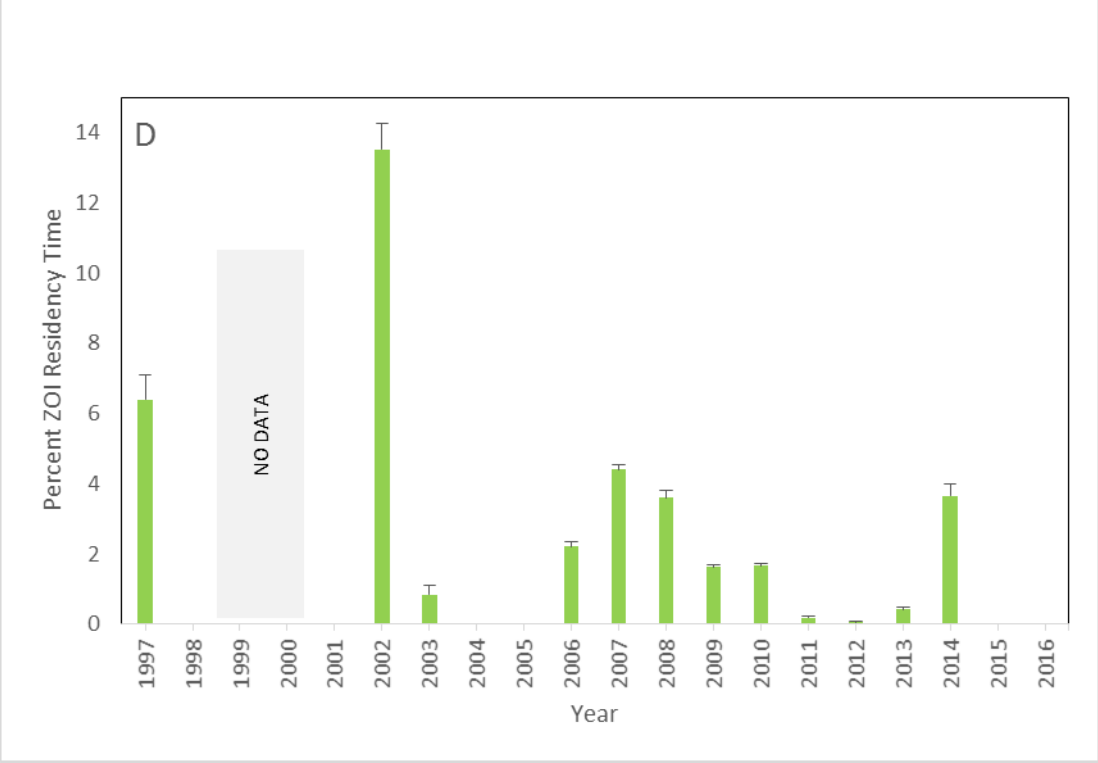
D
Percent ZOI Residency Time
NO DATA
Year
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1997
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2016

3.2.1.2 Beverly Herd

Spring Migration

Caribou paths monitored over 14 study years from 2001 to 2017 (no collar data 2011 to 2013) were used to calculate the residency time within ZOIs. The number of collared individuals ranged from a single caribou in 2001 to 2005, 2007 and 2010 to 44 caribou in 2015.

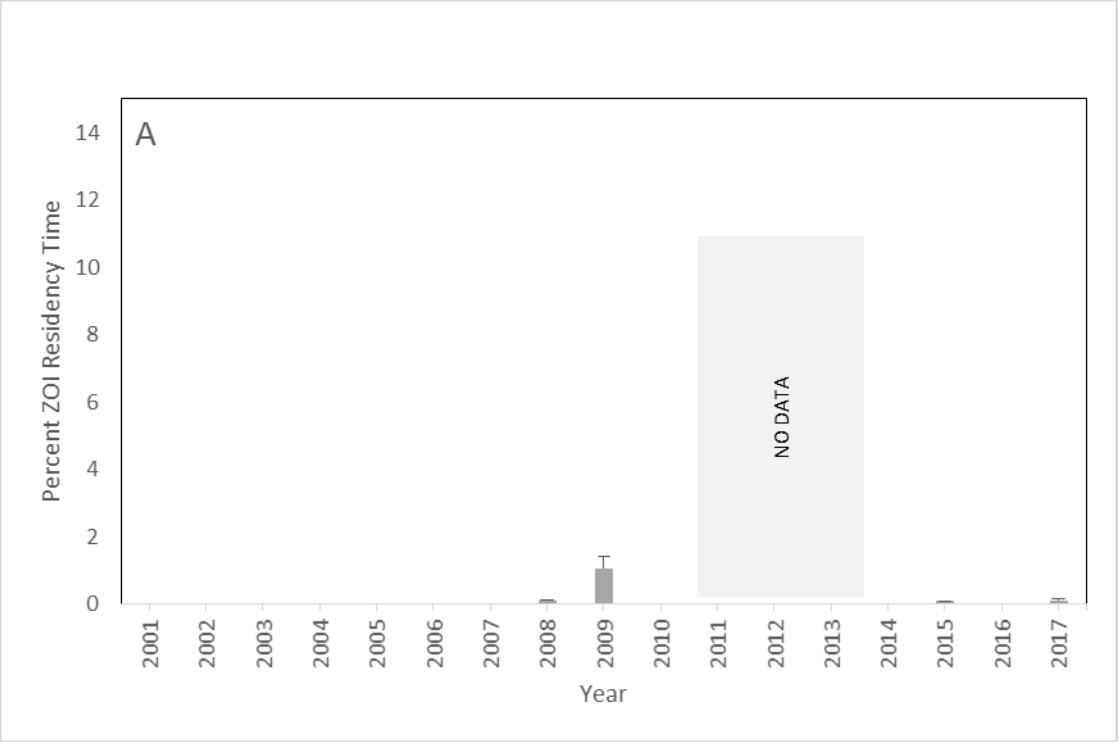
From 2001 to 2017 (Base Case), Beverly caribou resided in ZOIs for an average of less than 0.1 days (SD = 0.3 days) or 0.1% of their time during the spring migration period (n = 177 paths). No time was spent by female caribou in ZOIs during nine of the study years (2001 to 2007, 2010, and 2016). When there was interaction with ZOIs, the amount of time spent by female caribou in ZOIs ranged from less than 0.1% in 2014 to 1.1% in 2009 (Figure 24A). There was no evidence of a declining or increasing temporal trend.

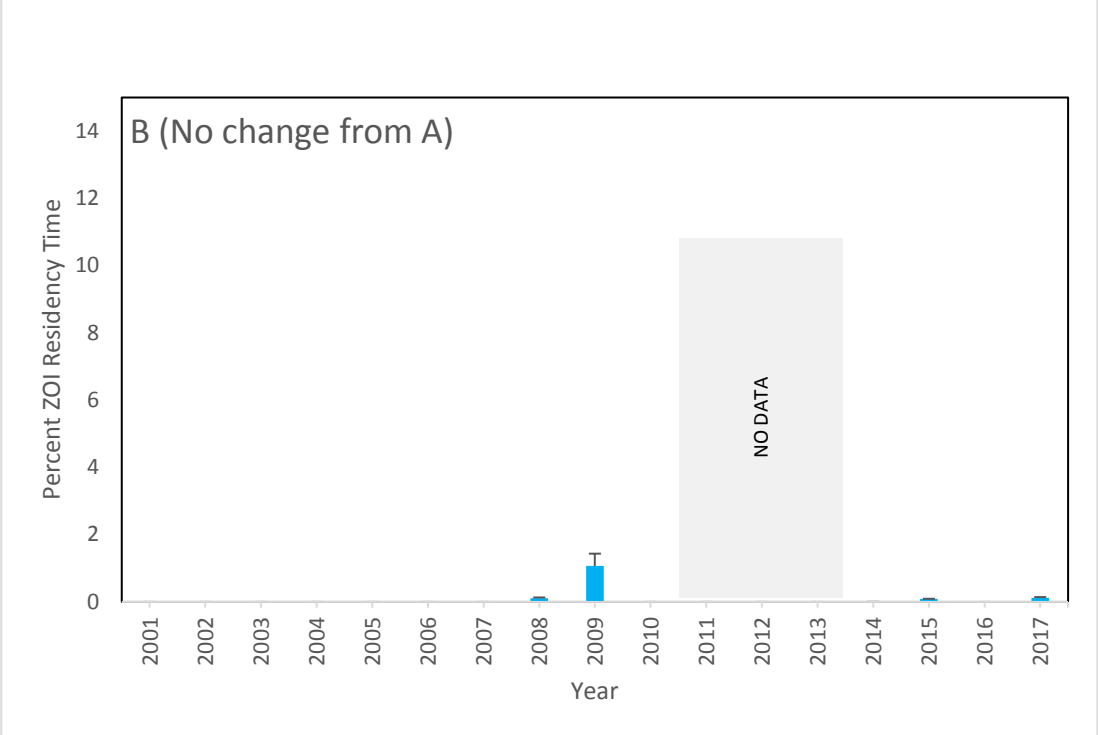
With the addition of the Meadowbank Mine and the AWAR to the spring range, the amount of time spent in ZOIs did not change relative to the Base Case (Figure 24B).

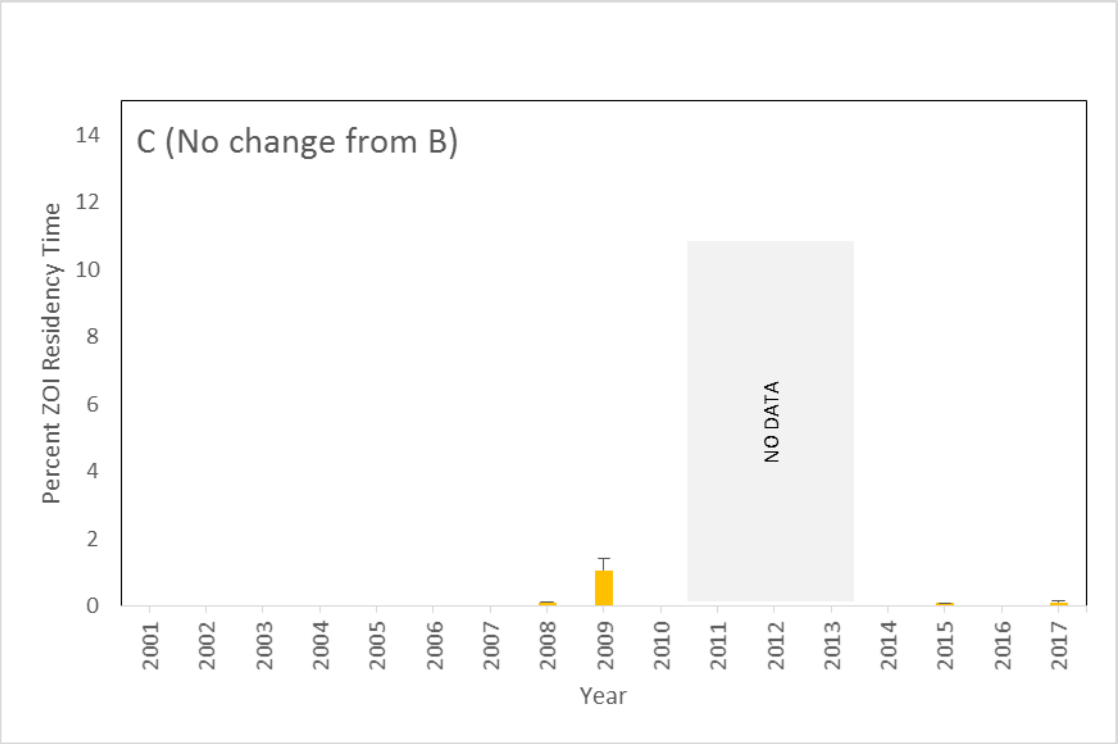
Relative to the Meadowbank Case, the projected average amount of time female caribou spend in ZOIs did not change for the Application Case (Figure 24C).

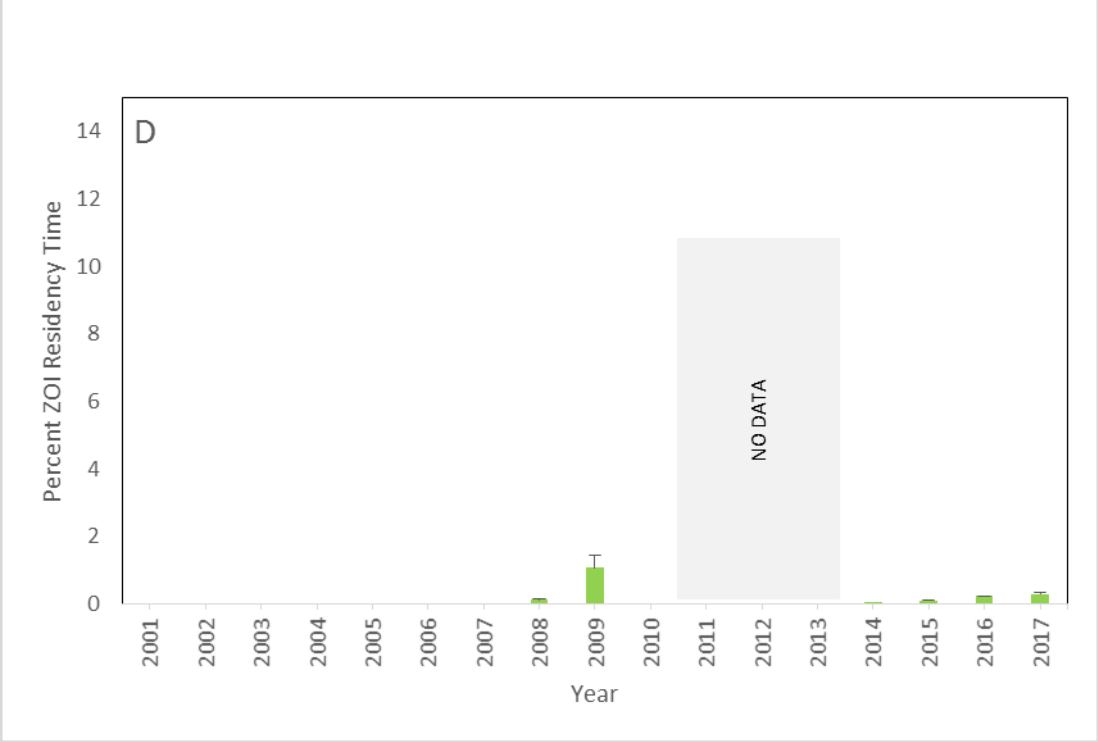
Simulations with the RFD Case projected that caribou may reside in ZOIs for an average of 0.1 days (SD = 0.3) or 0.1% of their time during the spring migration period. No time was spent by female caribou in ZOIs per 56 days in eight of the study years (2001 to 2007, 2010). When there was an interaction, residency time in ZOIs ranged from less than 0.1% in 2014 to 1.1% in 2009 (Figure 24D).

Figure 24: Temporal Trend in Mean Encounter Rates (± 95% Upper Interval) During Spring migration with Zones of Influence for Female Caribou in the Beverly Herd from 2001 to 2017 for the Base Case (A), Meadowbank Case (B) Application Case (C), and the Reasonably Foreseeable Development Case (D)






C (No change from B)
Percent ZOI Residency Time
0
2
4
6
8
10
12
14
NO DATA
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Year


D
Percent ZOI Residency Time
0
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8
10
12
14
NO DATA
2001
2002
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2004
2005
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2007
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2009
2010
2011
2012
2013
2014
2015
2016
2017
Year

Fall Migration

Caribou paths monitored over 11 study years from 2001 to 2016 (no collar data 2005, and 2010 to 2013) were used to calculate the residency time within ZOIs. The number of collared individuals ranged from a single caribou in 2001 to 2004 to 39 caribou in 2015.

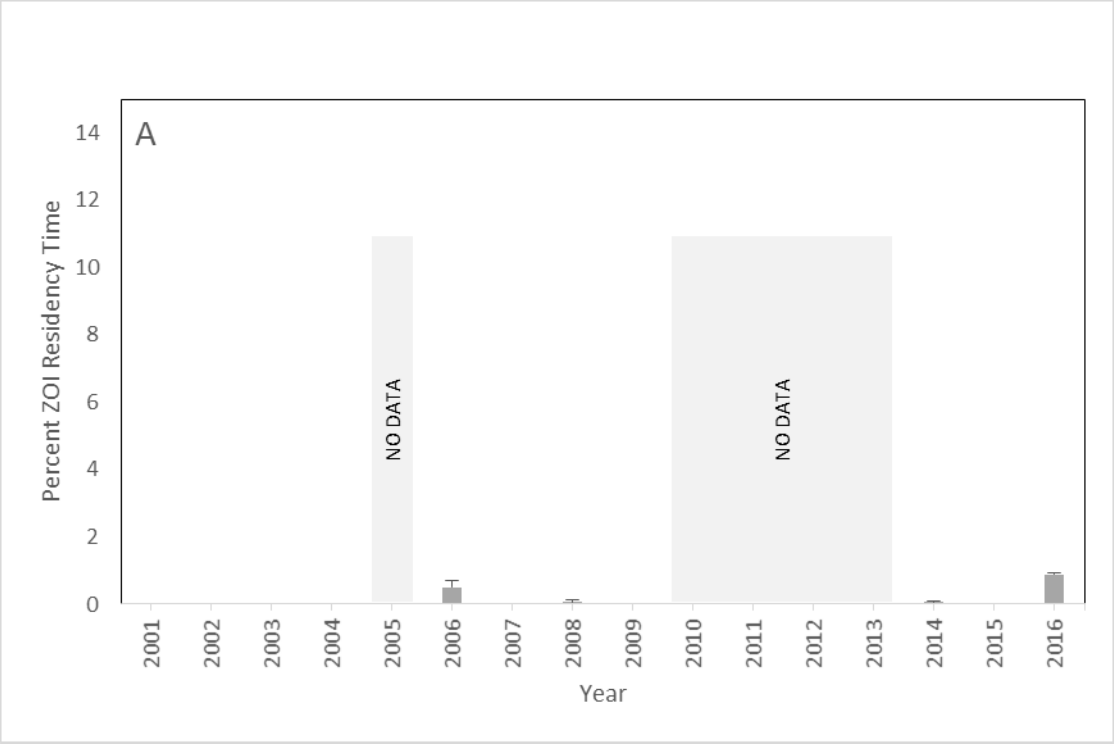
From 2001 to 2016 (Base Case), Beverly caribou resided in ZOIs for an average of 0.2 days (SD = 0.3 days) or 0.1% of their time during the fall migration period (n = 118 paths). No time was spent by female caribou in ZOIs during six of the study years (2001 to 2004, 2007, and 2009). When there was an interaction, the amount of time spent by female caribou in ZOIs ranged from less than 0.01% in 2015 to 0.9% in 2016 (Figure 25A). There was no evidence of a declining or increasing temporal trend.

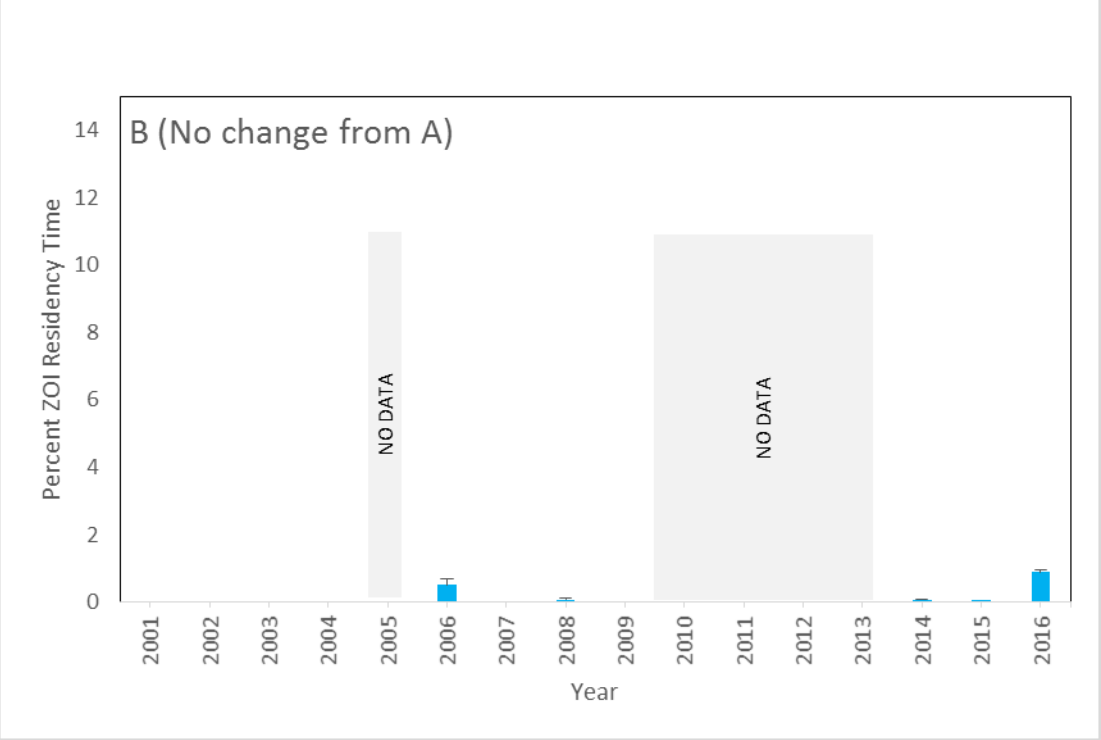
With the addition of the Meadowbank Mine and the AWAR to the fall range, the amount of time spent in ZOIs did not change relative to the Base Case (Figure 25B).

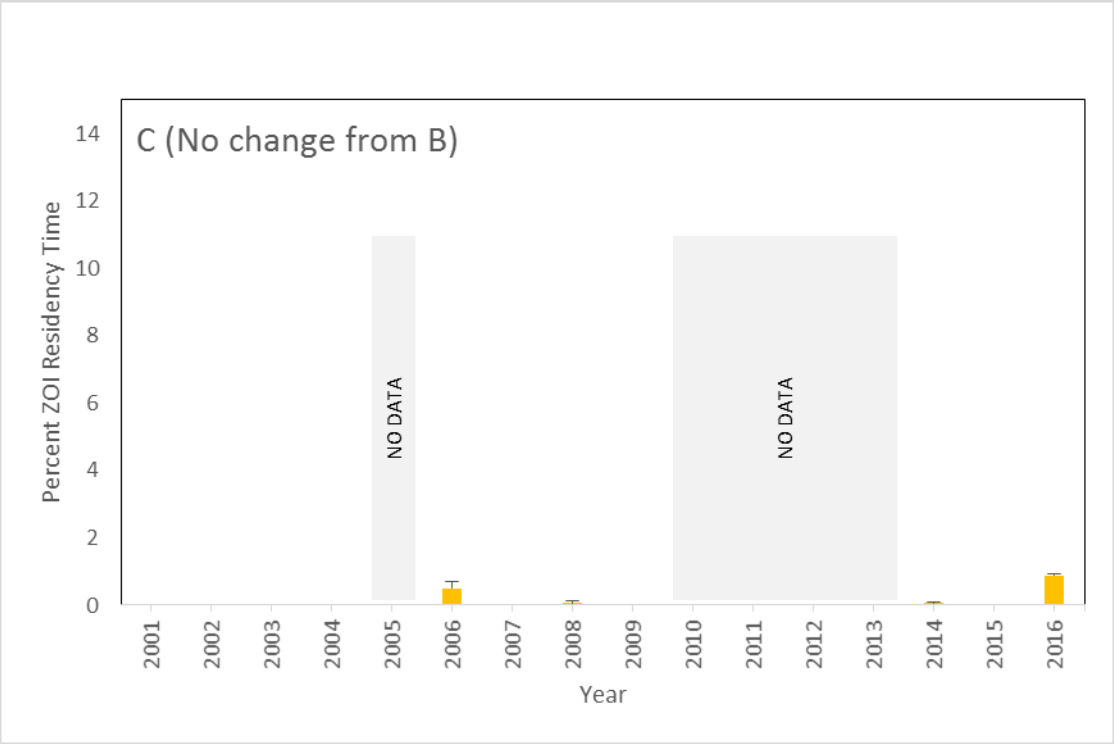
Relative to the Meadowbank Case, the projected average amount of time female caribou spend in ZOIs for the Application Case did not change (Figure 25C).

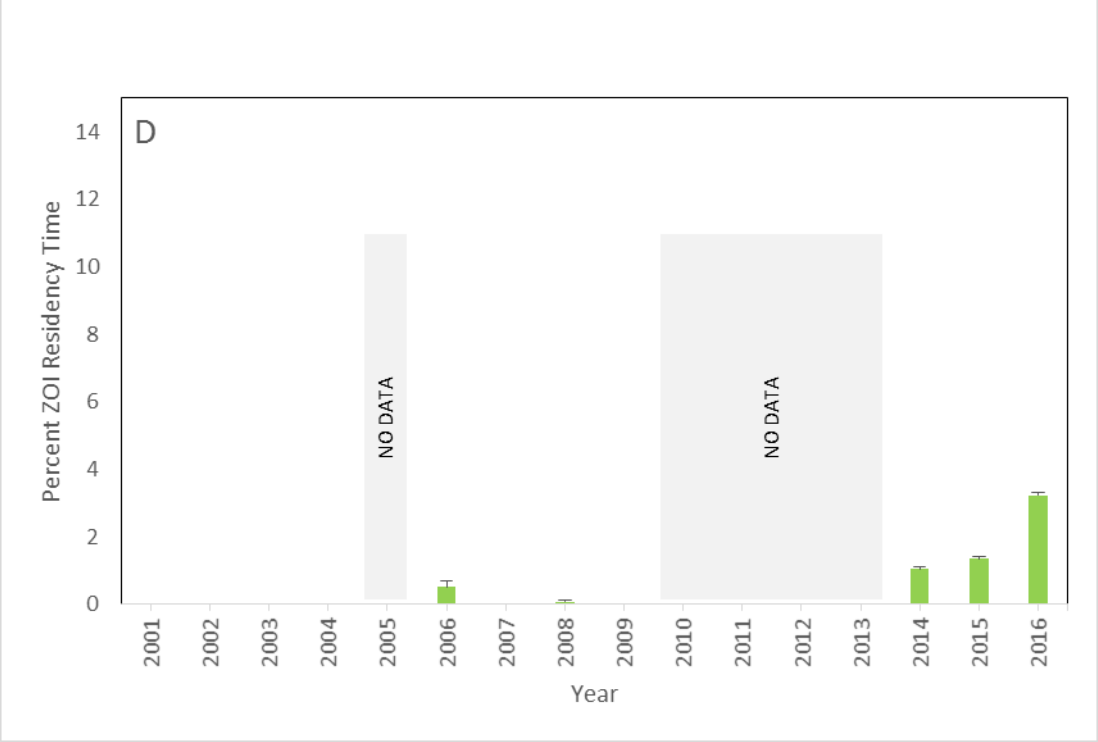
Simulations with the RFD Case projected that caribou reside in ZOIs for an average of 0.7 days (SD = 1.0) or 0.6% of their time during the fall migration period. No time was spent by female caribou in ZOIs per 56 days in six of the study years (2001 to 2004, 2007, and 2009). When there was an interaction, residency time in ZOIs ranged from less than 0.1% in 2008 to 3.2% in 2016 of the fall migration period (Figure 25D).

Figure 25: Temporal Trend in Mean Encounter Rates (± 95% Upper Interval) During Fall migration with Zones of Influence for Female Caribou in the Beverly Herd from 2001 to 2016 for the Base Case (A), Meadowbank Case (B) Application Case (C), and the Reasonably Foreseeable Development Case (D)






C (No change from B)
Percent ZOI Residency Time
0
2
4
6
8
10
12
14
NO DATA
NO DATA
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Year


D
Percent ZOI Residency Time
0
2
4
6
8
10
12
14
NO DATA
NO DATA
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Year

Winter

Caribou paths monitored over 14 study years from 2001 to 2017 (no collar data 2011 to 2013) were used to calculate the residency time within ZOIs. The number of collared individuals ranged from a single caribou in 2001 to 2005 to 45 caribou in 2015.

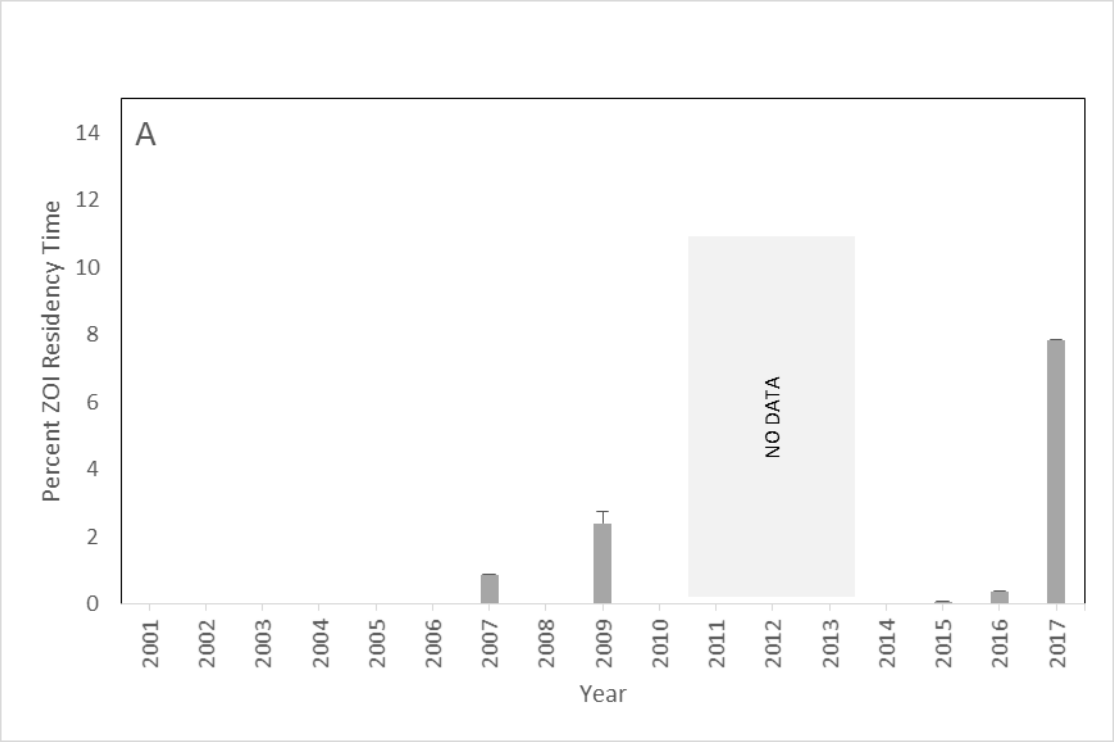
From 2001 to 2017 (Base Case), Beverly caribou resided in ZOIs for an average of 0.9 days (SD = 2.1 days) or 0.8% of their time during the winter period (n = 205 paths). No time was spent by female caribou in ZOIs during eight of the study years (2001 to 2005, 2008, 2010, and 2014). When there as an interaction, the amount of time spent by female caribou in ZOIs ranged from 0.08% in 2015 to 7.8% in 2017 (Figure 26A). Although there was no evidence of a strong declining or increasing temporal trend, residency time peaked in 2017 at 7.8%.

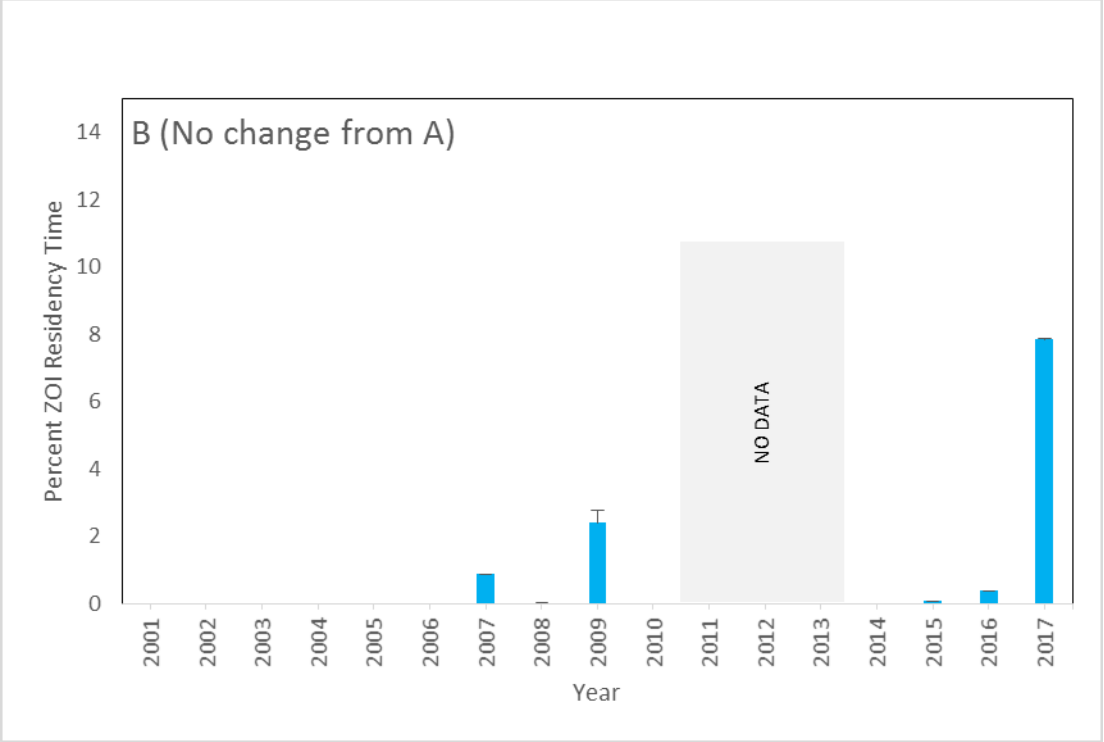
With the addition of the Meadowbank Mine and the AWAR to the winter range, the amount of time spent in ZOIs is predicted to not change relative to the Base Case (Figure 26B).

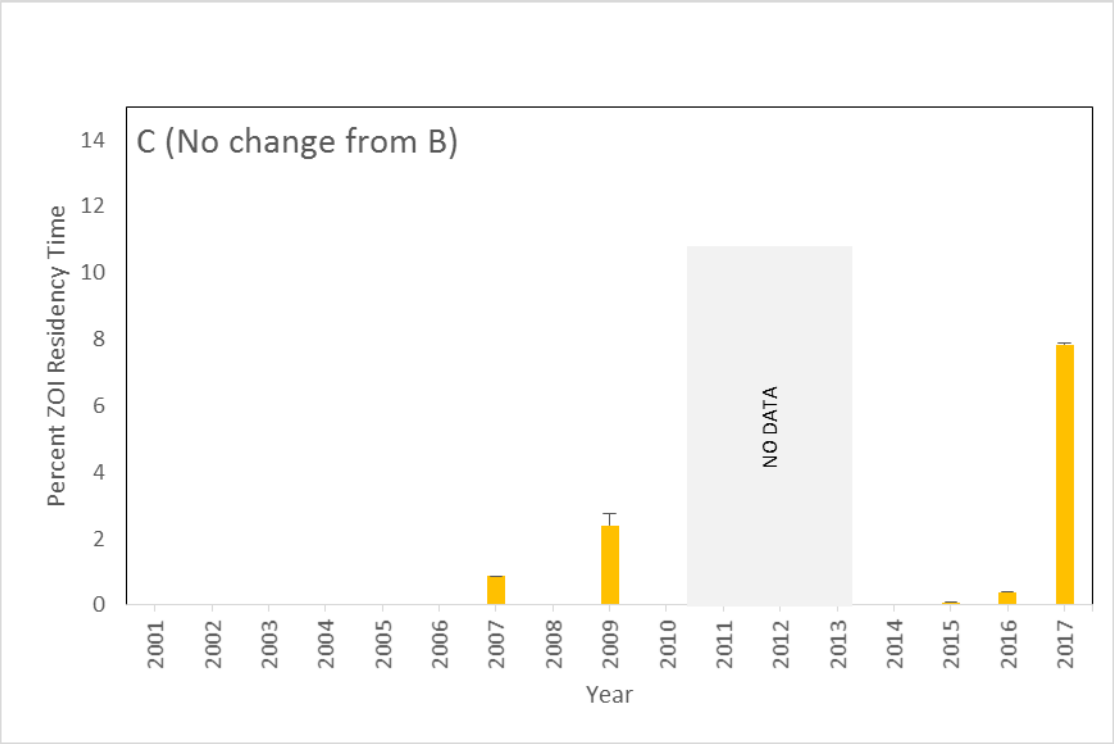
Relative to the Meadowbank Case, the projected average amount of time female caribou spend in ZOIs for the Application Case did not change (Figure 26C).

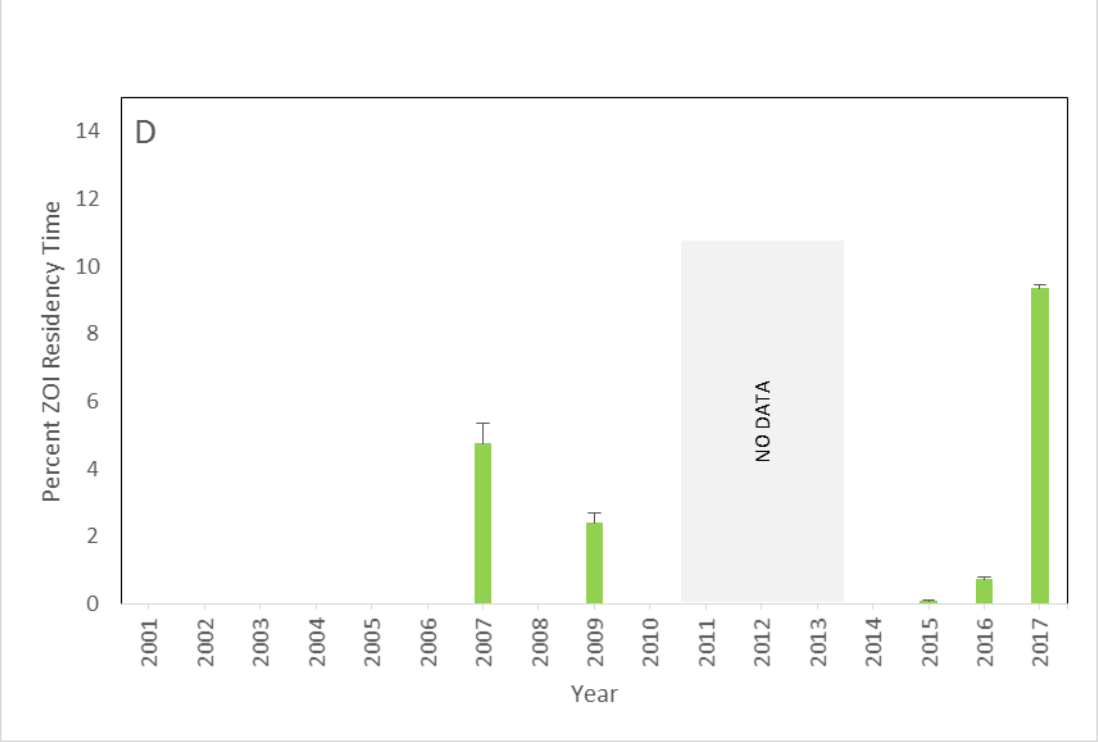
Simulations with the RFD Case projected that caribou reside in ZOIs for an average of 1.4 days (SD = 2.7) or 1.2% of their time during the winter period. No time was spent by female caribou in ZOIs per 114 days in eight of the study years (2001 to 2005, 2008, 2010, and 2014). When there was an interaction, residency time in ZOIs ranged from 0.08% in 2015 to 9.3% in 2017 (Figure 26D).

Figure 26: Temporal Trend in Mean Encounter Rates (± 95% Upper Interval) During Winter with Zones of Influence for Female Caribou in the Beverly Herd from 2001 to 2017 for the Base Case (A), Meadowbank Case (B) Application Case (C), and the Reasonably Foreseeable Development Case (D)






C (No change from B)
Percent ZOI Residency Time
0
2
4
6
8
10
12
14
NO DATA
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Year


D
Percent ZOI Residency Time
0
2
4
6
8
10
12
14
NO DATA
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Year

3.2.1.3 Lorillard Herd

Spring Migration

Caribou paths monitored over 16 study years from 1998 to 2017 (no collar data 2007 to 2010) were used to calculate the residency time within ZOIs. The number of collared individuals ranged from two caribou in 1998 and 2006 to 15 caribou in 2016.

From 1998 to 2017 (Base Case), Lorillard caribou resided in ZOIs for an average of 0.1 days (SD = 0.5 days) or 0.2% of their time during the spring migration period (n = 126 paths). No time was spent by female caribou in ZOIs during 1998 to 2002, 2012 to 2014, and 2016 to 2017. When there was an interaction, the amount of time spent by female caribou in ZOIs ranged from 0.1% in 2005 to 2.0% in 2006 (Figure 27A). There was no evidence of a declining or increasing temporal trend for the Base Case.

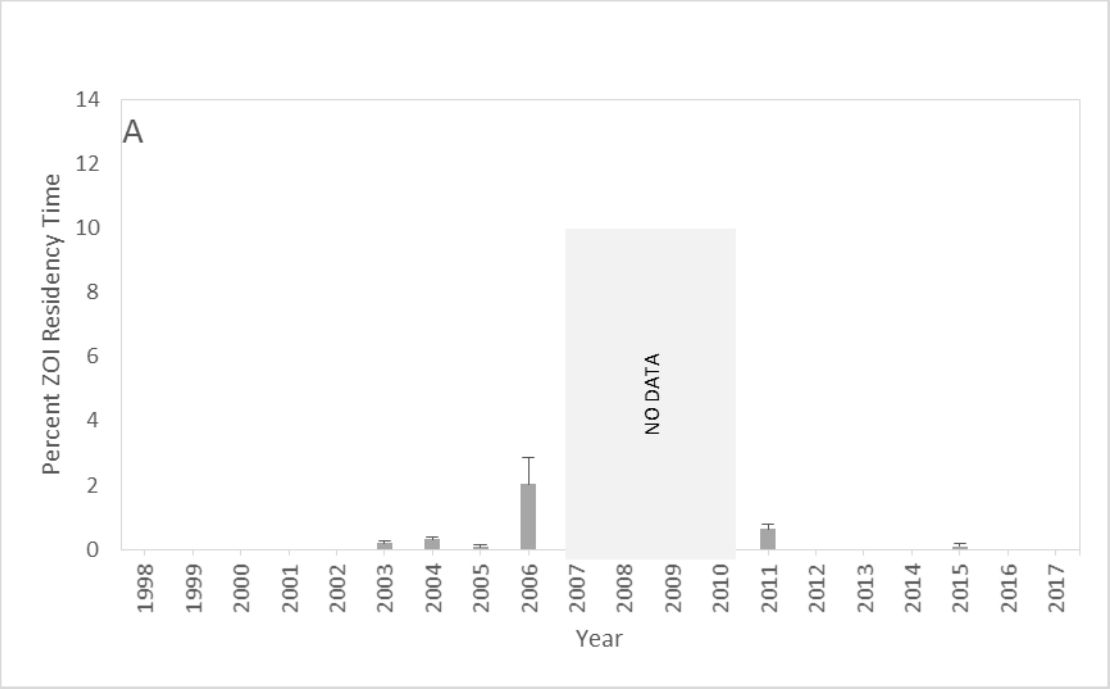
With the addition of the Meadowbank Mine and the AWAR to the spring range, the amount of time spent in ZOIs ranged from no change for 1998 to 2006, and 2017, to 3.6 additional days (or 6.8%) in 2011 per 53 days relative to the Base Case (Figure 27B). The overall mean incremental change in residency time was 0.6 days (or 1.1%) for the Meadowbank Case.

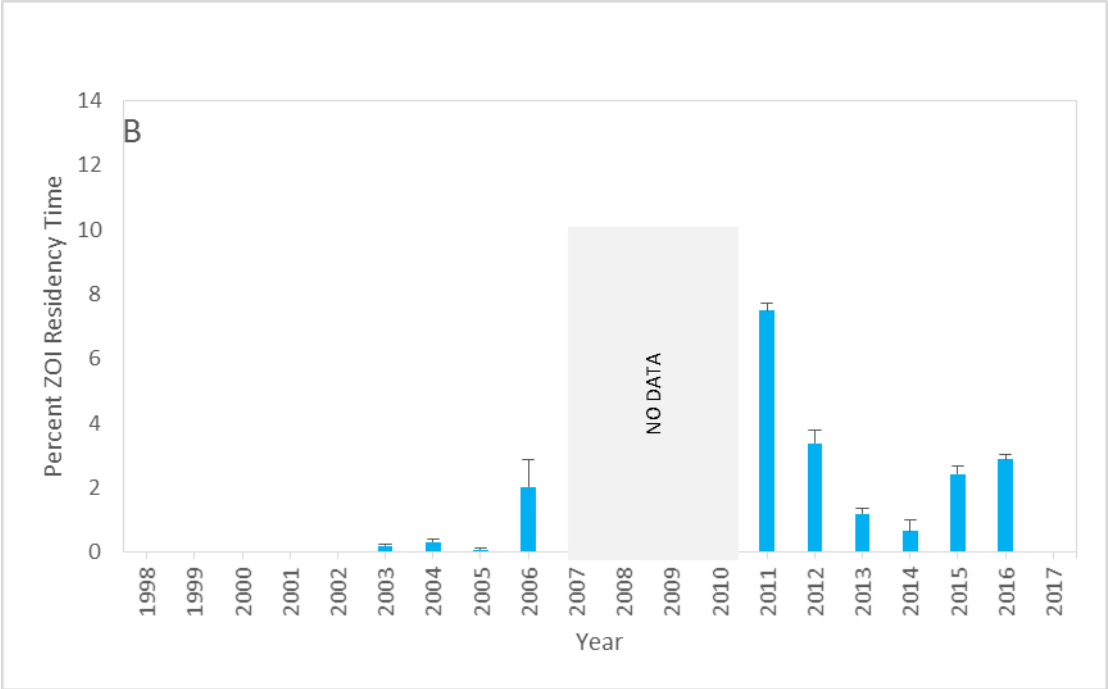
Relative to the Meadowbank Case, there were no incremental changes in projected residency times for 1998 to 2004, 2006, 2011, and 2015 to 2017 for the Application Case. Maximum incremental change was 0.8 days or 1.6% in 2014. The overall average amount of time female caribou spend in ZOIs is projected to increase by 0.2 days (or 0.4%) during the spring migration period for the Application Case (Figure 27C).

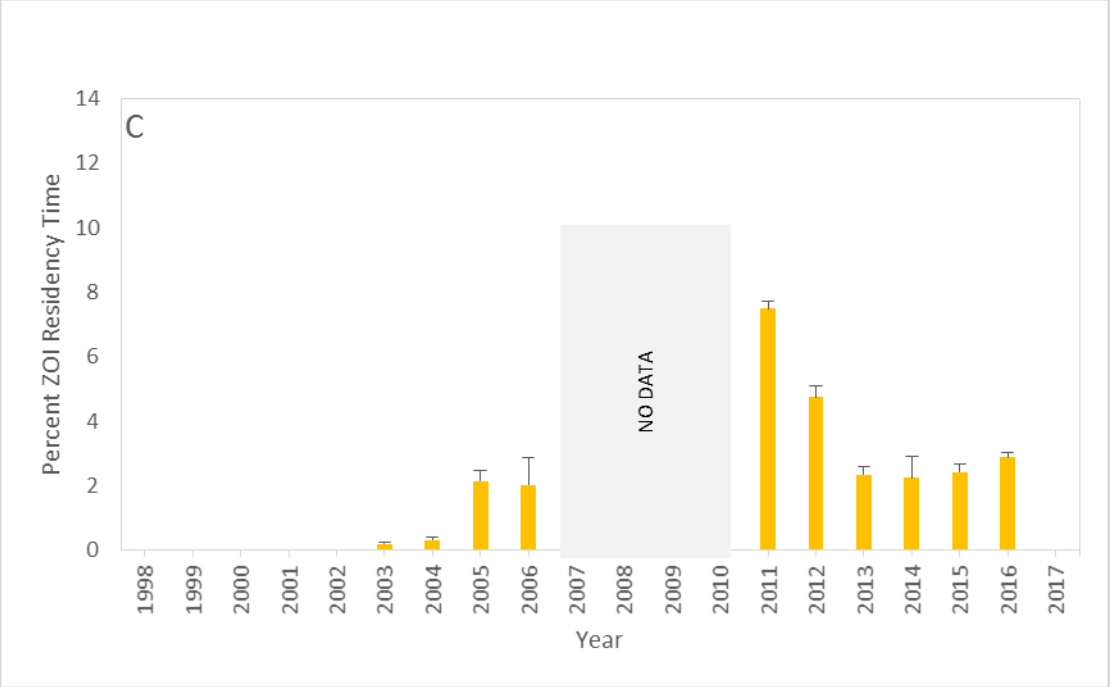
Simulations with the RFD Case projected that caribou reside in ZOIs for an average of 0.9 days (SD = 2.1) or 1.7% of their time during the spring migration period. No time was spent by female caribou in ZOIs per 53 days in 1998 to 2002, and in 2017. When there was an interaction, residency time in ZOIs ranged from 0.2% in 2003 to 7.5% in 2011 (Figure 27D).

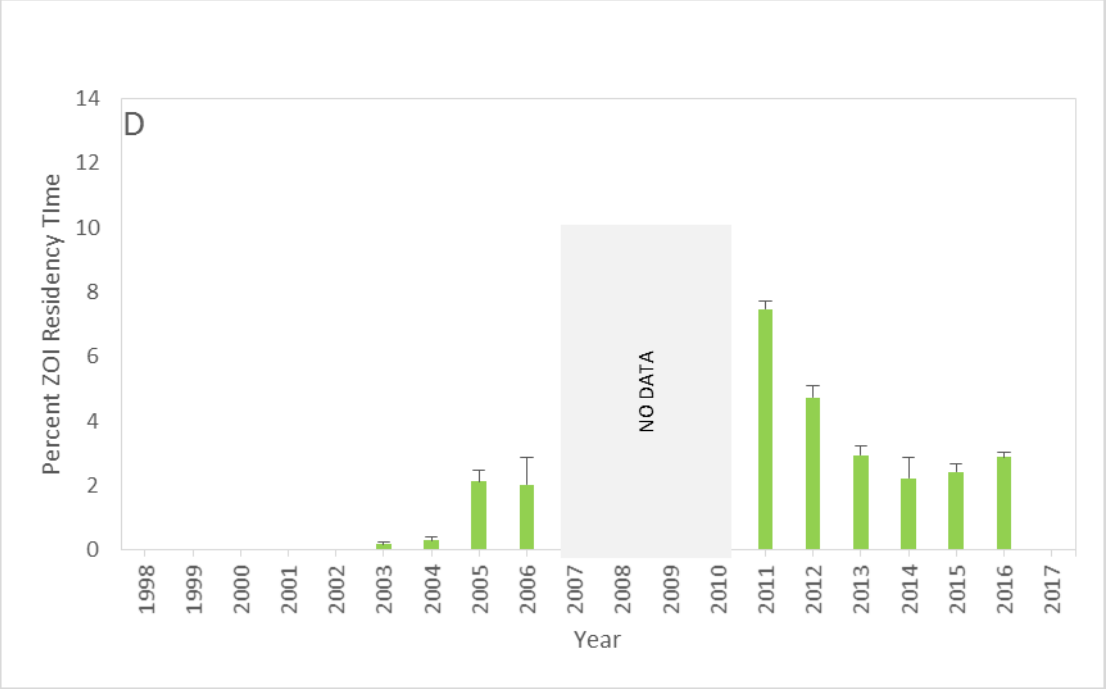
Important to note that results for the Meadowbank, Application and RFD simulations showed an increasing trend in residency time over time. For example, there were higher residency times for the period of 2011 to 2017 (mean = 3.2%) versus 1998 to 2006 (mean = 0.5%) for the Application case.

Figure 27: Temporal Trend in Mean Encounter Rates (± 95% Upper Interval) During Spring migration with Zones of Influence for Female Caribou in the Lorillard Herd from 1998 to 2017 for the Base Case (A), Meadowbank Case (B) Application Case (C), and the Reasonably Foreseeable Development Case (D)






C
Percent ZOI Residency Time
0
2
4
6
8
10
12
14
NO DATA
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Year


D
Percent ZOI Residency TIme
0
2
4
6
8
10
12
14
NO DATA
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Year

Fall Migration

Caribou paths monitored over 14 study years from 1998 to 2016 (no collar data 2006 to 2010) were used to calculate the residency time within ZOIs. The number of collared individuals ranged from two caribou in 1998 and 2014 to 12 caribou in 2003 and 2016.

From 1998 to 2016 (Base Case), Lorillard caribou resided in ZOIs for an average of 0.5 days (SD = 1.3 days) or 0.5% of their time during the fall migration period (n = 97 paths). No time was spent by female caribou in ZOIs during 1998 to 2002, 2005, and 2013 to 2014. When there was an interaction, the amount of time spent by female caribou in ZOIs has ranged from 0.04% in 2011 to 4.9% in 2012 (Figure 28A). There was no evidence of a declining or increasing temporal trend.

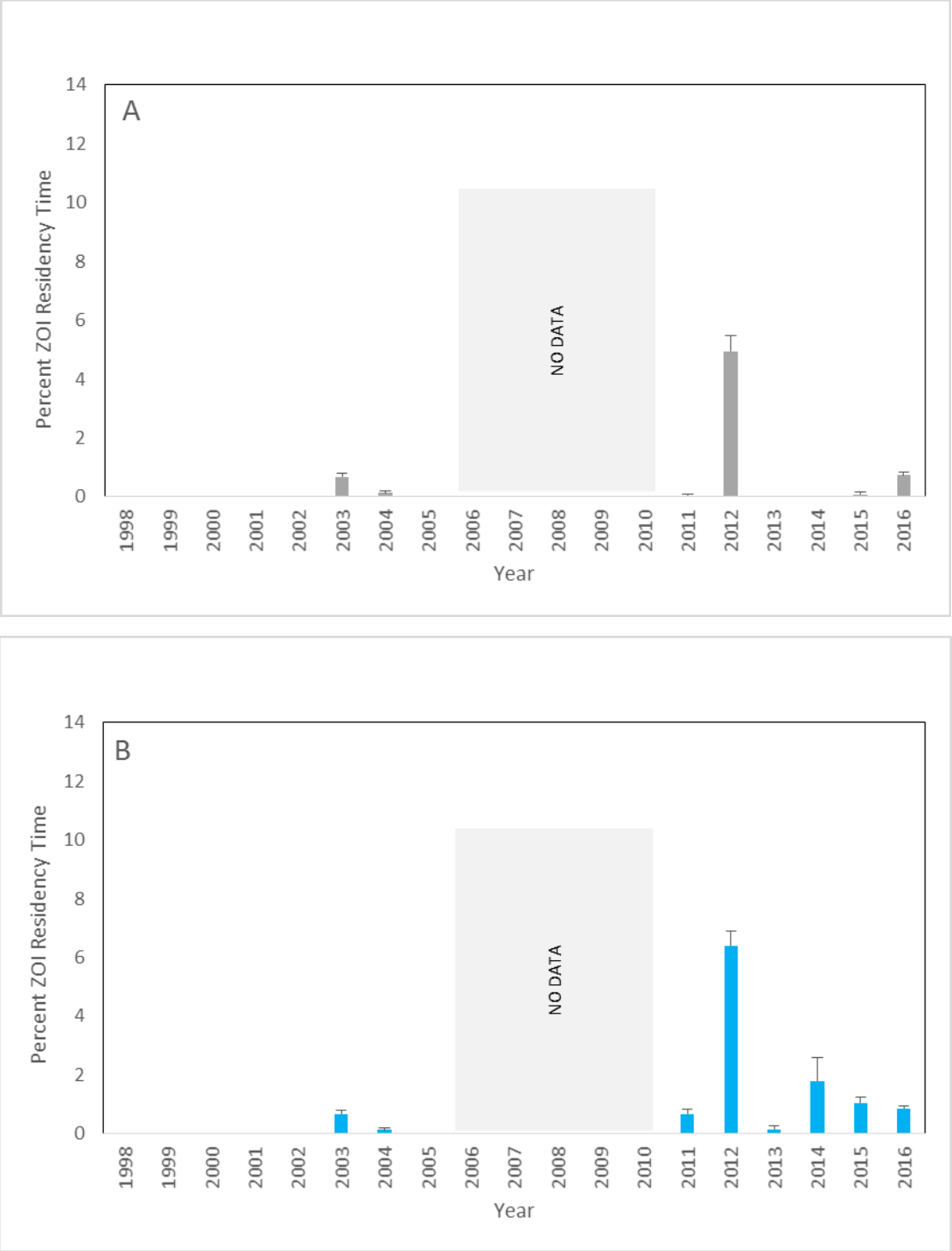
With the addition of the Meadowbank Mine and the AWAR to the winter range, the amount of time spent in ZOIs ranged from no change from 1998 to 2005 to 2.1 additional days (or 1.8%) in 2014 per 115 days relative to the Base Case (Figure 28B). The overall mean incremental change was 0.4 days (or 0.4%)

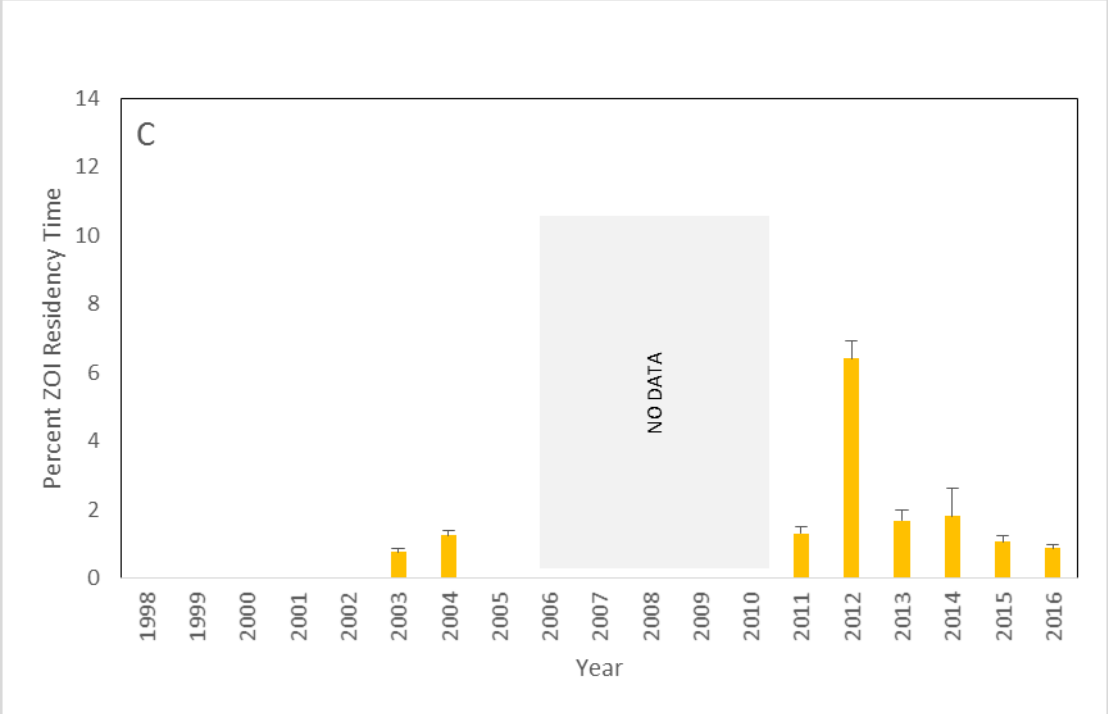
Relative to the Meadowbank Case, the incremental change in residency time for the Application Case ranged from no change for 1998 to 2002, 2005, 2012, and 2014 to 2016, to 1.8 additional days (or 1.5%) in 2013. The overall average amount of time female caribou spend in ZOIs is projected to increase by 0.3 days or 0.2% during the fall migration period for the Application Case (Figure 28C).

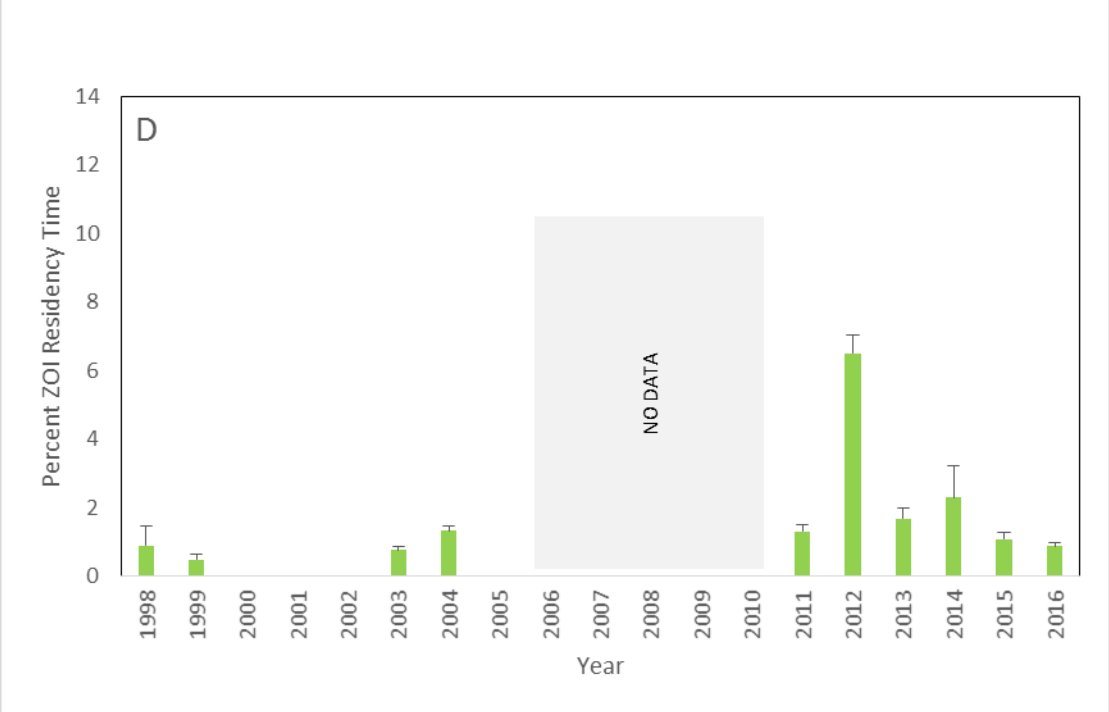
Important to note that results for the Meadowbank and Application case simulations showed an increasing trend over time, and that temporal trends for the Application case were marginally stronger. There were higher residency times for the period of 2011 to 2017 (mean = 2.2%) versus 1998 to 2006 (mean = 0.3%) for the Application case.

Simulations with the RFD Case projected that caribou reside in ZOIs for an average of 1.4 days (SD = 1.7) or 1.2% of their time during the fall migration period. No time was spent by female caribou in ZOIs per 115 days in 2000 to 2002, and 2005. When there was an interaction, residency time in ZOIs ranged from 0.4% in 1999 to 6.5% in 2012 (Figure 28D).

Figure 28: Temporal Trend in Mean Encounter Rates (± 95% Upper Interval) During Fall migration with Zones of Influence for Female Caribou in the Lorillard Herd from 1998 to 2016 for the Base Case (A), Meadowbank Case (B) Application Case (C), and the Reasonably Foreseeable Development Case (D)




C
Percent ZOI Residency Time
0
2
4
6
8
10
12
14
NO DATA
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Year


D
Percent ZOI Residency Time
0
2
4
6
8
10
12
14
NO DATA
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Year

Winter

Caribou paths monitored over 15 study years from 1998 to 2017 (no collar data 2007 to 2011) were used to calculate the residency time in ZOIs. The number of collared individuals ranged from a single caribou in 1998, to 12 caribou in 2004 and 2017.

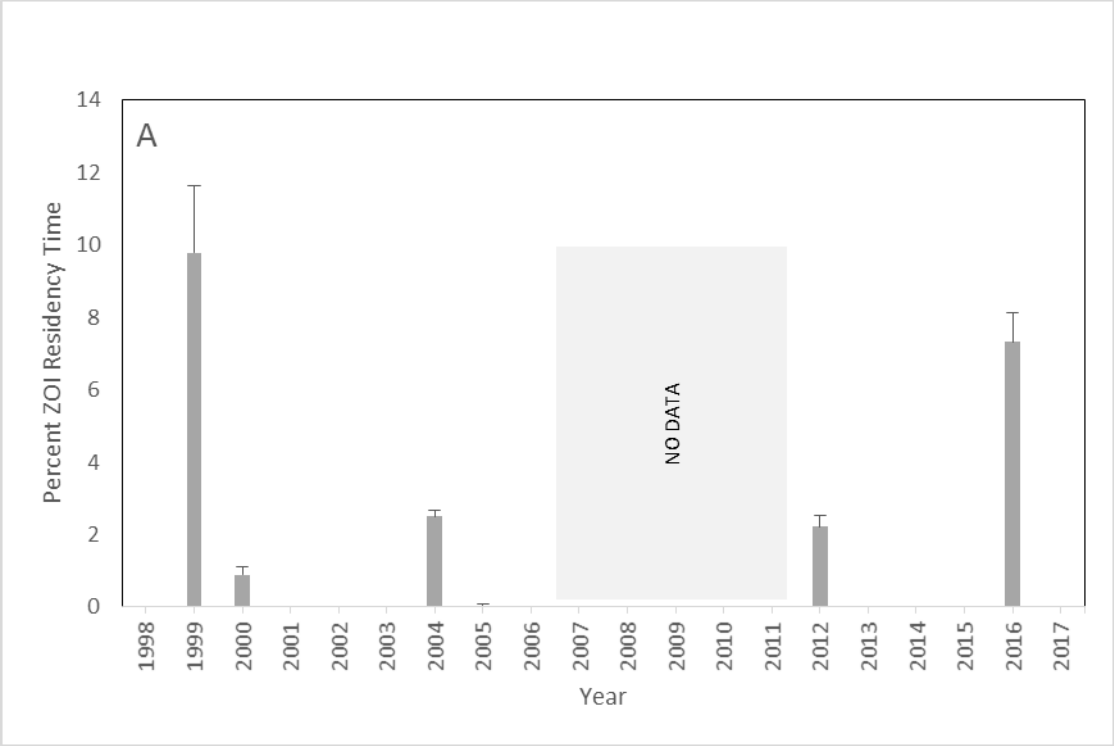
From 1998 to 2017 (Base Case), Lorillard caribou resided in ZOIs for an average of 1.7 days (SD = 3.0 days) or 1.5% of their time during the winter period (n = 96 paths). No time was spent by female caribou in ZOIs during 1998, 2001 to 2003, 2006, 2013 to 2015, and 2017. When there was an interaction, the amount of time spent by female caribou in ZOIs ranged from less than 0.1% in 2005 to 9.8% in 1999 (Figure 29A). There was no evidence of a declining or increasing temporal trend.

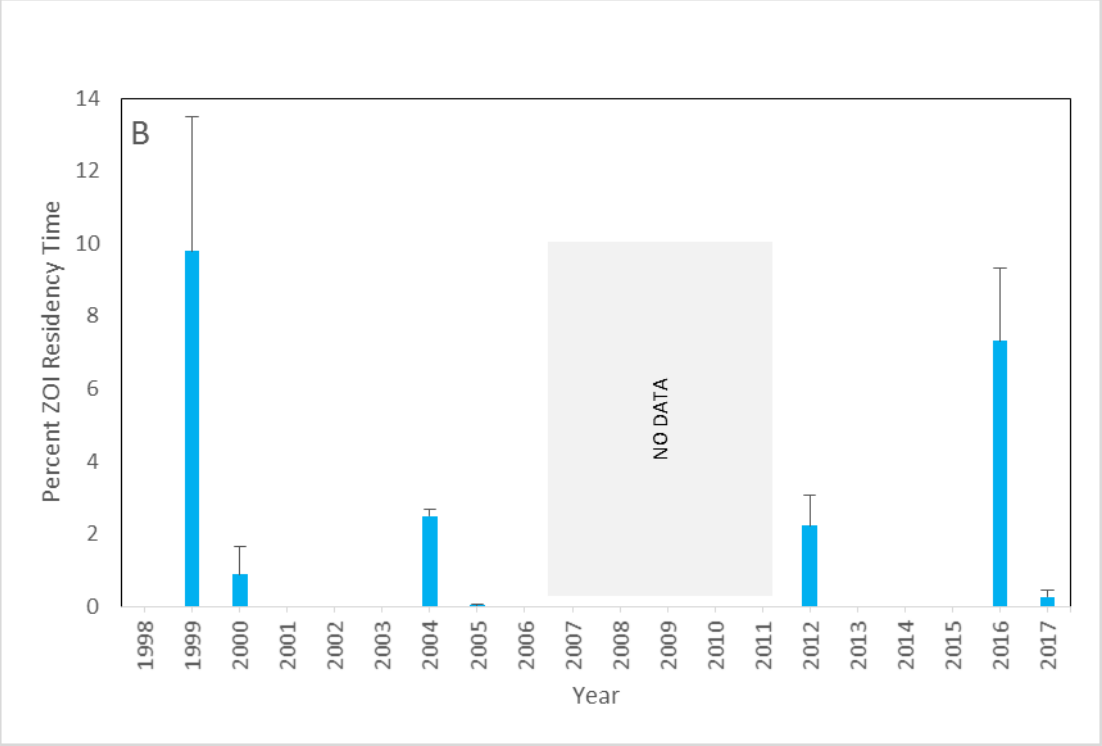
With the addition of the Meadowbank Mine and the AWAR to the winter range, the amount of time spent in ZOIs ranged from no change for 1998 to 2006, and 2012 to 2016, to 0.3 additional days (or 0.3%) in 2017 per 109 days relative to the Base Case (Figure 29B). The overall mean incremental change in residency time was less than 0.1 days (or <0.1%) for the Meadowbank Case.

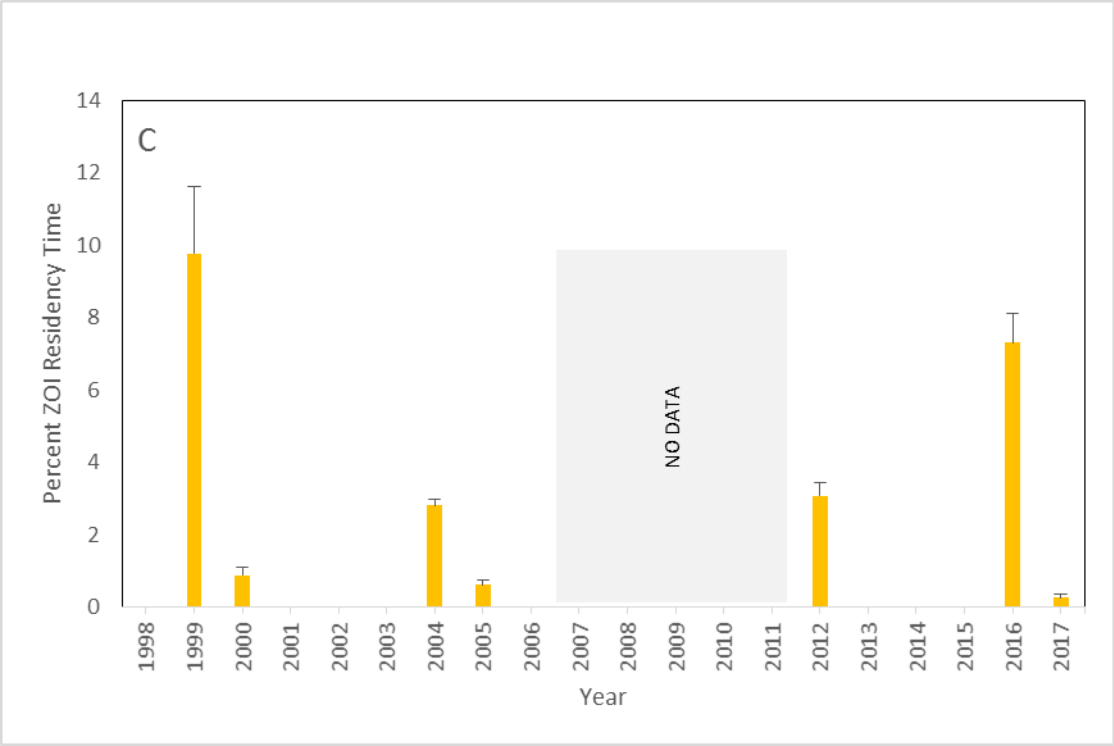
Relative to the Meadowbank Case, there were no incremental changes in residency time for 1998 to 2003, 2006, and 2013 to 2017 for the Application Case. Maximum incremental change on the winter range was 0.9 days (or 0.9%) in 2012 for the Application Case. The overall average amount of time female caribou spend in ZOIs is projected to increase by 0.1 days or 0.1% during the winter period for the Application Case (Figure 29C).

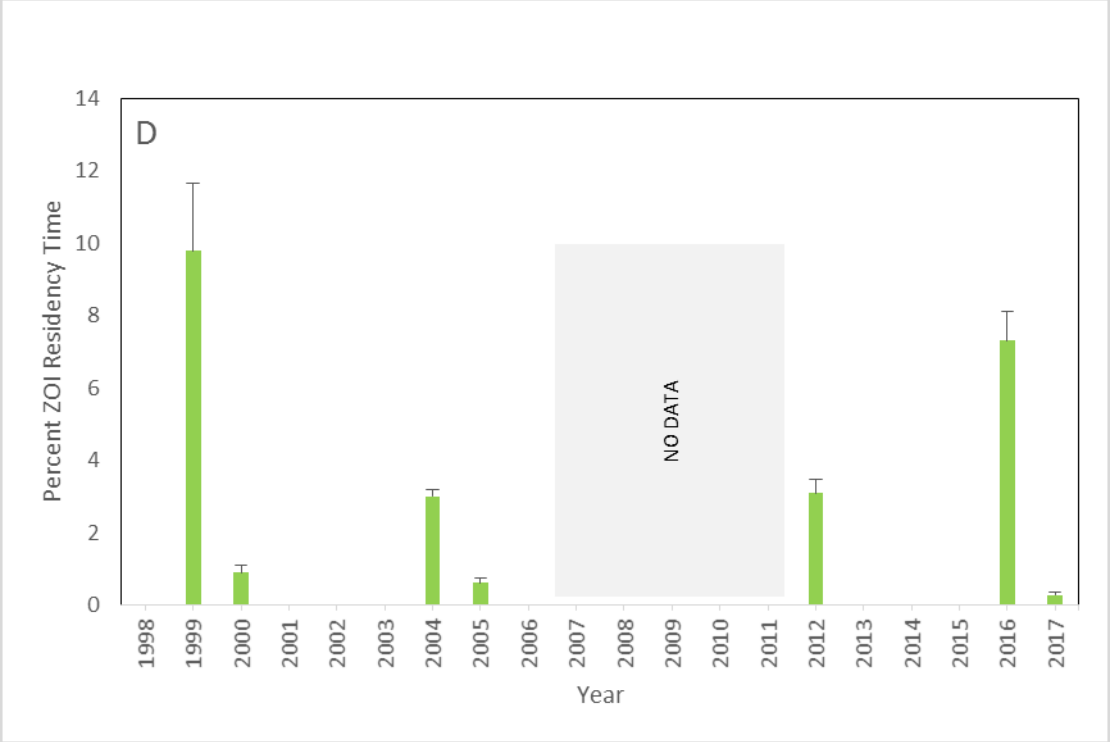
Simulations for the RFD Case projected that caribou reside in ZOIs for an average of 1.8 days (SD = 3.0) or 1.7% of their time during the winter period. No time was spent by female caribou in ZOIs per 109 days in 1998, 2001 to 2003, 2006, and 2013 to 2015. When there was an interaction, residency time in ZOIs ranged from 0.3% in 2017 to 9.8% in 1999 (Figure 29D).

Figure 29: Temporal Trend in Mean Residency Time (± 95% Upper Interval) During Winter with Zones of Influence for Female Caribou in the Lorillard Herd from 1998 to 2017 for the Base Case (A), Meadowbank Case (B) Application Case (C), and the Reasonably Foreseeable Development Case (D)






C
Percent ZOI Residency Time
0
2
4
6
8
10
12
14
NO DATA
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Year


D
Percent ZOI Residency Time
0
2
4
6
8
10
12
14
NO DATA
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Year

3.2.1.4 Wager Bay Herd

Spring Migration

Caribou paths monitored over 14 study years from 1999 to 2017 (no collar data 2007 to 2009, 2013, and 2014) were used to calculate the residency time within ZOIs. The number of collared individuals ranged from a single caribou in 1999, 2010, and 2012 to 12 caribou in 2003.

From 1999 to 2017 (Base Case), Wager Bay caribou resided in ZOIs for an average of 0.3 days (SD = 0.6 days) or 0.5% of their time during the spring migration period (n = 62 paths). No time was spent by female caribou in ZOIs during 1999, 2012, and 2015 to 2017. When there was an interaction, the amount of time spent by female caribou in ZOIs ranged from less than 0.1% in 2001 to 1.7% in 2010 (Figure 30A). There was no evidence of a strong declining or increasing temporal trend.

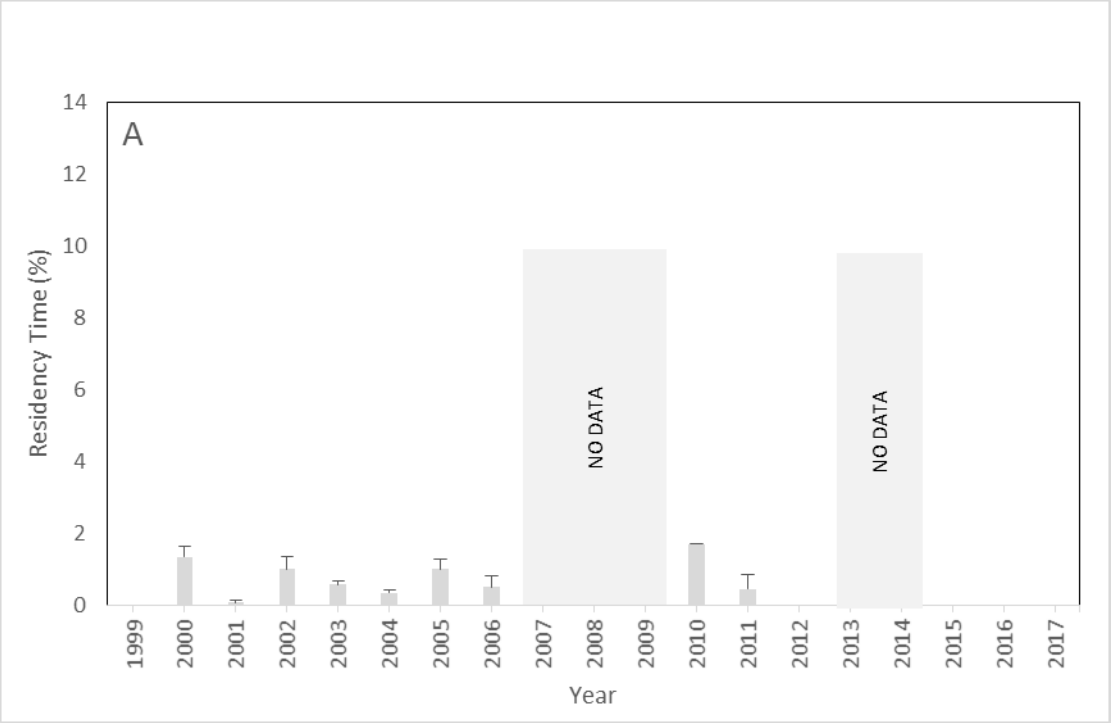
With the addition of the Meadowbank Mine and the AWAR to the spring range, the amount of time spent in ZOIs ranged from no change for 1999 to 2006, 2010 to 2012, and 2017, to 6.3 additional days (or 10.8%) in 2015 per 58 days relative to the Base Case (Figure 30B). The overall mean incremental change in residency time was 0.9% (0.5 days) for the Meadowbank Case.

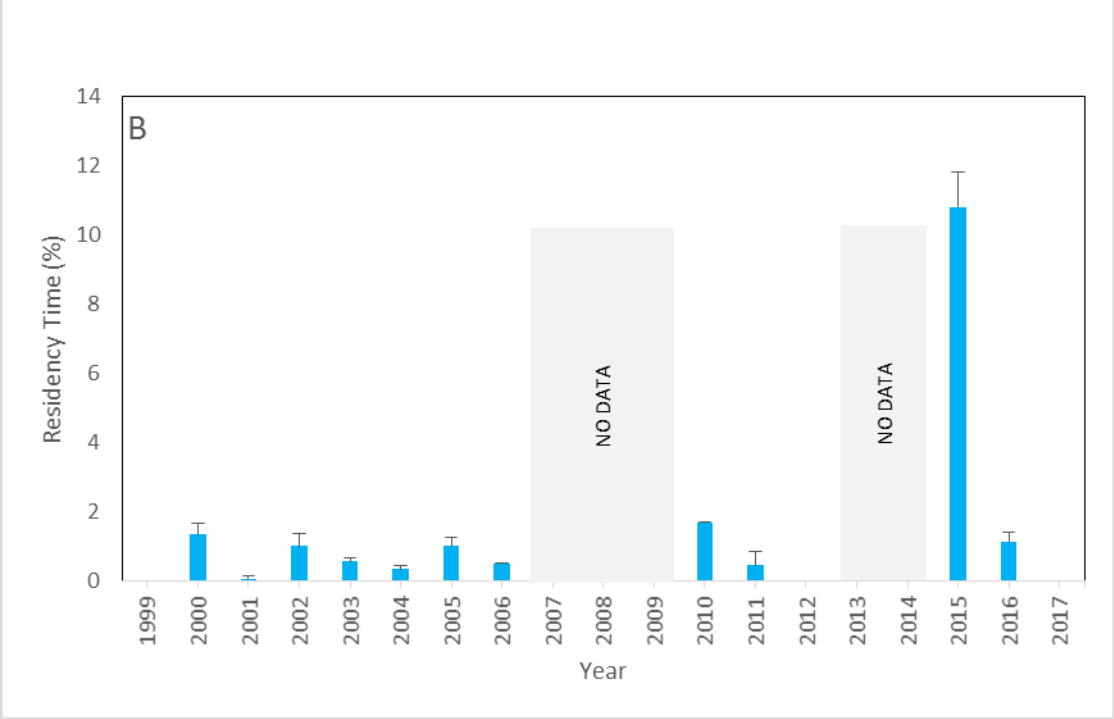
Relative to the Meadowbank Case, the projected average amount of time female caribou spend in ZOIs for the Application Case did not change for the spring migration period (Figure 30C).

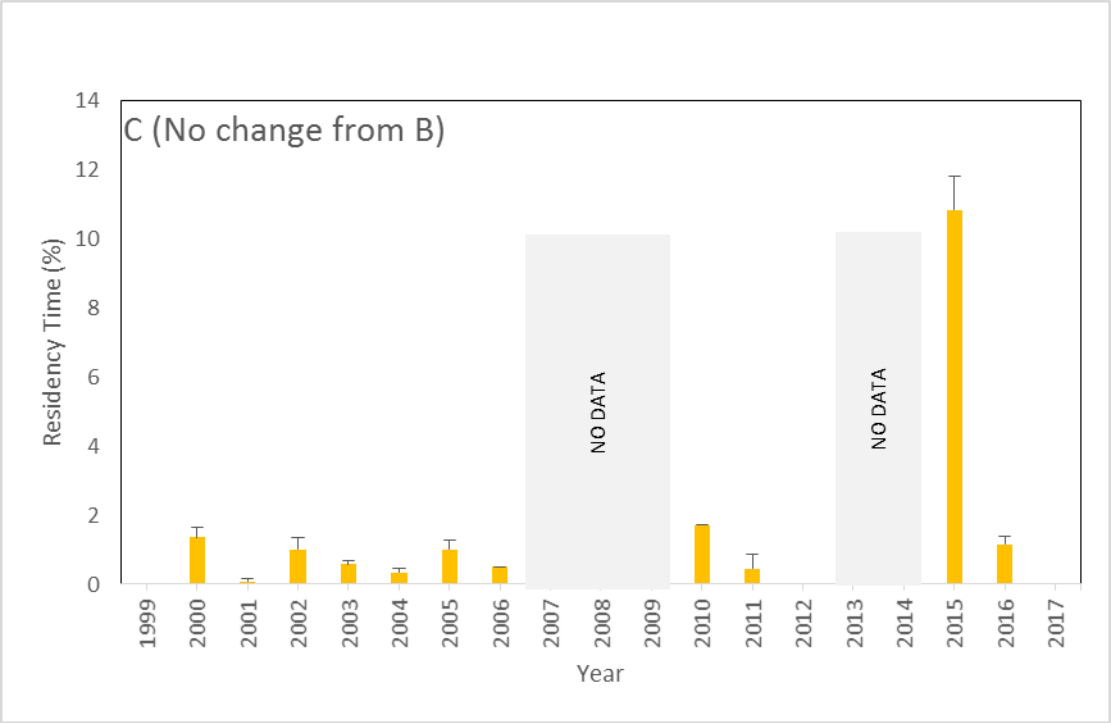
Simulations with the RFD Case projected that caribou reside in ZOIs for an average of 0.8 days (SD = 2.8) or 1.4% of their time during the spring migration period. No time was spent by female caribou in ZOIs per 58 days in 1999, 2012 and 2017. When there was an interaction, residency time in ZOIs ranged from less than 0.1% in 2001 to 10.8% in 2015 (Figure 30D).

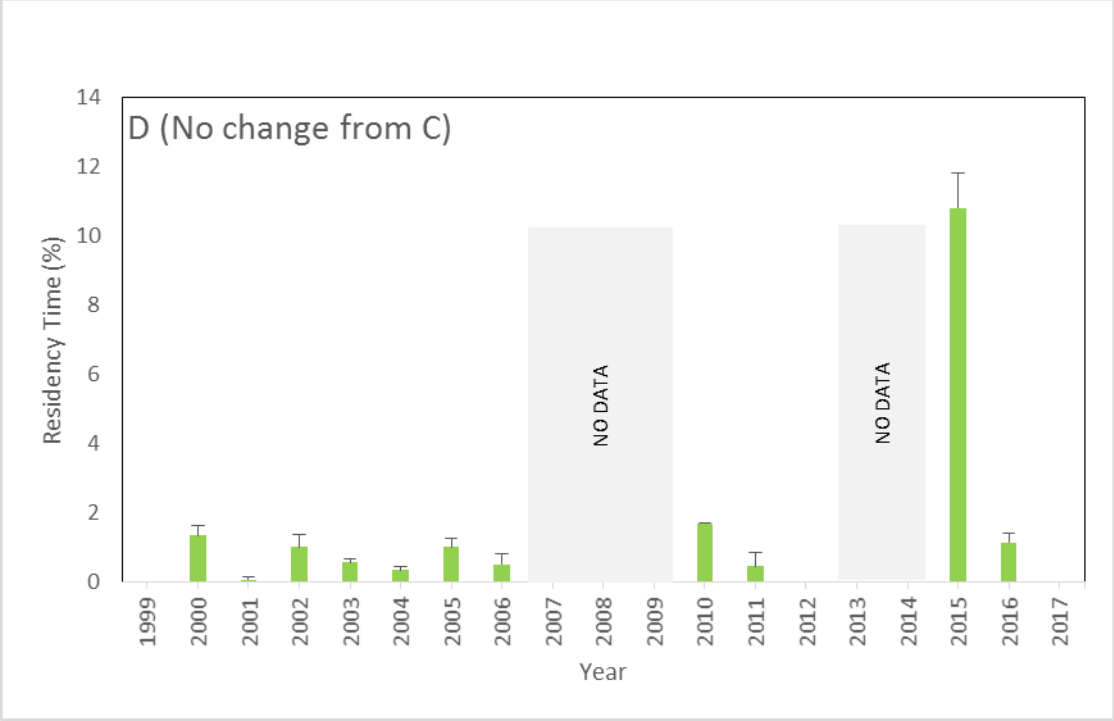
Peak residency time occurred in 2014 (10.8%) for the Meadowbank, Application, and RFD cases.

Figure 30: Temporal Trend in Mean Residency Time (± 95% Upper Interval) During Spring migration with Zones of Influence for Female Caribou in the Wager Bay Herd from 1999 to 2017 for the Base Case (A), Meadowbank Case (B) Application Case (C), and the Reasonably Foreseeable Development Case (D)






C (No change from B)
Residency Time (%)
14
12
10
8
6
4
2
0
NO DATA
NO DATA
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Year


D (No change from C)
Residency Time (%)
14
12
10
8
6
4
2
0
NO DATA
NO DATA
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Year

Fall Migration

Caribou paths monitored over 14 study years from 1999 to 2016 (no collar data 2007, 2008, 2013, and 2014) were used to calculate the residency time with ZOIs. The number of collared individuals ranged from a single caribou in 1999, 2000, 2009, 2010, and 2012 to 12 caribou in 2003.

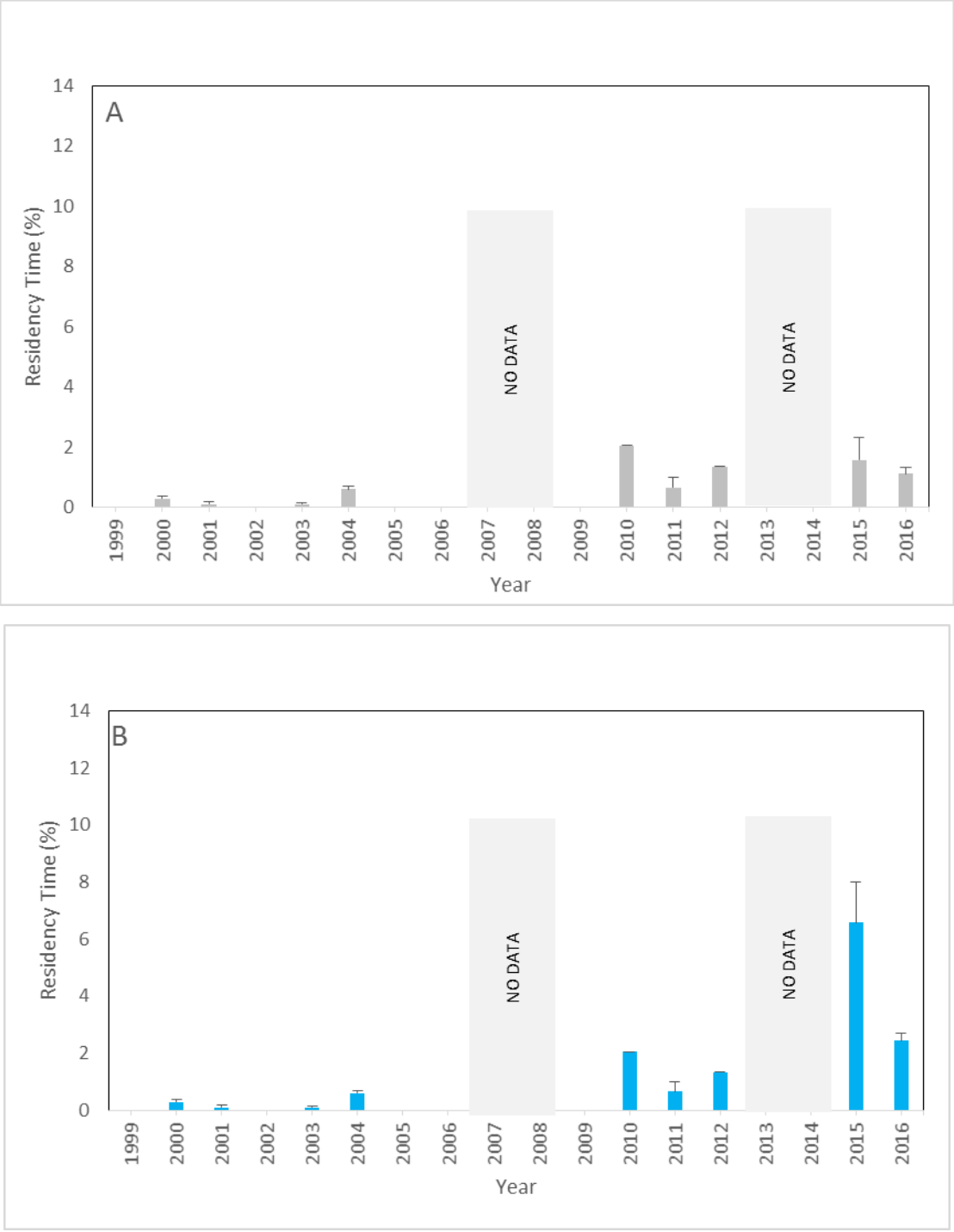
From 1999 to 2016 (Base Case), Wager Bay caribou resided in ZOIs for an average of 0.6 days (SD = 0.7 days) or 0.6% of their time during the fall migration period (n = 53 paths). No time was spent by female caribou in ZOIs during 1999, 2002, 2005, 2006, and 2009. When there was an interaction, the amount of time spent by female caribou in ZOIs ranged from 0.09% in 2001 and 2003 to 2.0% in 2010 (Figure 31A). There was no evidence of a declining or increasing temporal trend.

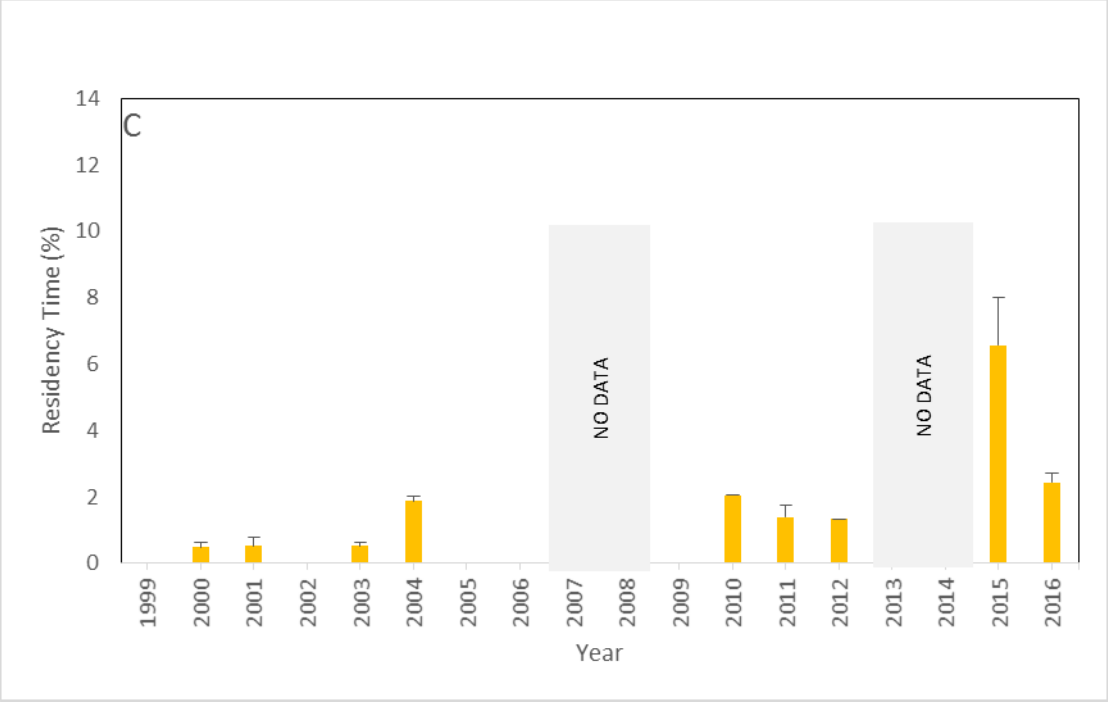
With the addition of the Meadowbank Mine and the AWAR to the fall migration range, the amount of time spent in ZOIs ranged from no change for 1999 to 2006, and 2009 to 2012, to 5.8 additional days (or 5.0%) in 2015 per 115 days relative to the Base Case (Figure 31B). The overall mean incremental change in residency time was 0.5% (0.6 days) for the Meadowbank Case.

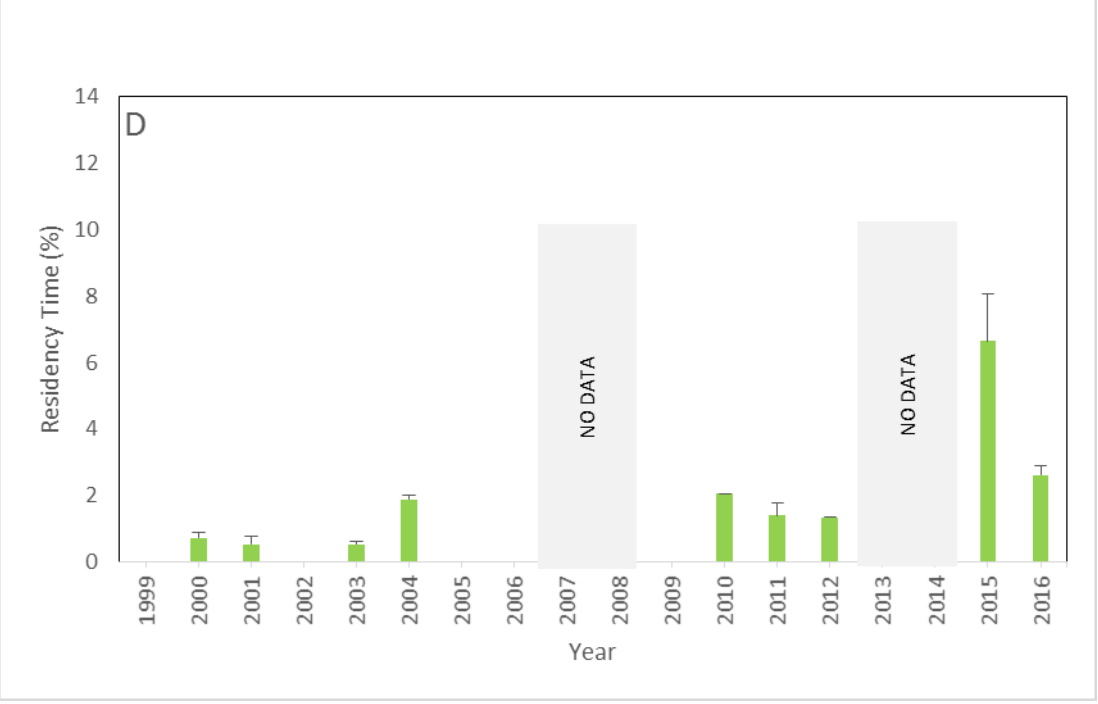
Relative to the Meadowbank Case, residency time projections for the Application Case ranged from no changes for nine of the study years (1999, 2002, 2005, 2006, 2009, 2010, 2012, 2015, and 2016) to 1.5 additional days (or 1.29%) for the fall migration in 2004. The overall average amount of time female caribou spend in ZOIs is projected to increase by 0.2% or 0.3 days during the fall period for the Application Case (Figure 31C).

Simulations with the RFD Case projected that caribou may reside in ZOIs for an average of 1.5 days (SD = 1.8) or 1.3% of their time during the fall migration period. No time was spent by female caribou in ZOIs per 115 days in 1999, 2002, 2005, 2006, and 2009. When there was an interaction with ZOIs, residency time ranged from 0.5% in 2000 to 6.6% in 2015 (Figure 31D). The peak residency time for the Meadowbank, Application, and RFD cases occurred in 2015.

Figure 31: Temporal Trend in Mean Residency Time (± 95% Upper Interval) During Fall migration with Zones of Influence for Female Caribou in the Wager Bay Herd from 1999 to 2016 for the Base Case (A), Meadowbank Case (B) Application Case (C), and the Reasonably Foreseeable Development Case (D)




C
Residency Time (%)
0
2
4
6
8
10
12
14
NO DATA
NO DATA
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Year


D
Residency Time (%)
0
2
4
6
8
10
12
14
NO DATA
NO DATA
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Year

Winter

Caribou paths monitored over 16 study years from 1998 to 2017 (no collar data 2008, 2009, 2014, and 2015) were used to calculate residency time within ZOIs. The number of collared individuals ranged from a single caribou in 2000, 2007, 2010, 2011, 2013 and 2006 to 11 caribou in 2004.

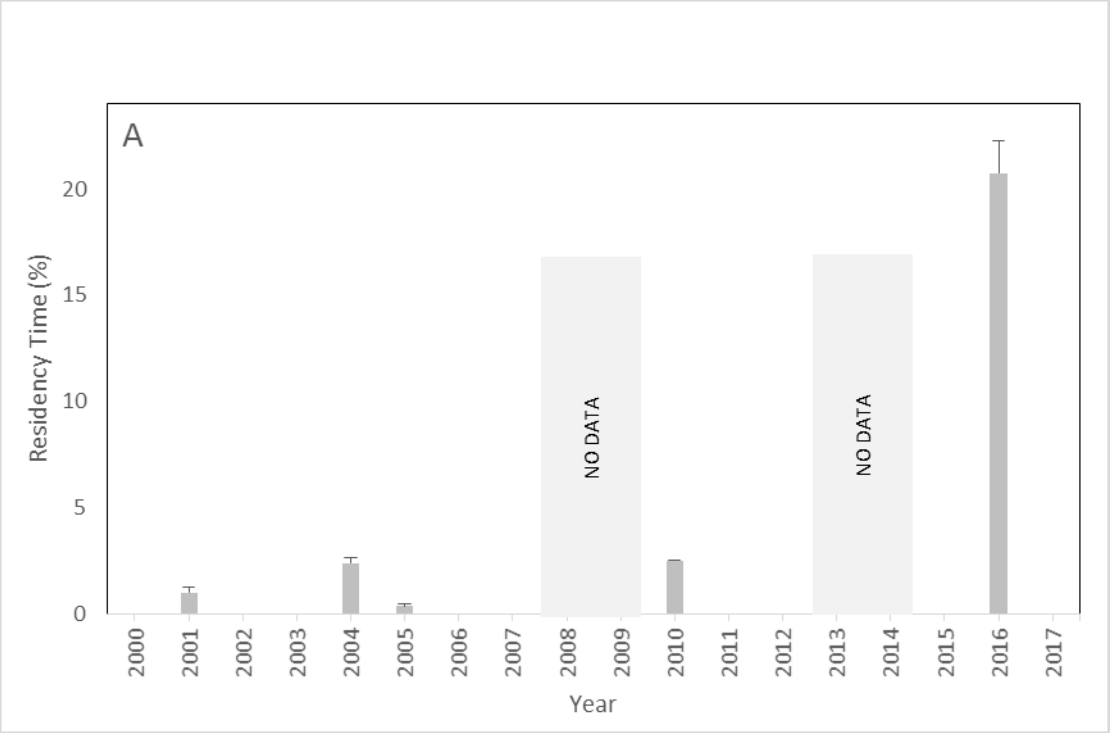
From 2000 to 2017 (Base Case), Wager Bay caribou resided in ZOIs for an average of 2.0 days (SD = 5.5 days) or 1.9% of their time during the winter period (n = 49 paths). No time was spent by female caribou in ZOIs during 2000, 2002 to 2003, 2006 to 2007, 2011 to 2013 or 2017. When there was an interaction, the amount of time spent by female caribou in ZOIs ranged from 0.4% in 2005 to 20.7% in 2016 (Figure 32A). Although there was no evidence of a strong declining or increasing temporal trend for the Base Case, residency time showed a marked increase in 2016.

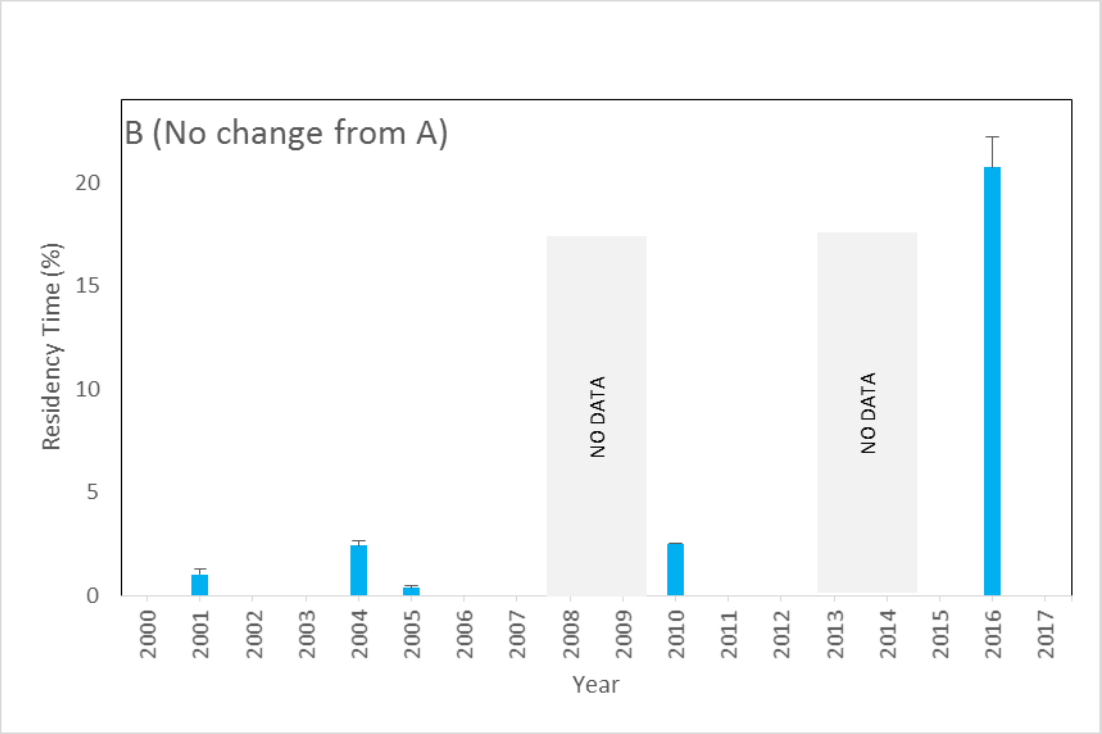
With the addition of the Meadowbank Mine and the AWAR to the winter range, the amount of time spent in ZOIs remains unchanged relative to the Base Case (Figure 32B).

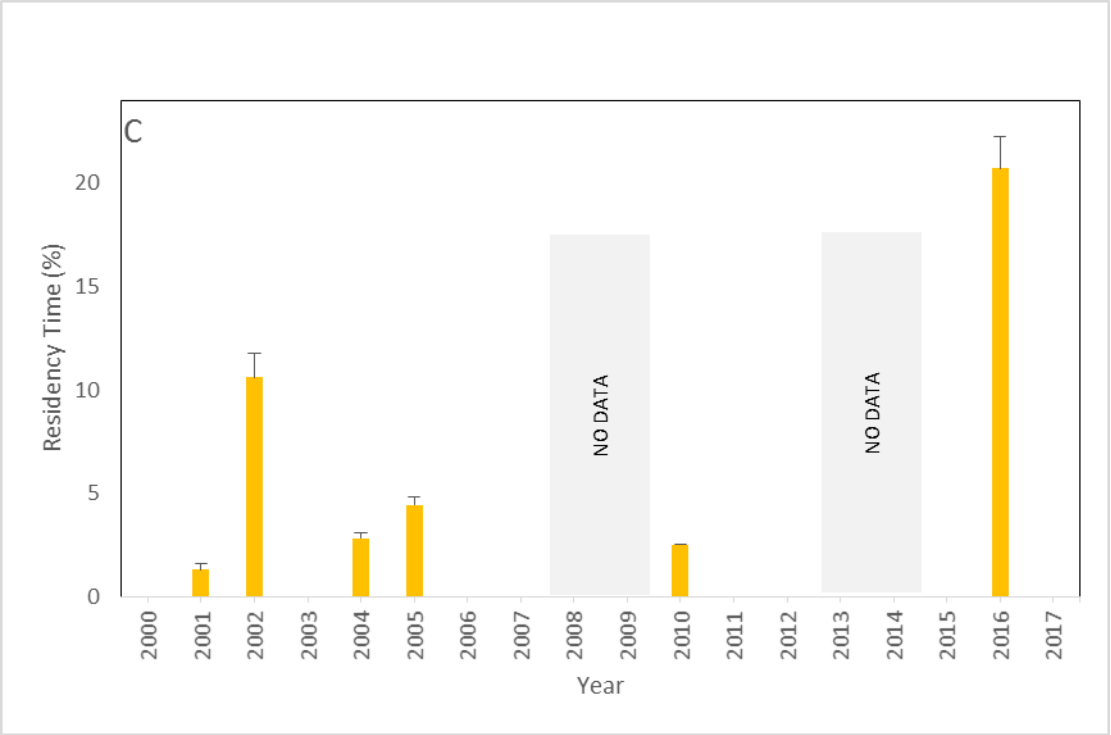
Relative to the Meadowbank Case, residency time projections for the Application Case ranged from no changes for ten of the study years (2000, 2003, 2006, 2007, 2010 to 2013, and 2016 to 2017) to 1.5 additional days (or 1.3%) for the fall migration in 2004. The overall average amount of time female caribou spend in ZOIs is projected to increase by 1.2 days or 1.1% during the winter period for the Application Case (Figure 32C).

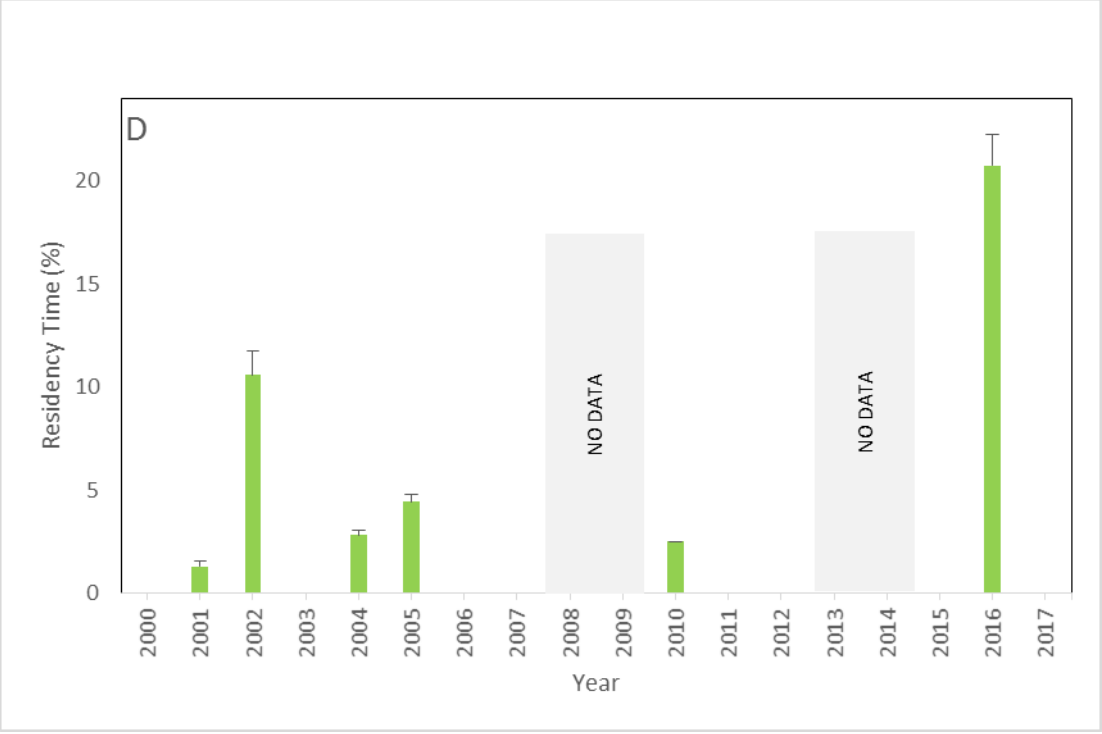
Simulations with the RFD Case projected that caribou reside in ZOIs for an average of 3.2 days (SD = 5.9) or 3.0% of their time during the winter period. No time was spent by female caribou in ZOIs per 105 days in 2000, 2003, 2006, 2007, 2011 to 2013, and 2017. Residency time in ZOIs ranged from 1.3% in 2001 to 20.7% in 2016 of the winter period (Figure 32D).

Figure 32: Temporal Trend in Mean Residency Time (± 95% Upper Interval) During Winter with Zones of Influence for Female Caribou in the Wager Bay Herd from 2000 to 2017 for the Base Case (A), Meadowbank Case (B) Application Case (C), and the Reasonably Foreseeable Development Case (D)






C
Residency Time (%)
0
5
10
15
20
NO DATA
NO DATA
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Year


D
Residency Time (%)
0
5
10
15
20
NO DATA
NO DATA
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Year

4.0 SUMMARY

Collared caribou data from the Ahiak, Beverly, Lorillard, and Wager Bay herds were evaluated for encounters and residency time in cumulative hypothetical ZOIs from active developments on their spring, fall, and winter seasonal ranges. The cumulative mean annual encounters in the Base and RFD case development scenarios, and the incremental changes from the Meadowbank Mine and AWAR (Meadowbank Case) and the Whale Tail Project (Application Case) for each herd and season are summarized in Table 4. The results for the Ahiak and Beverly herds indicate very small or no incremental encounters with the existing Meadowbank Mine and AWAR and the Project. Similar results were observed for the Base and RFD cases (Table 4). The results of low ZOI encounter rates and residency times are supported by Figures 1, 3, and 4, which indicate the Meadowbank Mine, AWAR and the Project are located outside the conservatively calculated seasonal ranges of the Ahiak and Beverly caribou herds.

Results for the Lorillard herd indicate an annual average incremental increase of 0.3 ZOI encounters in the spring, 0.4 in fall and 0.1 in winter for the Meadowbank Mine and AWAR from 2007 to 2017 relative to other previous and existing developments. Simulations predicted the Project will increase the annual average number of encounters by 0.3 in spring, 0.4 in fall and 0.1 in winter relative to previous and existing developments and the Meadowbank Mine and AWAR. Simulated mean annual cumulative encounters in the RFD Case were predicted to be 0.7 in spring, 1.0 in fall and 0.7 in spring. The incremental mean annual increase in the number of days Lorillard caribou resided in ZOIs from 2007 to 2017 for the Meadowbank Mine and AWAR was 0.6 days in spring, 0.4 days in fall and 0.2 days in winter. Simulations for the Project predicted a mean annual increase in residency by 0.2 days in spring, 0.3 days in fall and 0.1 days in winter from 1996 to 2017. Simulated cumulative residency time through the RFD Case was predicted to be 0.9 days in spring, 1.5 days in fall and 1.8 days in spring.

For the Wager Bay herd, the incremental average increase in encounters associated with the Meadowbank Mine and AWAR ZOI from 2007 to 2017 was 0.2 encounters in spring, 0.4 in fall and no encounters in winter, relative to the Base Case. Simulations predicted that the Project will increase the average number of ZOI encounters by 0.1 in spring, 0.2 in fall and 0.1 in winter relative to the Meadowbank Case. The projected cumulative annual mean number of ZOI encounters in the RFD Case was 0.6 in spring, 1.3 in fall and 1.4 in winter. The incremental increase in the mean annual number of days Wager Bay caribou resided in ZOIs from 2007 to 2017 for the Meadowbank Mine and AWAR was 0.5 days in spring, 0.6 days in fall and no days in winter. Simulations for the Project predicted no increase in mean annual residency days for spring, an increase of 0.3 days in fall and 1.2 days in winter from 1996 to 2017. Simulated cumulative mean annual residency time through the RFD Case was predicted to be 0.8 days in spring, 1.5 days in fall and 3.2 days in spring.

Overall, analysis of encounter rates and residency time predict that the Meadowbank Mine and AWAR, and the Project would result in no measurable changes to the energetic state of Ahiak, Beverly, Lorillard and Wager Bay caribou, and no demographic consequences to the populations.

Table 4: Summary of Hypothetical Incremental and Cumulative Indirect Effects from Development Zones of Influence in Seasonal Ranges of Ahiak, Beverly, Lorillard and Wager Bay Caribou Herds

Herd	Season	Active Development Scenario							
		Base Case (cumulative rate)		Meadowbank Case (incremental rate)		Application Case (incremental rate)		RFD Case (cumulative rate)	
		Mean Number of ZOI Encounters	Mean ZOI Residency Time (days)	Mean Number of ZOI Encounters	Mean ZOI Residency Time (days)	Mean Number of ZOI Encounters	Mean ZOI Residency Time (days)	Mean Number of ZOI Encounters	Mean ZOI Residency Time (days)
Ahiak	Spring	0.2	0.4	0.0	0.0	0.0	0.0	0.3	0.1
	Fall	0.2	0.7	<0.1	0.0	<0.1	<0.1	0.3	<0.1
	Winter	0.4	2.1	0.0	0.0	<0.1	0.0	0.1	0.2
Beverly	Spring	0.1	<0.1	0.0	0.0	0.0	0.0	0.1	<0.1
	Fall	0.2	0.2	0.0	0.0	0.0	0.0	0.3	0.5
	Winter	0.3	0.9	0.0	0.0	0.0	0.0	0.1	0.5
Lorillard	Spring	<0.1	0.1	0.3	0.6	0.3	0.2	0.7	0.9
	Fall	<0.1	0.5	0.4	0.4	0.4	0.3	1.0	1.4
	Winter	0.6	1.7	0.1	0.2	0.1	1.2	0.1	1.8
Wager Bay	Spring	0.3	0.3	0.2	0.5	0.1	0.0	0.6	0.8
	Fall	0.6	0.6	0.4	0.6	0.2	0.3	1.3	1.5
	Winter	1.1	2.0	0.0	0.0	0.1	1.2	1.4	3.2

Note that ZOI encounters were overestimated by not dissolving overlapping zones of influence from different developments. In contrast residency time was not doubled when caribou were present in overlapping ZOI areas of different developments.

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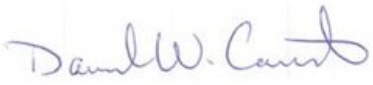

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https://capws.golder.com/sites/1658927regulatoryaffairs/p3100_temp_and_workshops/caribou encounter analysis/commitments 9,10_whaletail_encounterreport.docx

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