Potential Wildlife Corridors in Southwestern Halifax Regional Municipality, Nova Scotia

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INTRODUCTION

To make the Halifax Regional Municipality (HRM) a healthier and more livable community, Our HRM Alliance (a group of 40 member organizations) has begun a campaign that consists of seven recommendations for the Regional Municipality Planning Strategy. The first strategy put forth is to create a greenbelt, a zone of parks and rural land surrounding a city, to preserve natural areas and concentrate growth("Greenbelt," 2012; Our HRM Alliance, 2012). Protected areas make up 10.6 % of HRM and are often isolated and vulnerable patches of landscape that are not sufficient alone to maintain biodiversity and viable populations (Our HRM Alliance, 2012; T. V. Snaith, 2001).Wildlife corridors have the potential to reduce this isolation and provide added security for biodiversity. Wildlife corridors are vegetated linear strips of land that differ from the surrounding landscape and connect two or more distinct habitat areas, fostering movement of biota among them (Saunders & Hobbs, 1991; Williams, 1998). Connectivity between habitats and populations is vital to ensure the persistence of populations and ecosystems (Beier & Noss, 1998). Corridors have the potential to facilitate movement in a fragmented landscape and can act as a greenbelt creating safe havens for wildlife, with added benefits for urban populations (Williams, 1998).

Determining the appropriate corridor width will depend on the objectives of the corridor. Narrow corridors will likely be used for movement purposes, whereas wide corridors have the ability to support corridor dwellers. The width of a corridor will determine the percentage of core interior habitat or the percentage of habitat not influenced by edge effects. Edges are defined as the junction between two different habitat types or land uses and can be a well-defined boundary or a transition between different habitat types (Yahner, 1988). Corridor width subsequently determines the effectiveness of corridors for species that experience edge avoidance.

This project aims to propose a wildlife corridor(s) that would connect the Terence Bay Wilderness Area with forests currently owned by Resolute Forest

Products Inc.in southwestern Halifax Regional Municipality. Since the June 2012 closure of the Bowater Mersey Paper Co. Ltd, the Province of Nova Scotia andResolute Forest Products Inc. have been in negotiations apropos acquiring these lands (Lambie, 2012). Considering this recent development and HRM Alliance's recommendation for a greenbelt, it is beneficial to determine the feasibility of corridors connecting this land to neighbouring wilderness areas in the HRM. To determine potential locations for corridors within the HRM we will (1) select a focal species to act as a surrogate for the conservation of a suite of species and to define the spatial extent of the corridors, (2) determine the habitat/area requirements for this species through literature, and (3) use ArcGIS to create a habitat suitability model that will then be used in conjunction with the extension *CorridorDesigner* in a preliminary evaluation of a potential wildlife corridor(s) in the southwestern portion of HRM.

SELECTING A FOCAL SPECIES

Focal species have the potential to act as surrogates for conservation of a suite of species and processes (Lambeck, 1997; D.B. Lindenmayer, 1999; T. Snaith & Beazley, 2002). A species that constitutes designation as a focal species should be wide-ranging or space demanding, a habitat quality indicator, a 'flagship' species, and/or a vulnerable species or part of a special population (Beazley & Cardinal, 2004). The American Moose (*Alces alces americana*) has been suggested as an appropriate focal species for Nova Scotia (T. Snaith & Beazley, 2002). Moose are listed as endangered in Nova Scotia with a population in HRM currently experiencing conflicts between urbanization and movement between habitat patches(CBC News, 2012; Government of Nova Scotia, 2009). The Halifax peninsula population is a special population that currently has less than 50 individuals (T. V. Snaith 2001).

Home range size is determined by the area appropriate to ensure survival during critical biological periods of an animal's lifecycle (Lindstedt, Miller, & Buskirk, 1986). Therefore, energetics plays an important role in determining home range size (Hundertmark, 1997). The greater the metabolic requirements of the animal the larger the required home range size (Hundertmark, 1997; McNab, 1963). Mean home range size of moose ranges from 30 to 55 km ^{2} with an average home range size of 42.5 km ^{2}(4250 ha) (reviewed in Beazley et al. 2005). Migrations to and from summer and winter ranges are common in moose populations (Hundertmark, 1997). However, moose in Nova Scotia do not exhibit long-distant seasonal migration but do exhibit seasonal movements due to change in forage availability and snow conditions (T. V. Snaith, 2001).

Moose are large animals that require a large home range to satisfy their diverse habitat requirements (T. V. Snaith, 2001). Moose select their habitat based on nutritional needs and cover requirements (Dussault, Courtois, & Ouellet, 2006). However, these are not the only factors that predict the presence or absence of moose in the landscape. In a study on habitat suitability for moose, road density was used as a surrogate for human influence (T. V. Snaith, Beazely, MacKinnon, & Duinker, 2002). This study found that road density was able to significantly predict the presence of moose pellets, suggesting that as road density increases moose presence decreases (T. V. Snaith et al., 2002). Furthermore, Laurian et al. (2008) found that moose avoided crossing roads and additionally avoided the lands adjacent to road networks.

Nutritional requirements are another important factor that influence moose habitat selection (Dussault et al., 2006). Moose diet varies with summer and winter energy requirements, with moose consuming four times as much food in the summer as compared to winter (T. V. Snaith, 2001). The diet of moose in the summer months consists of nutrient and protein rich vegetation where they consume a variety of terrestrial and aquatic vegetation to meet their energetic requirements (C. C. Schwartz, Regelin, Franzmann, & Hubbert, 1987; C. Schwartz & Renecker, 1997; T. V. Snaith, 2001). This vegetation includes leaves of deciduous trees and shrubs, grasses, forbs, aquatic plants, and young plant shoots (T. V. Snaith, 2001). Food intake decreases in the winter mainly due to the poor forage quality available and snow conditions which restrict movement (T. V. Snaith, 2001).Moose require high forage biomass both in quantity and quality to meet their energetic needs (C. Schwartz & Renecker, 1997). High forage biomass is often found in alluvial habitats along floodplains and deltas (Peek, 1997). This makes wetland areas a priority for moose habitat selection.

METHODS

To identify wildlife corridors within Southwestern HRM ArcGIS 10.0 was used in conjunction with extensions Spatial Analyst and CorridorDesigner. Through a preliminary literature review, moose was determined to be an appropriate focal species for Nova Scotia (T. Snaith & Beazley, 2002). Four factors were determined to influence habitat suitability for moose: foraging habitat, thermal cover habitat, wetland habitat, and road density (Dussault et al., 2006; T. V. Snaith et al., 2002; T. V. Snaith, 2001). Areas of good habitat would include low road density, good thermal cover, moderate wetland habitat, and good foraging locations. Data for these factors and subsequent analysis were gathered from: (1) *forest* layer (Department of Natural Resources- GIS Division, 2012), (2) *RoadsandRails_NSRoadNetwork_line* layer (Nova Scotia Geomatics Centre, 2012), (3) *HRMzoning*layer (HRM Geographic Information Systems and Services Group, 2012), (4) *HRMproperty* layer (Nova Scotia Geomatics Centre, 2012), and (5) *T4* layer (wilderness areas) (Nova Scotia Environment and Labour, 2011).

Road density was calculated by first creating a grid of cells (1 x 1 km), (using fishnet) for the study area (the southwestern portion of HRM). This layer was intersected with the *RoadsandRails_NSRoadNetwork_line*layer and the road length was recalculated. A summary table was then created and joined to the fishnet layer. This layer was classified into six road density classes (0, 0.1-0.06, 0.06-0.6, 0.6-1, 1-3, >3 km/km2) and converted into a raster file (10m cell size) (See Appendix A, Fig.1.).

The aquatic resources (wetlands) layer was created from the *forest* layer, which was selected for wet and non-wet areas (See Appendix A, Table 1) based on the FORNON field that distinguishes forest from non-forest types (Department of Natural Resources- GIS Division, 2012; T. V. Snaith, 2001). A dissolve was performed on this layer, which was then converted into a raster format (10m cell size) (See Appendix A, Fig.2.).

The foraging layer was created using the *forest* layer based on tree species (using fields SP1, SP2, SP3, and SP4) (See Appendix A, Table 2). These fields were reclassified into three classes (1) hardwood species, (2) softwood species, and (3) mixed-wood species (See Table 1). This layer was dissolved and the new polygons were scored based on their composition (mixed = 3, hardwood = 2, softwood = 1). This layer was then converted into raster format (10m cell size) (See Appendix A, Fig.3.).

Table.1. Reclassification table of the forest layer for the forage factor

Softwood	> 60% softwood species
Hardwood	> 60% hardwood species
Mixed	> 40% and < 60% hardwood and softwood species

Source: (Rader, 2001)

Stand height, softwood tree species, and crown closure percentage (CRNCL) were used to classify thermal cover. Past studies on habitat suitability for moose used maturity class and species to determine thermal cover. That data was unavailable for this study (Rader, 2001; T. V. Snaith, 2001). Therefore, based on the 'height' field and the 'crown closure' field in the *forest* layer, stands over the median height class of 12m and with a greater than 50% crown canopy closure were classified as good thermal cover (See Appendix A, Table 3). Thus, good thermal cover was determined to be mature, dense, primarily softwood stands. This layer was dissolved and converted into a raster format (10m cell size) (See Appendix A, Fig.4.).

Reclassification tables were created for each of the four factors and a fifth table was created for the weighting criteria (See Appendix B). Road density was determined to be the factor that better predicted moose presence/absence and was therefore given the highest weight of 55% (T. V. Snaith et al., 2002). Foraging habitat was given a weight of 25% (as the second best predictor of moose presence/absence; thermal cover and aquatic resources were each given a lesser weight of 10%. These four factors (road density, thermal cover, forage, and aquatic resources) were input into the CorridorDesigner extension along with the weighting criteria and the reclassification tables to create a habitat suitability model for moose in southwestern HRM. The habitat suitability model combined the four factors using a geometric mean method. The geometric mean model was used so that areas where moose cannot survive (ocean) would continue to be classified as completely unsuitable habitat in the output raster.

The Terence Bay Wilderness Area was selected from the *T4* layer to create a starting location for the CorridorDesigner extension. The Bowater-Mersey lands were selected from the *HRMproperty* layer and used as the end location for the CorridorDesigner extension (See Appendix C, Fig.1.). Using the Terence Bay Wilderness Area location, the Bowater-Mersey lands location, and the habitat suitability model corridors were created using the CorridorDesigner extension. The habitat suitability threshold was set at 30 and the minimum breeding patch size was set at 4250ha (the average home range of an individual). The extension uses the habitat suitability model to determine habitat patches within the focus areas and then, based on a least cost path, attempts to connect these starting and ending patches.

Due to the complexity of the *HRMzoning*layer, the data was generalized into 4 categories and scored (See Appendix C, Table 1). Scores were based on the amount of conflict the area would form with biota such as the focal species. Urban areas are not conducive to supporting moose populations and so were given the second lowest score (1). Since moose were chosen as an umbrella species, islands were given a score of (0) as many other species will not be able to access these locations within the corridor. Protected areas were given the highest score (3) as they will form the least conflict with urban populations and be most conducive to supporting wildlife populations.

The HRM zoning layer was symbolized based on the new scores and overlain with the corridor and habitat patches layers. The zoning areas within the corridor were then analyzed to locate areas of possible current and future conflict with wildlife.

RESULTS

Our results suggest that the southwestern portion of HRM has moderate to poor foraging habitat for moose, a high proportion of thermal cover, and scattered aquatic resources are available (See Appendix A). Road density is high in certain areas of the study area (such as the Halifax Peninsula), but is offset by low density areas in wilderness area locations (See Appendix A). The habitat suitability model illustrates the effectiveness of wilderness areas in providing good habitat for moose as indicated by the high proportion of suitable habitat depicted in these areas (See Fig.1.).

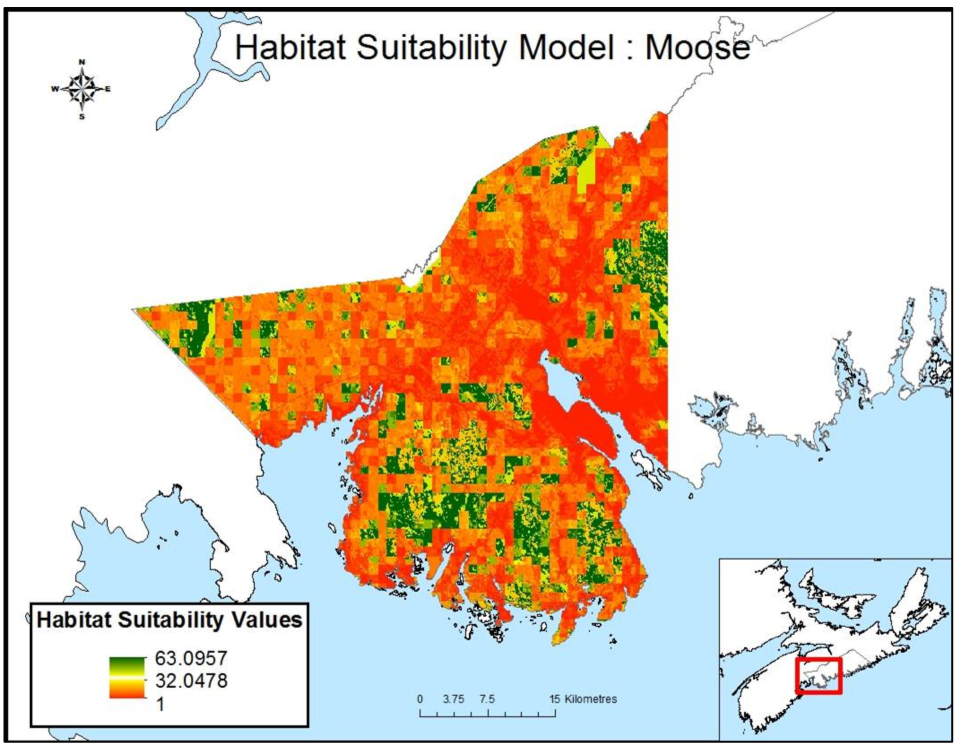

Figure.1. Habitat suitability model for moose (*Alces alces americana*) in southwestern Halifax Regional Municipality, Nova Scotia.

The CorridorDesigner extension was able to create habitat patches within the starting (Terence Bay Wilderness Area) and end (Bowater-Mersey Lands) locations based on the habitat suitability model. CorridorDesigner makes the assumption that habitat suitability and habitat permeability are synonyms and they define resistance as the inverse of habitat suitability. Resistance is the basis of the cost distance model that is used to create the corridor slices. CorridorDesignercalculates the areas of continuous swaths of low-resistant pixels to determine where connectivity is most feasible (Corridordesign.org, 2010). Using this least cost path, it was able to create a corridor from the habitat patches created in the habitat suitability model. The following figure (Fig.2.) depicts the varying corridor sizes (widths) and the habitat patches.

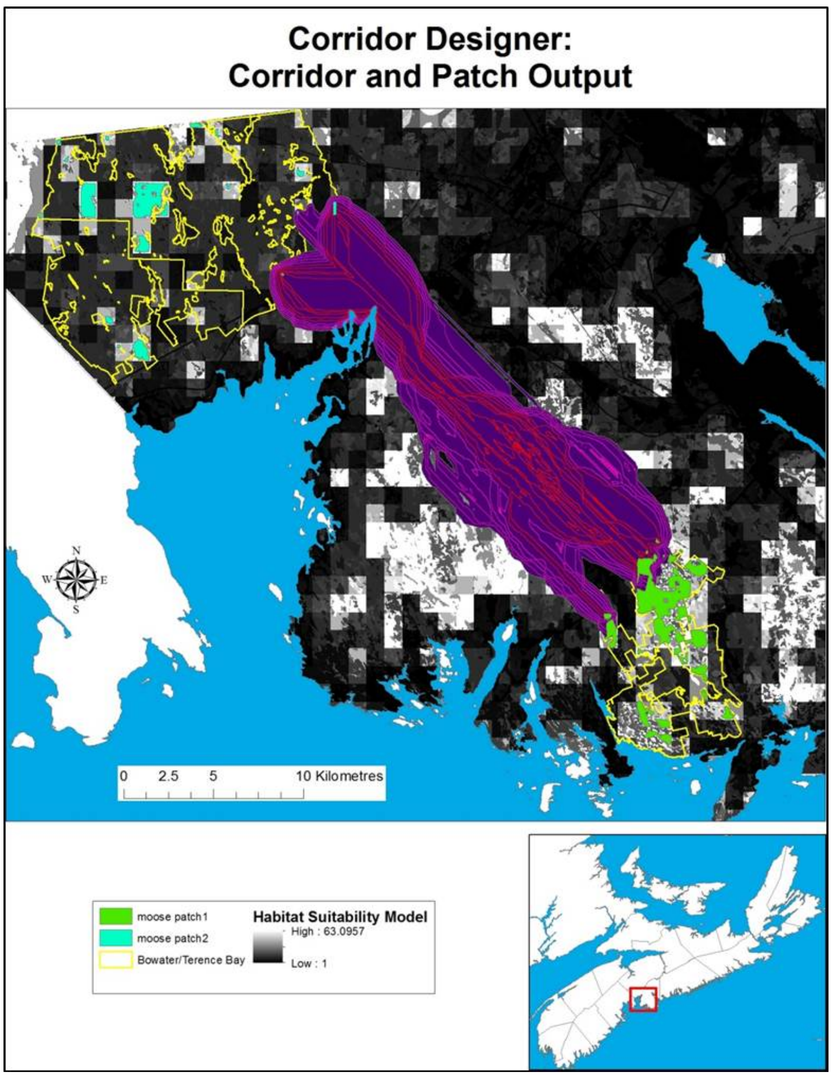

Figure.2. Habitat patches within focus areas and corridors(1%-100%) for moose (*Alces alces americana*).

The majority of the corridor falls within mixed-use and residential zoning. The corridor also intersects with two previously protected areas, Five Bridges Wilderness Area and Lewis Lake Provincial Park. However, using the largest (100%) corridor width and the HRM zoning layer, two areas of concern can be identified in regards to having a negative effect on wilderness connectivity. The first (See Fig.3.) identifies the Prospect Road area as having the potential to severely restrict movement to and from the Terence Bay Wilderness Area for two reasons. Prospect Road completely intersects the identified corridor just beyond the wilderness area boundaries and secondarily this area contains several locations that have been zoned for industrial/commercial activities.

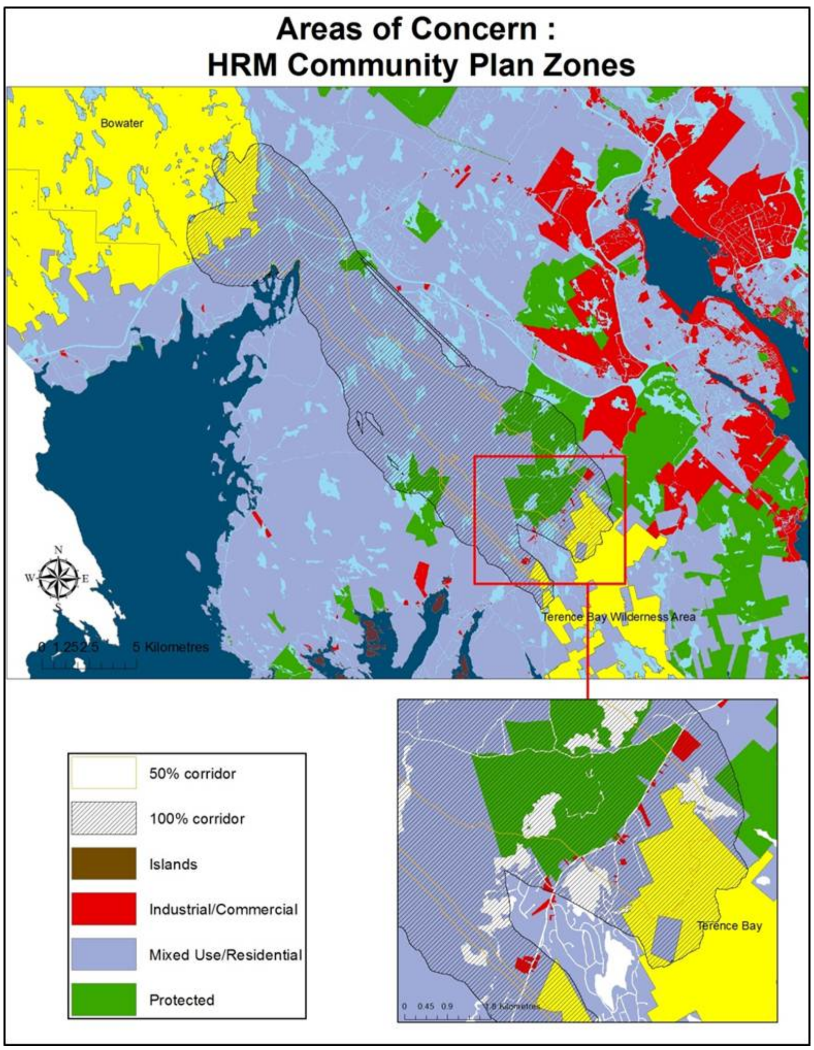

Figure.3. Areaof concern (Prospect Rd) that may impact wilderness connectivity and species movement within the proposed corridor

The second area of concern is located to the north of the corridor where Highway 103 also completely intersects the corridor (See Fig.4). The presence of a major highway has the potential to impact the movement of wildlife from and into the southwestern peninsula of Halifax Regional Municipality.

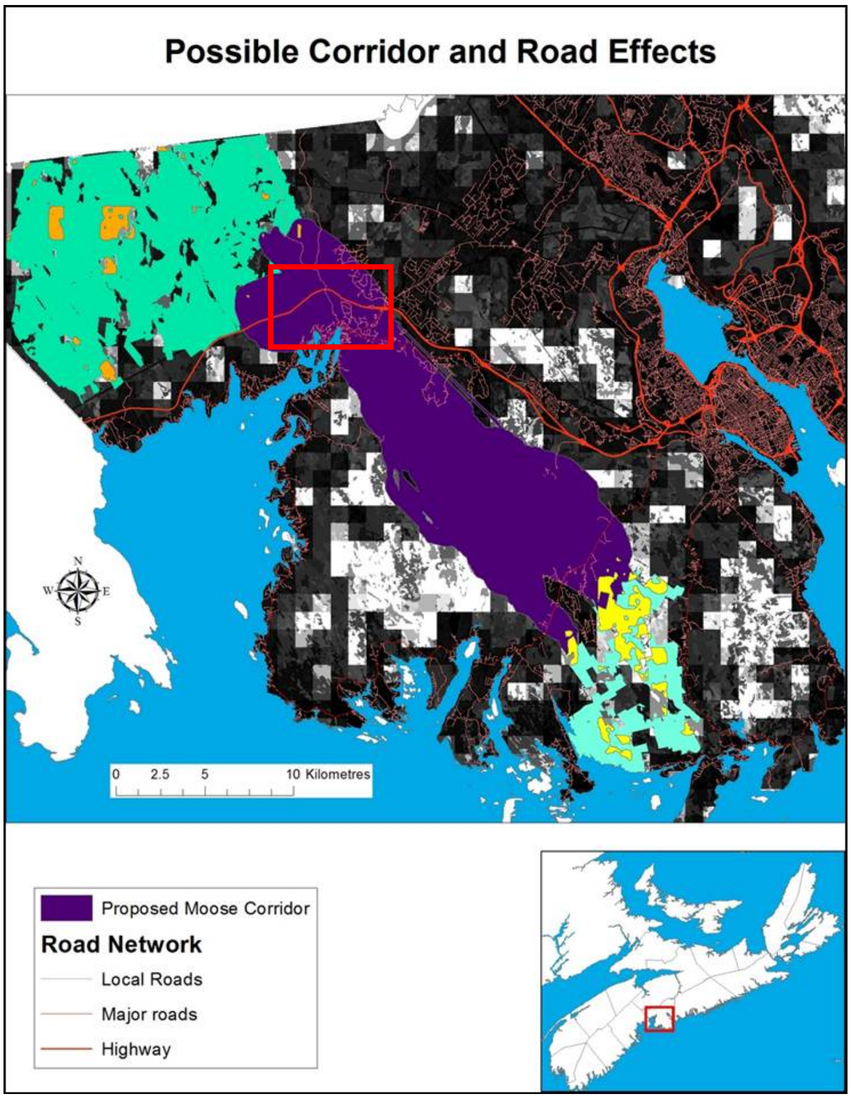

Figure.4. Area of concern (Hwy 103) that may impact wilderness connectivity and species movement within the proposed corridor

Discussion

Spatial modeling is a useful tool that can aid in the development of management plans, in particular wildlife corridor design. Steinberg & Steinberg (2006) give five reasons when spatial analysis should be applied. This study fell under four of these reasons: (1) our study has a clear spatial component, (2) our analysis benefited from spatial analysis (such as CorridorDesigner), (3) our study built on existing data sets (e.g. forest, roads, and zoning layers), and (4) the visualization capabilities of GIS were appropriate for our map and data output. At this point however, although it is recommended, it is uncertain whether this study will be revisited.

There is debate on the effectiveness of wildlife corridors in facilitating connectivity for biodiversity (Beier & Noss, 1998; David B. Lindenmayer & Franklin, 2002; Noss, 1987; Simberloff, Farr, Cox, & Mehlman, 1992). However, a recent meta-analysis on the effectiveness of corridors in conservation found that movement was greater between habitat patches that were connected by corridors than those that were not(Gilbert-Norton, Wilson, Stevens, & Beard, 2010). This is especially true concerning natural corridors, as the study showed they facilitated greater movement than man-made corridors (Gilbert-Norton et al., 2010). The Terence Bay Wilderness Area and other natural areas in southwestern HRM are in danger of losing their connectivity within the landscape due to the threat of a growing urban population. Terence Bay Wilderness Area lies on a peninsula, where a natural corridor likely exists and where the spread of urbanization from the core of HRM can easily hinder the dispersal of wildlife from isolated habitat patches.

Moose were found to forage on both hardwood and softwood tree species such as maple, birch, and balsam fir (T. V. Snaith, 2001). Therefore, optimal foraging habitat was designated as mixed-wood stands, as defined by Rader (2001). Given that moose prefer more hardwood species and fewer softwood species, hardwoods were designated as the second best foraging stands and softwoods as the third best stands. Thermal cover was classified as important to moose habitat selection. Cover adds protection from predation and the heat in the summer. The greatest amount of cover protection year round therefore will be from softwood tree species. Consequently,optimal cover habitat for moose was classified as mature, dense, softwood stands.

As illustrated in the habitat suitability map and the forage locations map, available habitat within HRM is limited and patchy. This is concurrent with Snaith (2001), who examined moose habitat suitability in Nova Scotia. Snaith (2001) discovered that southwestern Nova Scotia was overall less productive due to poor soils, acidic precipitation, and rocky barrens containing few hardwood species. However, habitat patches were generated in each study blocks as part of the habitat suitability model. Habitat patches determined the starting and ending points of the corridor within the original designated habitat blocks. CorridorDesigner calculates suitable habitat patches within the designated areas based on the input factors. These factors and the weight of importance attached to them can greatly influence the output of the habitat suitability model. To create a more robust corridor model, we advise that this corridor design model be run multiple times with varying factors and for multiple species. A single species approach may fail to capture important aspects of the ecosystem and is not true to the concept of focal species (Franklin, 1994; Lambeck, 1997). Additionally, it has been shown the importance of corridors for movement varied between taxa (Gilbert-Norton et al., 2010). Therefore, the holistic approach of using multiple focal species for conservation purposes seems warranted.

Using CorridorDesigner, the final output of the corridor model is a suite of corridor "slices" (listed as a percent of the total corridor) that vary in location and width. The smaller corridor slices may be comprised entirely of edge habitat that could increase predation pressure on species attempting to utilize this habitat, as has been seen in birds (Rich, Dobkin, & Niles, 1994). Conversely, edges are also known to be areas of high habitat complexity and can be suitable habitat for a variety of species (Yahner, 1988). To accommodate corridor dwellers, CorridorDesigner recommends corridors be constructed wider than the home range size of the focus species (Corridordesign.org, 2010). Given that there are current areas of human settlement within and surrounding the corridor, we advise the largest (100%) corridor width be used for planning purposes to accommodate a variety of species some of which may experience edge effects. Further examination of species occurrence within the southwestern HRM, such as any species at risk, would be useful in determining an appropriate corridor width.

The majority of the land within the proposed corridor consists of mixed-use and residential zoning (based on zoning codes from HRM Community Plan Areas). Unsurprisingly, the proposed corridor travels through another wilderness area, Five Bridges Wilderness Area, which is located in close proximity to Terence Bay Wilderness Area. Although this is a good outcome there is a potential conflict in the form of the Prospect Road area. Prospect Road runs between Terence Bay and Five Bridges Wilderness Area and areas adjacent to the road have been designated as industrial or commercial zones. Due to the major road and industrial/commercial zoning this area could morph into a hotspot of urbanization that has the potential to severely restrict movement within the southern portion of the corridor. This could result in the isolation of the Terence Bay Wilderness Area leading to detrimental consequences for wildlife populations within southwestern HRM. Potential rezoning of mixed-use residential areas could help to restrict urbanization in this corridor.

A limitation of this study was the habitat suitability model. It used an average home range of moose as an input for breeding population patch. In hindsight, the breeding patch threshold should be twice this value to accommodate a breeding event for a pair of moose who would subsequently have overlapping home ranges, but likely not entirely overlapping home ranges. Therefore, a more extensive examination of potential corridors, using a multi-species approach and examination of various factors, in this area could lead to a superior corridor design.

Conclusion

In conclusion, the feasibility of corridors in this area will be determined by: economic considerations, policy, physical barriers (highway 103, industrial and commercial areas), social perceptions of wildlife corridors, and poor habitat due to urbanization and past land use. Smaller corridors are generally less economically taxing but may be less beneficial to wildlife. Zoning could potentially be a significant factor in determining corridor feasibility by allowing or mitigating further development within the corridor. The goal of the proposed corridor is not to restrict development, but to focus development in core areas. This will allow wildlife movement within greenbelts further reducing the conflict between wildlife and human populations. Roads have the potential to act as barriers for some species with major roads and highways having potentially more negative effects than unpaved roads on animal movements (Forman et al., 2003). Given that urbanization has spread throughout the southwestern peninsula, a corridor devoted solely to wildlife is unreasonable. However, addressing urban expansion within the proposed corridor area can aid wilderness connectivity and promote wilderness recreation. Choosing the largest corridor 'slice' in future decision making will allow flexibility in zoning or land protection decisions. This was a preliminary study to evaluate a potential corridor(s) in southwestern Halifax Regional Municipality, with moose (*Alces alces americana)* as the focal species. Including multiple focal species in the examination of potential corridors along with an extensive generation of habitat suitability and corridor models would make for a strong evaluation of corridor location in southwestern Halifax Regional Municipality.

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APPENDIX A

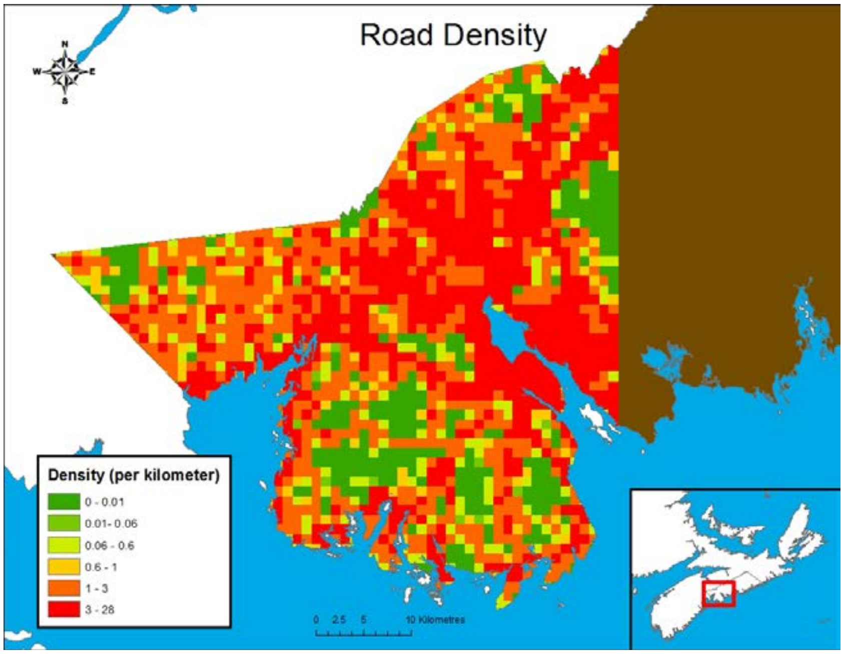

Figure.1. Road density (1kmx1km grid) in southwestern Halifax Regional Municipality

Table.1. Aquatic resource reclassification criteria based on attribute codes 'FORNON' (Source: NSDNR 2012)

Code	Description
70	Wetlands general - any wet area, not identified as a lake, river or stream, excluding open and treed bogs, and beaver flowage. (In forestry data, wetland complexes may include open and treed bogs)
71	Beaver flowage - an area that is or has been occupied by beavers
72	Open bogs - any area consisting primarily of ericaceous plants, sphagnum or other mosses with less than 25% live tree cover and poor drainage, (wet all year). Indicator plants: Bog Rosemary, Leather Leaf, Labrador Tea, Cranberry and Lambkill. Ericaceous plants being plants in or related to the heather family (ericaceae). They are typically plants of acid soils, bogs and woodlands.
73	Treed bogs - any area consisting primarily of ericaceous plants, sphagnum or other mosses with stunted softwood or hardwood species having 25% or more live tree cover.
75	Lake wetland - any area that has been defined as a wetland that lies within freshwater (lake or river)
77	Inland water - inland water bodies which may include lakes, rivers, reservoirs, canals and ponds (STAND_ value: 9003)

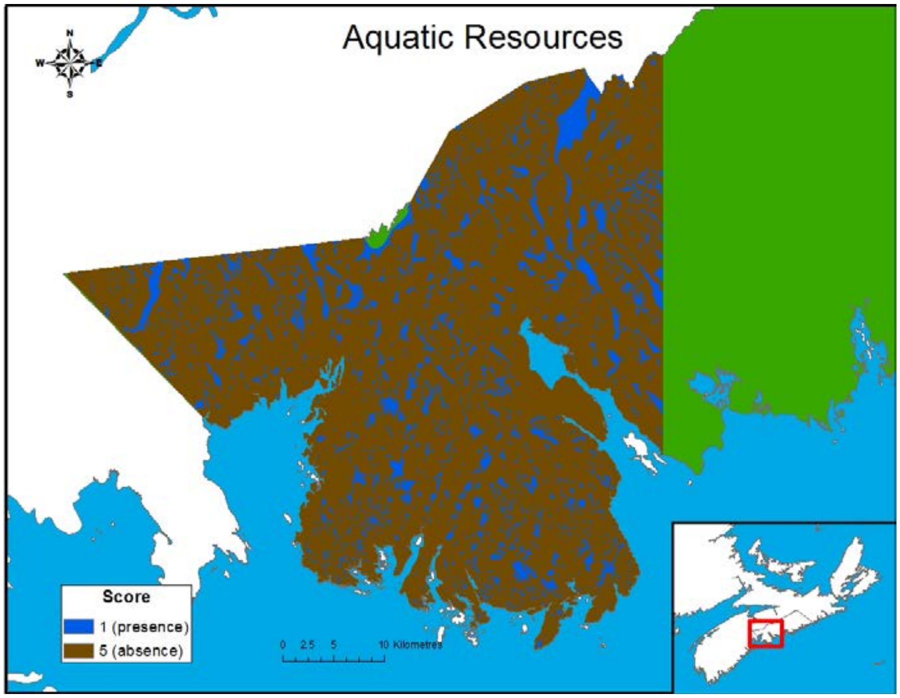

Figure.2. Wetland and non wet areas in southwestern Halifax Regional Municipality

Table.2. Attribute codes for forest species used to classify forage layer (Source: NSDNR 2012)

Code	*Softwood Species*	*Code*	*Hardwood Species*
AP	Austrian Pine	TA	Aspen - Large Tooth and Trembling
JP	Jack Pine	AS	Ash (Black & White)
RP	Red Pine	BC	Black Cherry
SP	Scots Pine	BE	Beech
WP	White Pine	BP	Balsam Poplar
BF	Balsam Fir	WE	White Elm
DF	Douglas Fir	GB	Gray Birch
BS	Black Spruce	YB	Yellow Birch
NS	Norway Spruce	WB	White Birch
RS	Red Spruce	IW	Ironwood
SS	Sitka Spruce	RO	Oak
WS	White Spruce	RM	Red Maple
XS	Red & Black Spruce - mixed standnot a hybrid	SM	Sugar Maple
EC	Eastern Cedar (white)	TH	Tolerant hardwood
EH	Eastern Hemlock	IH	Intolerant hardwood
EL	European Larch	OH	Other hardwood ***
JL	Japanese Larch	UH	Unclassified hardwood
TL	Eastern Larch	UC	Unclassified species
WL	Western Larch	WI	Willow
XL	Hybrid Larch		
OS	Other softwood		
US	Unclassified softwood		

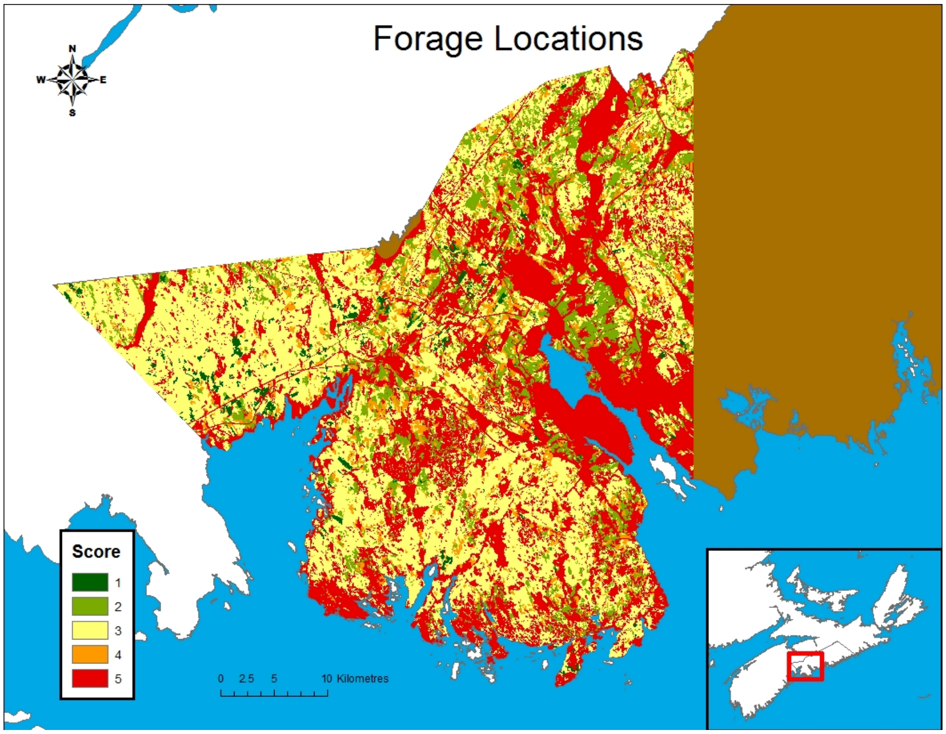

Figure.3. Forage habitat for moose (*Alces alces americana*) in southwestern Halifax Regional Municipality

Table.3. Selection criteria for attributes 'CRNCL' and 'HEIGHT' (for determining Thermal Cover) and total area of polygons after reclassification.

Optimal		Suboptimal		Poor	
Crown Closure (%)	Height (m)	Crown Closure (%)	Height (m)	Crown Closure (%)	Height (m)
>=75	>=12	<75 > = 50	>=12	=50	<12
				<50	>12
				<50	<12
				>50	<12
Area = 5,826 ha		Area = 20, 828 ha		Area = 213,357 ha	

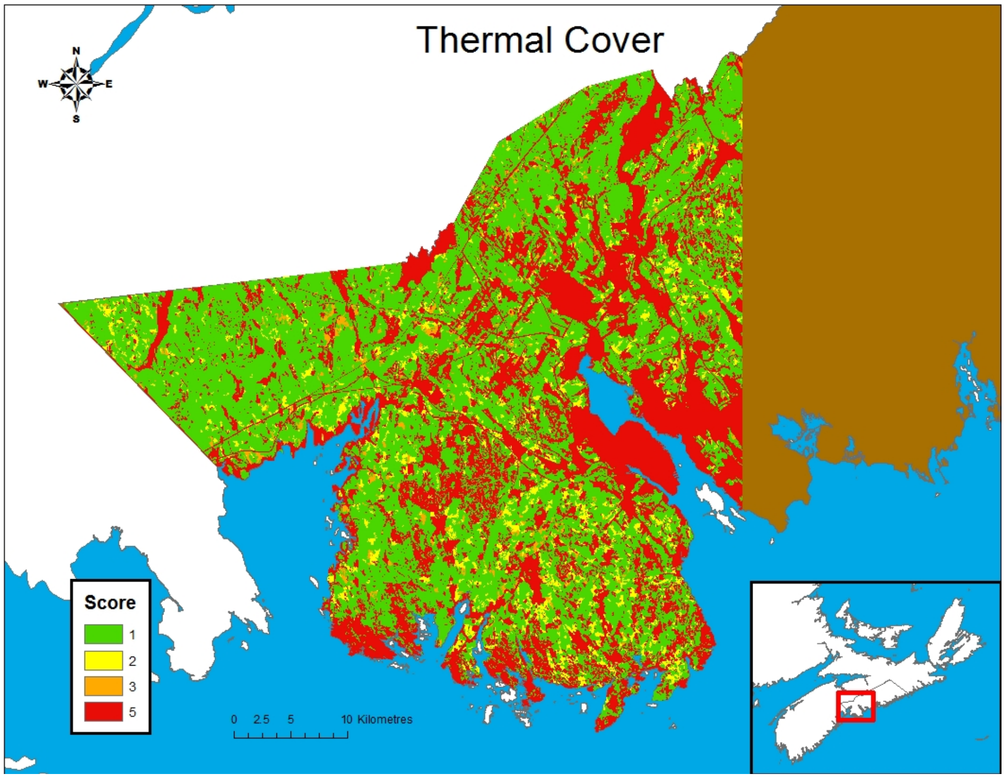

Figure.4. Thermal cover based on softwood stands in southwestern Halifax Regional Municipality

APPENDIX B

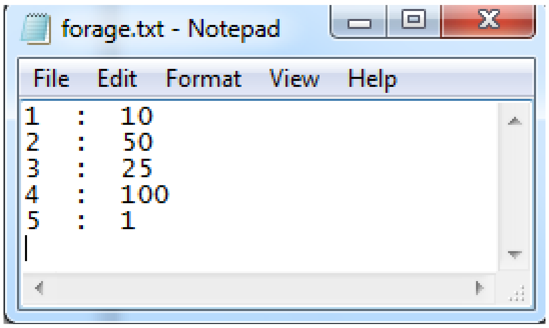

Figure.1. Foraging reclassification text file

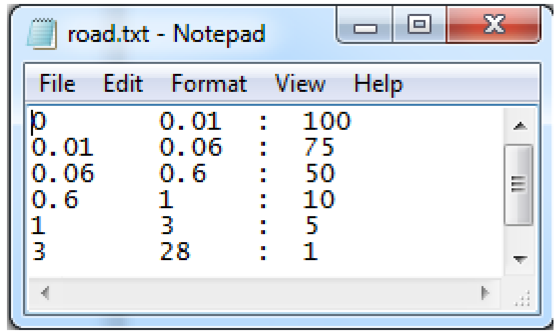

Figure.2. Road reclassification text file

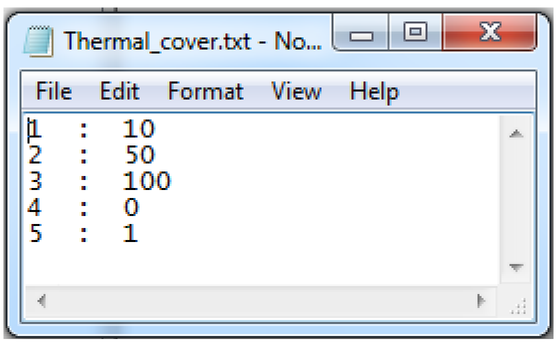

Figure.3. Thermal cover reclassification text file

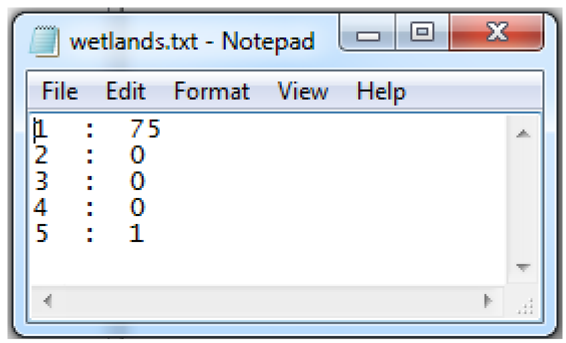

Figure.4. Aquatic resources reclassification text file

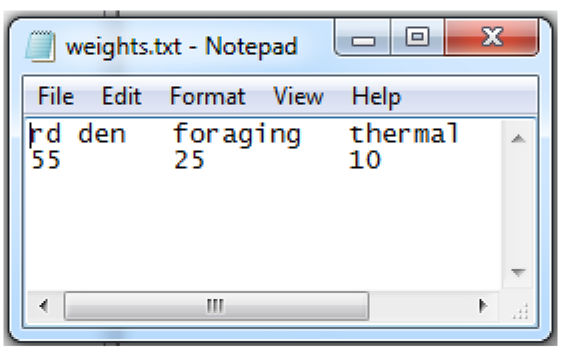

Figure.5. Habitat suitability model factor weights

APPENDIX C

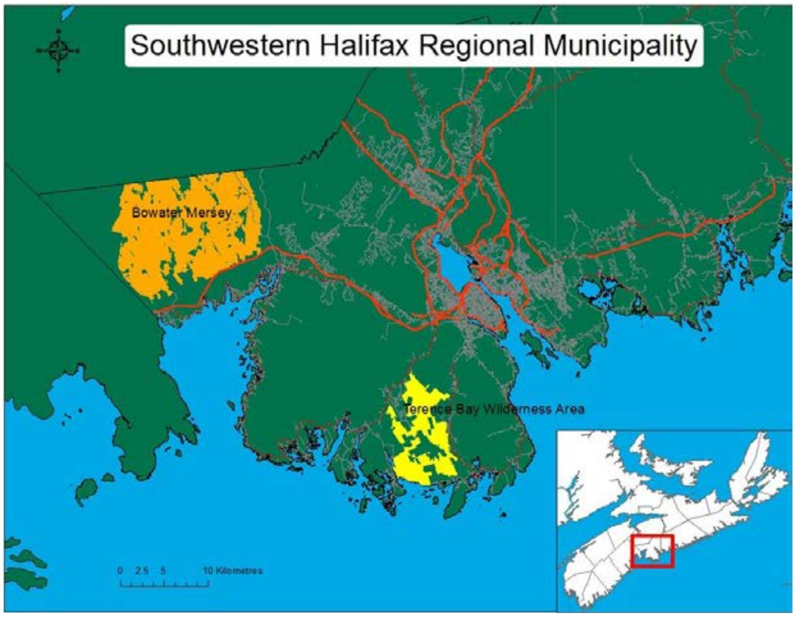

Figure.1. Starting and ending locations for the habitat suitability model

Table.1. HRMZone scoring based on attribute code (Source: HRM Community Plans 2012).

Class	Score	Code
Islands	0	I
Industrial/Commercial	1	WFCDD, UR, US, V-1, V-3, V-4, PUD, HCR, TH, CR-1, CR-2, C-1(A), C-5, C-6, F-1, SI, SU, AE,CGB, CSC, CMC, CHWY, CCDD, C-2, C-3, C-4, I-1, I-2, I-3, I-4, ILI, IHO, IHI, BWBC, CD-1, CD-2, CD-3, BSCDD, TR, ICH, D1, DND, DB, DC-1, DC-2, DC-3, DH-1, DN, LS, NZ, P_SI, PC, TH, TH-R1M, TR, W, WA, EX
Residential/Mixed Use	2	RSU, RTU, RMU, RTH, RCDD, RR, T, K, RRC-1, R-1, R-2A, RA(1), R-6(a), RA-(1-4), RB-(1-4), R-5, RR-E1, RRD-1, R-2, R-2B, RC, RA1, R-1E, RRA-1, RRB-1, RRB-2, MRR-1, R-3(A), P-2, P3, P, P5, MU-1, CDD, R-6, MU-2, GU-1, R-8, MR-1, MR-2, PCPA, RE, FV, T
Protected	3	RPK, P4, C, PR, PA, PWS, EC, PK