Wilderness Corridors:

Habitat for Moose and Mink on the Chebucto Penninsula

Landscape Ecology PLAN 3001

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Background

A wildlife corridor is a general area of land that connects wildlife habitats that would otherwise be separated by anthropogenic features such as roads and buildings. Corridors allow the movement of different size animals/mammals by increasing the connectivity of their habitat, therefore increasing overall habitat size. Corridors promote species richness and diversity of both plants and animals (WRWEO, 2009). They also aid in the conservation of protected species. The Chebucto peninsula is home to Nova Scotia‟s 30 remaining mainland moose (Nova Scotia Department of Natural Resources, 2007). Mink are another, less vulnerable species that lives in the Chebucto Peninsula.

The Halifax Municipal Planning Strategy proposes that work should be done to determine the recreational, wilderness, and ecological values of large tracts of crown land in the Chebucto Peninsula (Halifax Regional Municipality, 2010). Since this document was originally published in 1995, a lot of work has been done on refining this idea; largely lead by the Regional Planning Open Space Planner John Charles. Part of the advances that were made for this project was an examination of the potential for the development of wilderness corridors for mainland moose on the peninsula. The work that we conducted is based largely on the work of Erin Macintyre‟s report “Wildlife Conservation Corridor Modeling for the Halifax Regional Municipality”, which he created as part of his requirements as a Centre of Geographic Sciences student (Macintyre, 2004).

Project Objectives

The objective of this study is to examine 3 wildlife corridors in the Chebucto Peninsula and determine if they are suitable for two native species: Mainland Moose and Mink. These corridors have been selected by HRM and outlined in the RMPS. We aim to examine and test their feasibility. In order to analyze these corridors, we must determine relevant criteria related to moose and mink habitat and analyze their connectivity. Delineated corridors will be compared to corridors created by the municipality.

Study Area Overview

Source: http://d-maps.com/carte.php?num_car=23334&lang=en

The context map above shows the region of Nova Scotia that this study will focus on. The study area is located on the Chebucto Peninsula, which is in the southwestern region of Halifax Regional Municipality.

The Chebucto Peninsula has cover types that include softwoods, hardwoods, and mixed wood patches. This is ideal habitat for Mainland Moose, which is most likely the reason why this endangered species has settled in the region. The Chebucto Peninsula also has an abundance of lakes and rivers that make up riparian landscapes. Riparian landscapes are ideal habitat for mink species, making this region a popular settlement area for them as well.

Criteria

Our analysis of these three corridors involved determining relevant criteria for both mink and moose habitats. These criteria can be subdivided into anthropogenic and natural features. Anthropogenic features have a larger influence on habitat suitability for corridor delineation then natural features.

Anthropogenic:

Zoning: Necessary to consider because it affects the feasibility of fitting corridors in certain areas. Areas which are zoned as open space and protected areas are most suitable for corridor delineation. Whether or not areas would have to be zoned, and if it would be possible is important to consider in the feasibility of HRM"s proposed corridors.

Land ownership: Whether land is owned privately, by the municipality, or by the province will affect the feasibility of creating a wildlife corridor. This involves consideration of whether or not the land would have to be purchased or not, or if the area is currently being used for a different activity.

Development (Buildings and Roads): The proximity and density of the built environment to moose habitat affects the connectivity of wildlife corridors. Human-land use, such as settlement and development, as well as road development have been known to restrict and at times eliminate moose habitat (Beazley et al., 2004). Roads and buildings fragment the land significantly limiting the connectivity of habitats. They have also been known to isolate moose populations and affect the moose density by limiting their movement within their current habitats. Human negative impacts have been decreasing habitat quality for moose, mortality by vehicle collision, as well as human access to poaching (Beazley et al., 2004). In Beazley et al (2004), it is suggested that road density is the best indicator of human land use intensity as well as ecological integrity.

General Moose Habitat:

20 to 40km^2 habitat size: Moose require a habitat size of approximately 20 to 40 km^2 in order to ensure enough resources are available to them (MacIntyre, 2004).

Riparian communities (tree stand data 15years or greater): riparian forests are important areas of refuge and suitable travel corridors for large mammal communities. Nova scotia legislation classifies a 30m buffer around all water bodies as a „riparian zone‟ (MacIntyre, 2004).

Food: Alder, Willow, Birch, Aspen, Aspen, Balsam Fir, Lichens, Fireweed, Lupine, Water Horsetail, and Pondweed are plant species that mainland moose feed on. Their availability will affect habitat suitability for moose (MacIntyre, 2004).

Slope: Moose tend to avoid slopes steeper than 30%. The steep slopes that moose avoid also tend to be wide and lone, taking up a large patch of land (MacIntyre, 2004).

Open plant community's forage abundant: open spaces with high amount of forage are appealing areas for moose habitat, especially in the summer when these areas are less vulnerable (MacIntyre, 2004).

Winter Moose Habitat:

Elevation: An elevation below 1067m is suitable in winter, while an elevation of 1524m is suitable in summer; elevation requirements are based on temperature changes (MacIntyre, 2004).

Dense conifer forest 60% or greater: This forest type allows moose to avoid deep snow. Moose find it difficult to move in snow deeper than 1m and deep snow also inhibits their ability to find food (MacIntyre, 2004).

Woody Plants: These plants are favored by the moose as a main food source (MacIntyre, 2004).

Firs taller then 6m: As snow deepens in the winter, moose tend to travel to denser softwood areas (MacIntyre, 2004).

Summer Moose Habitat:

Travel bogs and Outer aquatic areas: Moose prefer eating aquatic plants in the summer. Therefore, they can be found in bogs, swamps, fens, etc. in the warmer months. This is the most distinct seasonal difference in moose habitat (MacIntyre, 2004).

Clear and partial cuts: these are important for moose habitat because early successional vegetation is their primary source of forage (Snaith et al., 2002). Further, these spaces provide wind exposure, which help to cool the moose and have fewer insects than the forest cover areas

Mink Habitat:

General: Mink are very adaptable to their surroundings, and are able can change their habitats easily due to poor conditions. Mink are also fairly tolerant to anthropogenic interference and can occupy less suitable environments if an acceptable food source is available (Nova Scotia Natural Resources 2012).

Water: The mink's niche is usually associated with aquatic habitats, mink movement usually can range from approximately 100m-200 m from water anything further is very uncommon. Practices to increase mink populations should encourage the maintenance and improvement of habitat diversity instead of encouraging prey abundance (Allen, 1986).

Cover: Mink are most active in wooded areas immediately adjacent to rivers, creeks, and streams in summer. In winter inland food becomes a more important part of the mink's diet, this occurs most often in areas where aquatic prey is particularly less abundant (Allen, 1986).

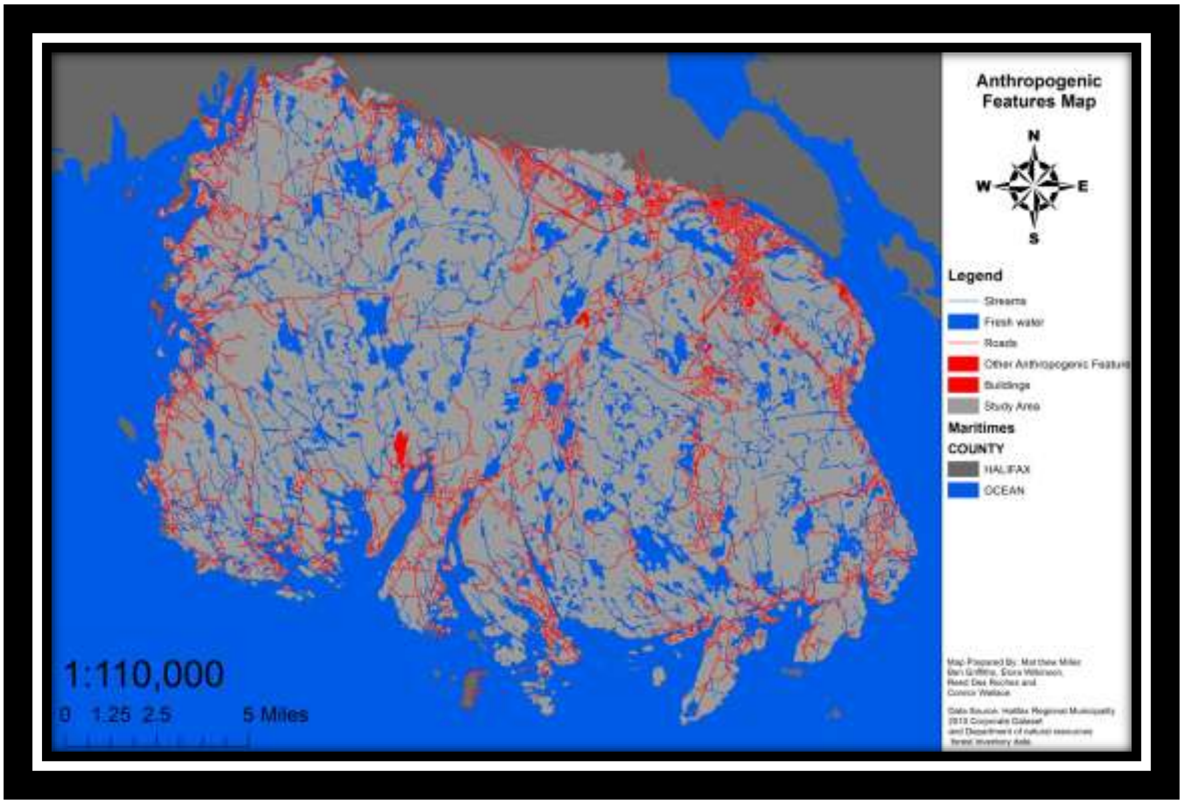
Methods

We collected information about habitat requirements for both mink and mainland moose. Based on this research, we outlined the criteria requirements for suitable habitats. The necessary data was then collected from the GIS center at Dalhousie University including the HRM corporate dataset and the Forestry dataset. All information was then entered into ArcGIS to complete the analysis of suitable habitat connectivity. Each criterion was analyzed as a unique entity to completely understand the availability of the habitat criteria in the study area:

Anthropogenic

Development (Buildings and Roads):

Roads and buildings were the two layers inputted into GIS. Once inputted in GIS, each layer was clipped to the surrounding boundary. The last step was to change the symbology (colour representation), in the properties tab, to make the features noticeable on the map, and separate from the other layers (See Anthropogenic Features Map).



General Moose Habitat:

Riparian communities (tree stand data 15years or greater):

Riparian tree stand data was found in the Department of Natural Resources Forest Inventory dataset. Using the select by attribute tool in ArcGIS, we selected areas classified in HEIGHT that are greater than 3m and exported this layer as TreeStands_15. We then created a riparian buffer layer around all watercourses within the Chebucto Peninsula and called it rip_buffer. Lastly, we clipped the TreeStands_15 layer to the riparian buffer layer. This created a new shapefile, which served as our Riparian Communities layer.

Food:

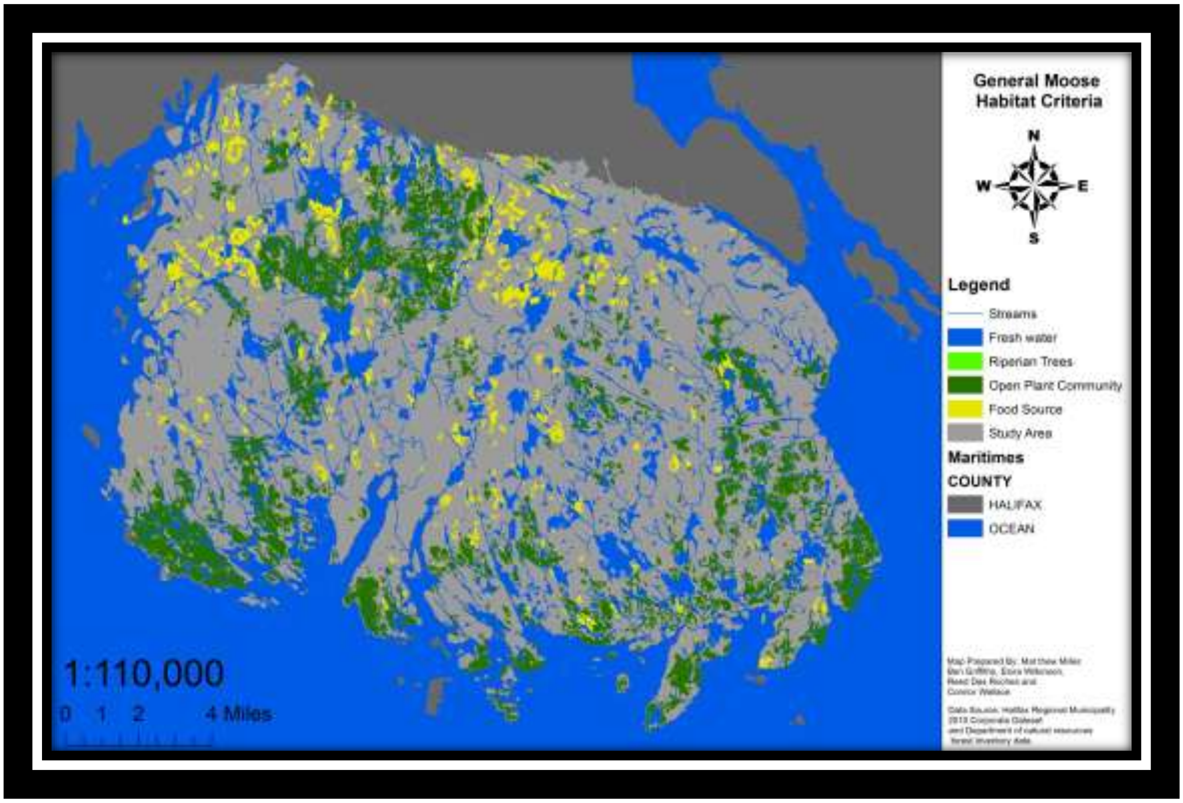
Food data was found in the Department of Natural Resources Forest Inventory dataset. Using the select by attribute tool in ArcGIS, we selected areas classified in SPECIES [SP1] as WI (Willow), TA (Aspen) , BF (Balsam Fir), GB (Gray Birch), YB (Yellow Birch), WB (White Birch). This selection created a new shapefile , which served as our Food layer.

Slope:

Slope data was found in the Halifax Regional Municipality cooperate data set. We added the Hfx_DEM raster file to ArcGIS and ran the „slope" tool. This created a new layer called slope_tool. We then converted this new layer from a raster to a polygon in order to run the reclassify tool. We then reclassified the polygon layer into two categories: Slopes < 30% and Slopes >30%. This reclassification created a new shapefile, which served as our Slope layer

Open plant communities forage abundant:

Open plant community's data was found in the Department of Natural Resources Forest Inventory dataset. Using the select by attribute tool in ArcGIS, we selected areas classified in FORNON as 5 (Old field), 33 (Brush), 60 (Clear cut), 83 (Brush), 84 (Rock Barren), 85 (Barren). This selection created a new shapefile, which served as our open plant community's layer.



Winter Moose Habitat:

Elevation:

During winter moose prefer lower elevations because of temperature changes (temperature decreases as elevation increases). To find elevations below 1067m the Hfx_DEM was placed in ArcGIS. The raster Hfx_DEM was converted to a polygon using the raster to polygon tool. Next we selected by attribute, the query was: Elevation =< 1067m. This showed us that the entire area of the Chebucto peninsula is below 1067m.

Woody Plants:

Moose eat a variety of woody plants during the winter. These plants can be found throughout the entire Chebucto peninsula; therefore data on woody plant did not have to inputted and manipulated in ArcGIS.

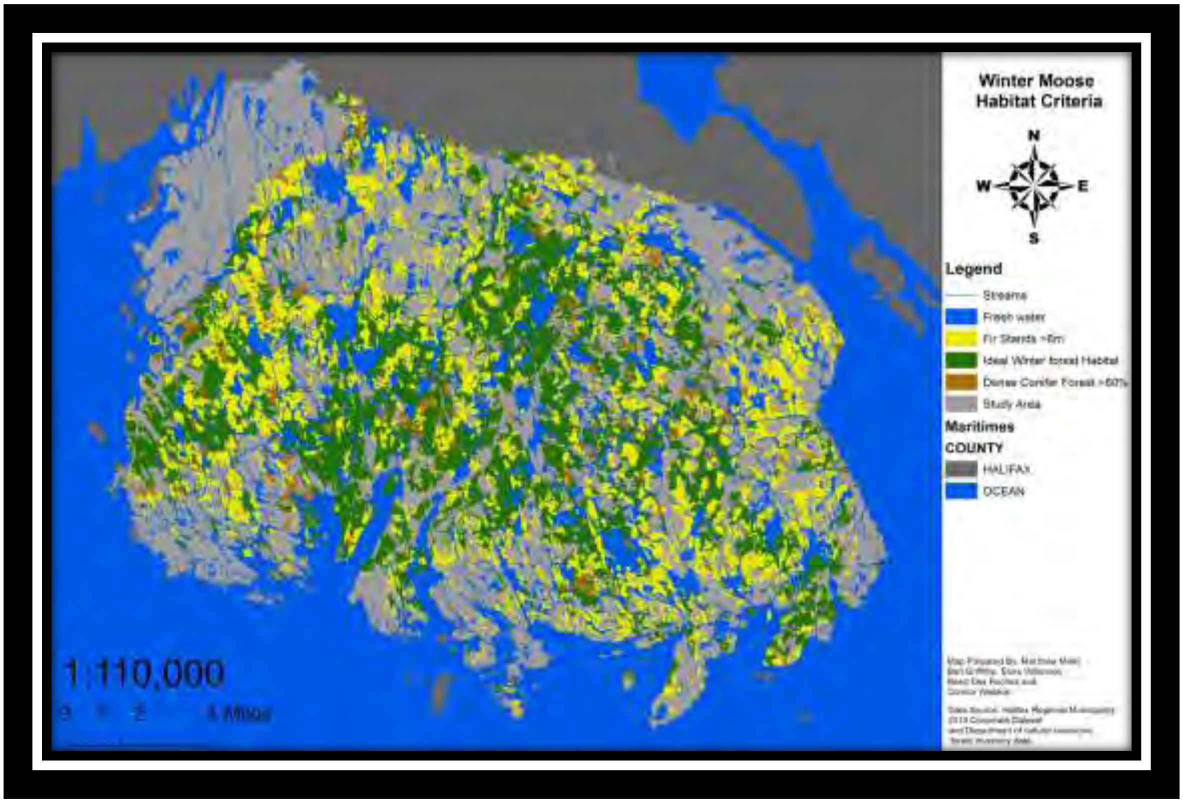
Dense conifer forest 60% or greater cover:

Forestry data from the Department of Natural Resources was entered in ArcGIS. To find coniferous dominated forest we selected by attribute using Main Species Type

(SP1), the query was: SP1 = AP OR SP1 = JP OR SP1 = RP OR SP1 = WP OR SP1 = BF OR SP1 = DF OR SP1 = BS OR SP1 = NS OR SP1 = RS OR SP1 = SS OR SP1 = WS OR SP1 = XS OR SP1 = EC OR SP1 = EC OR SP1 = EH OR SP1= EL OR SP1 = JL OR SP1 = TL OR SP1 = WL OR SP1 = XL OR SP1 = OS. This selection was exported and re-added to ArcGIS. To find 60% cover of coniferous forest we used the coniferous forest layer that we had created in the prior step and selected by attribute using first story density, the query was: CRNCL >= 60. This selection was exported as a shapefile.

Coniferous Fir stands 6m or taller:

Forestry data from the Department of Nature Resources was placed in ArcGIS. To find fir stands that are taller than 6 meters we selected by attribute using Main Species Type, the query was: SP1 = BF OR SP1 = DF OR SP2 = BF OR SP2 = DF OR SP3 = BF OR SP3 = DF OR SP4 = BF OR SP4 = DF. Then queried using height the query was: HIEGHT >=6. This selection was exported as a shapefile. To find areas that moose favor in the winter both „Dense Conifer Forest 60% or Greater Cover and „Coniferous Fir Stands 6m or Taller‟ layers were intersected in ArcGIS. This gave us a final output where forest types were fir trees that had 60% or greater cover and were 6m or taller.



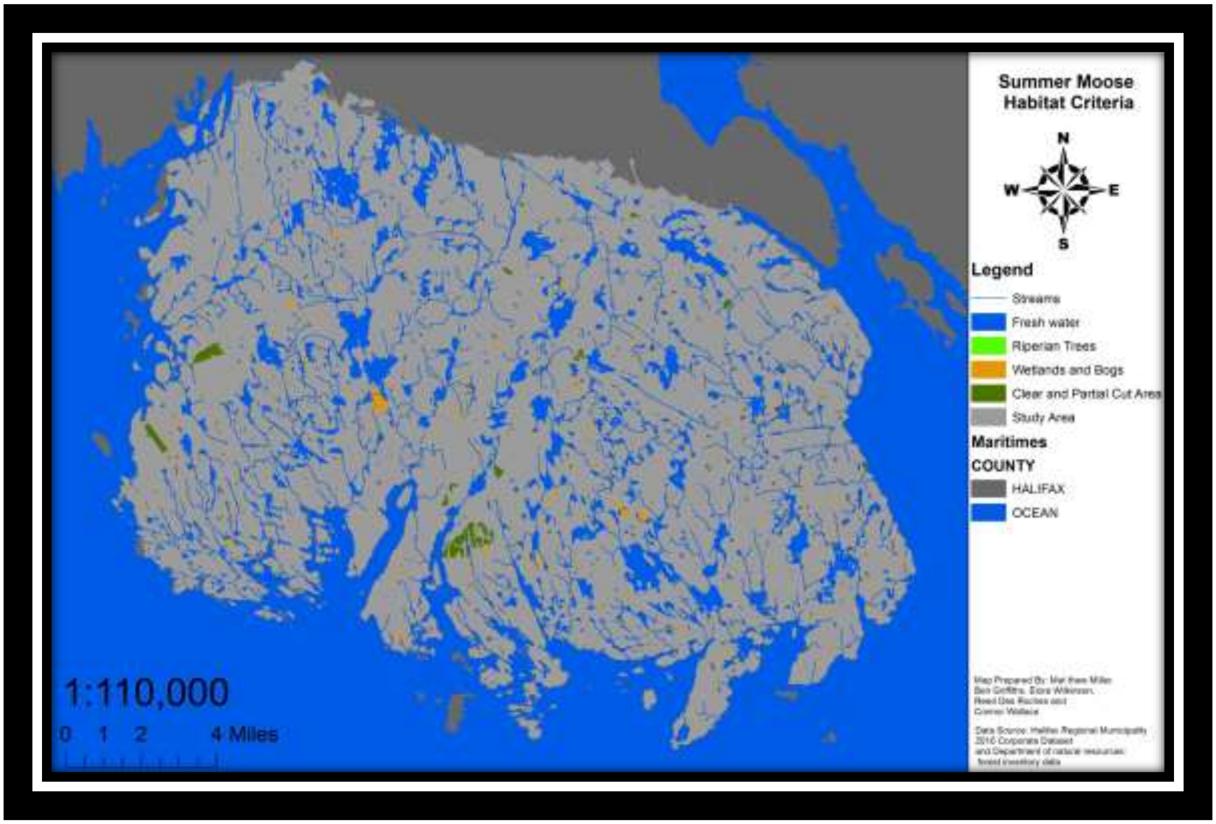
Summer Moose Habitat:

Travel Bogs and Outer Aquatic Areas:

Bogs and wetlands were found in the Department of Natural Resources Forest Inventory dataset, using the Select by Attribute tool in ArcGIS. We selected areas classified in FORNON as 70 (wetland general), 72 (open bog) and 73 (treed bog). The query was: “"FORNON" = 70 OR "FORNON" = 72 OR "FORNON" = 73”. A new shapefile was created with this selection, which served as our Bogs and Wetlands layer.

Clear and Partial Cuts:

Clear and partial cuts were found using the Department of Natural Resources Forest Inventory dataset. In order to determine which areas are clear and partial cuts, we used the Select by Attribute tool in ArcGIS. We selected areas classified in FORNON as 60 (clear cut), 61 (partial cut) and 62 (partial cut). The query was: “"FORNON" = 60 OR "FORNON" = 61 OR "FORNON" = 62”. A new shapefile was created with this selection, which served as our Clear and Partial Cuts layer.



Mink Habitat:

100m buffer:

We put a 100m buffer along all watercourses in the Chebucto peninsula, which includes swamps, bogs, ponds, lakes and rivers. This covers mink primary habitat range within the Chebucto peninsula. It was given a green color (ideal habitat) on the maps.

First we collected data from the HRM corporate data set, which related to water on the Chebucto peninsula. The hydrology shape file and stream polyline file were used to show location of watercourses with the Chebucto peninsula. Using the buffer tool with a 100m distance selected, individual buffers were created for each layer. Which were then merged and dissolved. This created the 100m Buffer Layer.

200m buffer:

A 200m buffer was also placed along watercourses in the Chebucto peninsula. Although it is rarer for mink to venture this far from riparian habitat, they will do so if inadequate food sources are not available. The same steps were repeated to create the 200m Buffer layer, except in the buffer tool menu a distance of 200m was selected.

Blow down:

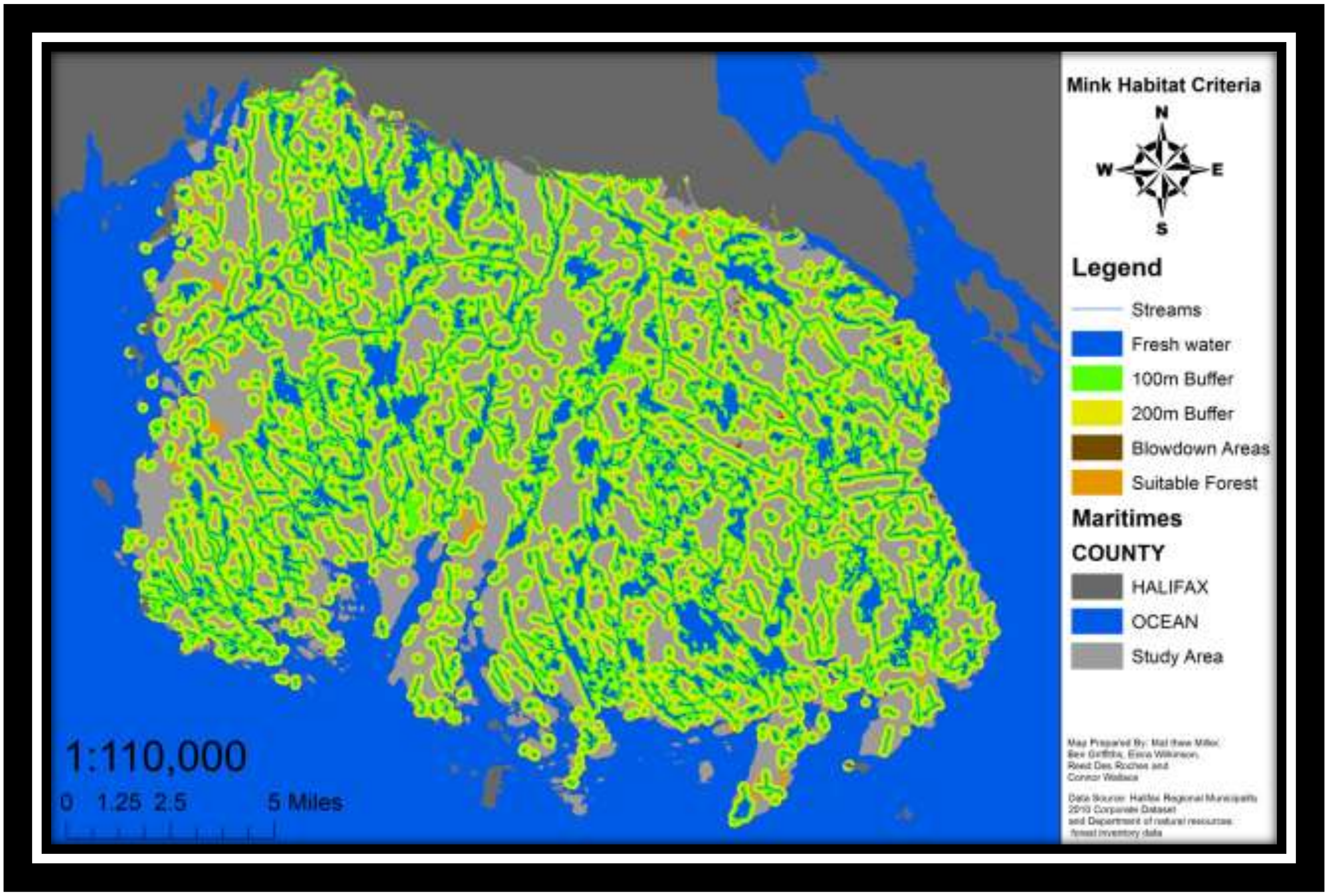
Mink are most common along streams where there is abundance of downfall or debris for cover and areas for foraging. Logs provide great foraging cover for mink because they provide shelter for aquatic organisms and security from the environment.

To create the Blow down Areas layer we took data available online form the Nova Scotia Department of Natural Resources. Once the forest layer was added to the map we selected locations within the layer with a "FORNON" attribute of "6" which is blow down trees, deadfall or debris. After these attributes were selected we exported the data to its own layer called Blow Down Areas.

Suitable Forest:

Mink are not totally dependent on aquatic or wetland associated prey species. However, they do form the largest part of their diet. Mink are most active in wooded areas immediately adjacent to water. For protection, away from water, mink prefer vegetation that is between 1-2m tall to shelter them from larger predators.

To create this layer the data from Nova Scotia Department of Natural Resources was used once again. This time we opened the forest layer attribute table and selected by attribute, vegetation 1m to 2m tall. The data selected was exported to its own layer titled Suitable Forest.



Corridor Delineation

The process of delineating the corridors required a careful selection of methods because of the complicated composition required. While there are various GIS plug-in options, such as Linkage Mapper, we opted for visual delineation. First we simplified the criteria into a single map and then used Photoshop in order to draw the corridors as an overlay.

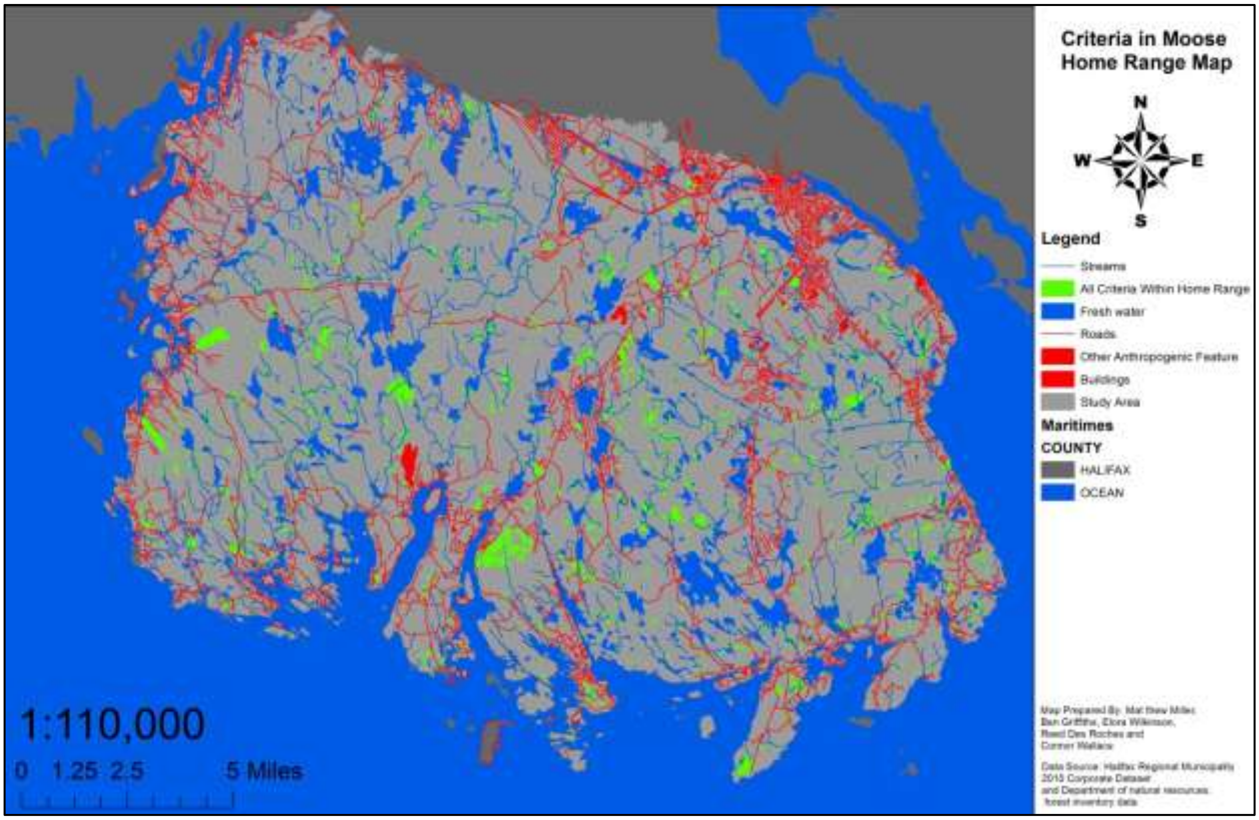
In order to simplify the criteria into a single map, we created a series of layers that group criteria into four sections: Moose General, Moose Winter, Moose Summer and Mink. For the Moose General layer we merged the Riparian Communities, Open Plant Communities and Food layers. For Moose Winter we merged the Dense Conifer Forest and Fir Stand 6m and Taller layers. For Moose Summer we merged the Clear and Partial Cuts and Bogs and Wetlands layers. For mink we merged the 200m Buffer and the Blow down layers. We did not include the 100m Buffer layer, because it overlaps the 200m Buffer. We ran each of the simplified criteria shape files through Patch Analyst. The results are in the Table 1 below.

Criteria	Total Number of Patches	Mean Patch Size (ha)	Total Area (ha)	Percentage of Study Area
Moose General	2847	4.210211	11986.471343	19.6%
Moose Winter	4435	9.315076	41312.36202	67.6%
Moose Summer	1190	2.318139	2758.58499103	4.5%
Mink	71	621.056963	44095.044346	72.2%
Summer Moose Criteria Within Home Range of General and Winter Criteria	1190	2.318139	2758.58499103	4.5%
Study Area	N/A	N/A	61095.266219	100%

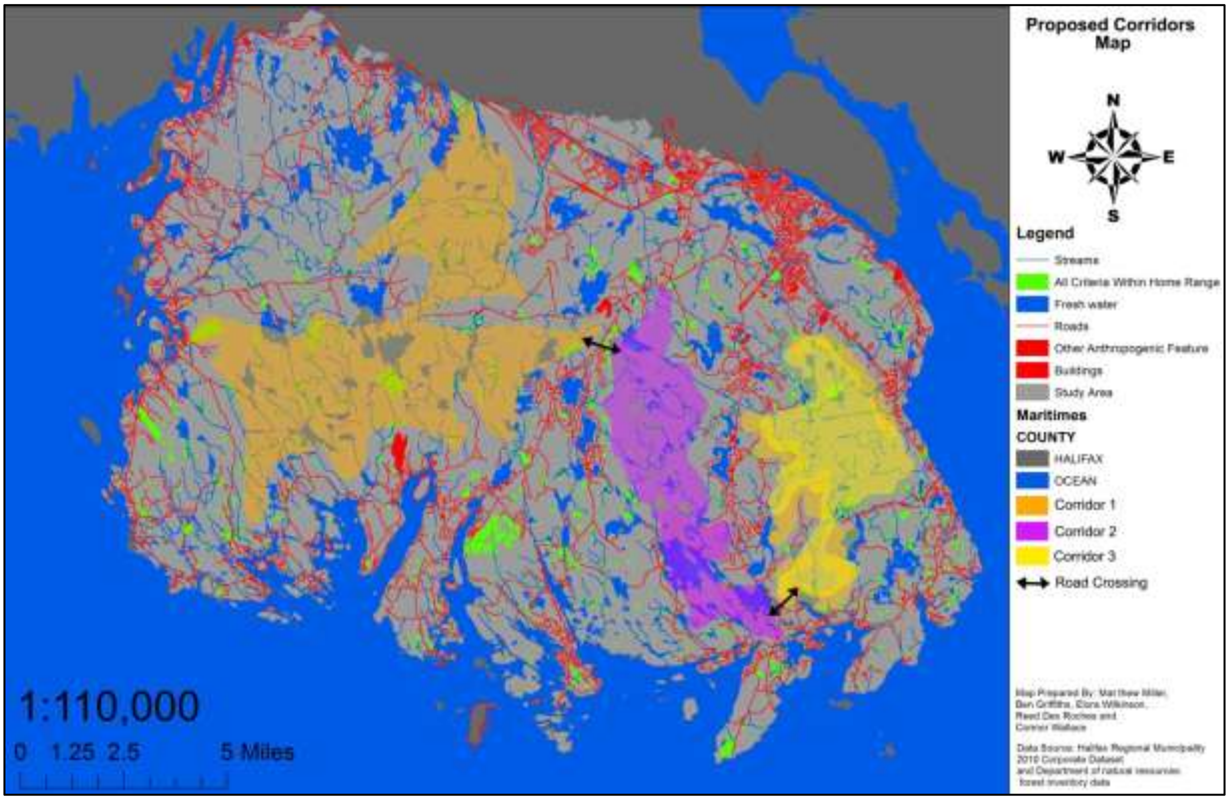
The results allowed us to determine that the mink habitat is the most abundant and that moose summer habitat is the least abundant. Mink habitat covers 72.2% of the study area and a large portion of the unsuitable area has anthropogenic features, the mink habitat layer was left out of the simplified map. Because moose summer habitat is by far the least abundant, the corridors were delineated with a focus on those criteria.

To achieve this, we created a map that illustrates areas of summer habitat that are within the moose"s home range of both general and winter criteria. The home range is the area that an animal lives and travels within. For moose, the home range is 20 to 40 square kilometers. To create this map, we used a 40 kilometer distance to have the highest number of potential habitats. To create the map we used the Select by Location tool in ArcGIS. For the first query, the Target layer was Moose Summer Habitat and the Source layer was Moose General Habitat. The Spatial selection method was "Target layer(s) features are within distance of source layer feature" and we selected "Apply a search distance" with the distance set to 40 kilometers. A new layer was created from this selection: Moose Summer Selection. For the second query, the Target layer was Moose Summer Selection and the Source layer was Moose Winter Habitat. The Spatial selection method was "Target layer(s) features are within distance of source layer feature" and we selected "Apply a search distance" with the distance set to 40 kilometers. We created the layer Moose Home Range from this selection. We ran the Moose Home Range layer through Patch Analyst and discovered that all the moose summer habitats are within the home range of the other habitats (see Table 1 above).

The simplified map shows the Moose Home Range layer and the Anthropogenic features layer (see Criteria in Moose Home Range Map). The Anthropogenic features are important because they are a limiting factor.



Using Photoshop, we drew three corridors in the peninsula. Our delineation sought to encourage East/West movement as this was more restricted by anthropogenic development than North/South. Further, to encourage connectivity, we incorporated moose crossings establish by the Department of Transportation. Moose crossing are marked in areas with a high number of moose-vehicle collisions. We selected two of these crossings that improved connectivity between the corridors. The final product was three corridors that generally stretched North to South, but were connected East to West by road crossings (see Proposed Corridors Map).



Comparison

After we delineated our three corridors we then proceeded to compare and contrast them to HRM‟s proposed wildlife corridors. Through this comparison we noted that our proposed corridors and HRM‟s were similar in location and direction. The first proposed corridor (orange) was the least similar to HRM‟s. Though the direction was the same, HRM‟s location was in closer proximity to the coast and did not extend as far into the peninsula. Our second proposed corridor (purple) was similar to HRM‟s though it also varied slightly. While the location was the same, the direction was not. We suggested our corridor run southeast to northwest, while HRM‟s proposed corridor runs closer to north to south. The last proposed corridor (yellow) was almost exactly the same as HRM‟s. The only difference was the size between the two corridors. Our proposed corridor had more width, while HRM‟s had more length. Overall, HRM‟s proposed corridors were not defined specifically, which is something we tried to address when delineating our own corridors.

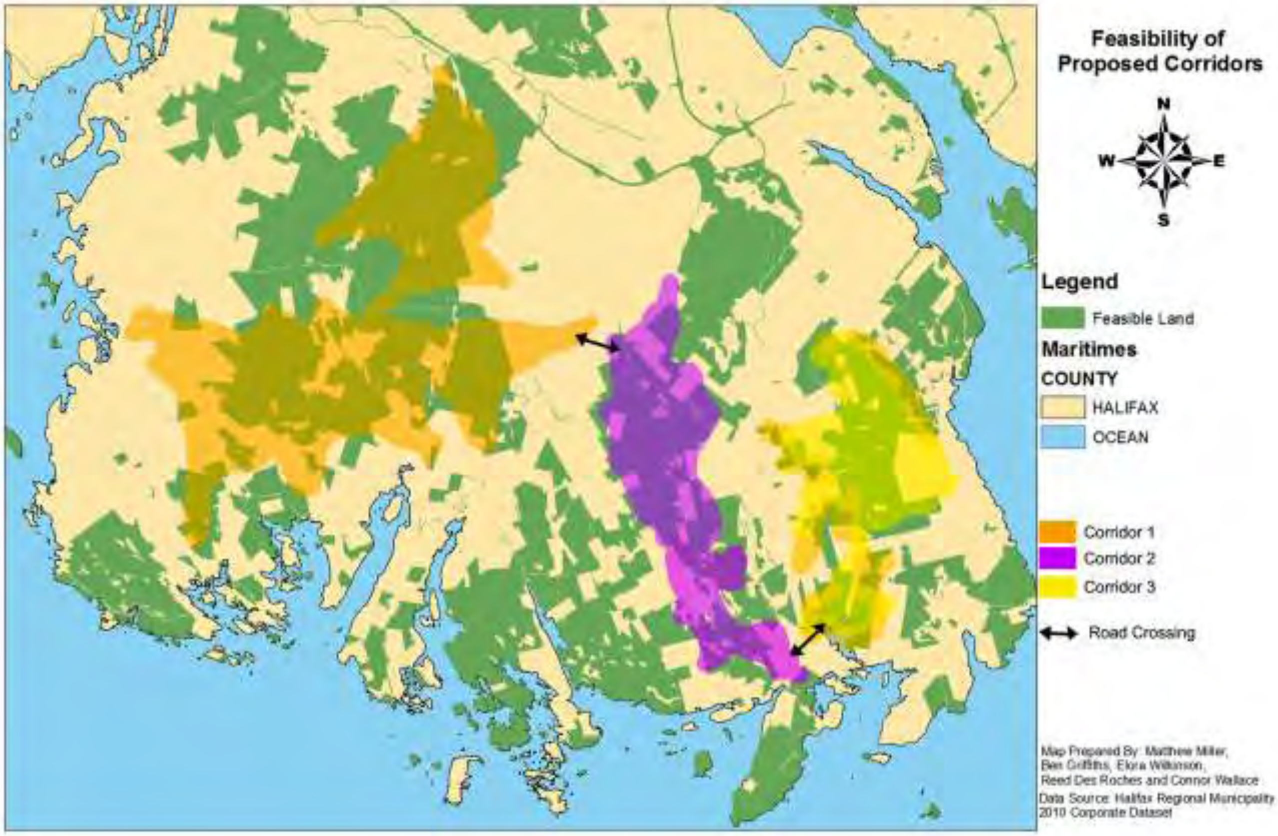
The largest difference between the two proposed corridor maps was the east-west delineation. HRM‟s proposed corridors only ran north to south and through research we found that in order to increase the habitat usage east to west delineation was necessary. In our delineation our corridors were wider to improve east to west mobility. We used existing frequent moose crossing to connect our three corridors east-west across Anthropogenic features.

Having our three delineated corridors line up relatively well to HRM‟s proposed corridors was ideal. The purpose of the report was to test the feasibility of their three proposed corridors and to make improvements.

Feasibility

After delineating the corridors we felt it was important to investigate the feasibility of their implementation. Feasible land was defined as provincial crown land, open space, and protected land. The ideal criteria were queried out, selected, and over layed over our proposed corridors.

Through this analysis it was confirmed that the location of the proposed corridors and feasible area were consistent. This was ideal for the purpose of the project; however, it was not a surprising conclusion. The original intention of HRM"s proposed corridors in the Municipal Planning Strategy was to find a wilderness protection use for the provincial crown lands. As our proposed corridors were similar to HRM"s it is no surprise that the land proposed for the corridors is suitable.



Map Prepared By: Matthew Miller, Ben Griffiths, Elora Wilkinson, Reed Des Roches and Connor Wallace
Data Source: Halifax Regional Municipality 2010 Corporate Dataset

Conclusion

To conclude, the final corridors that were delineated through the multi criteria analysis process were mainly influenced by anthropogenic features. These features had higher influence because the two species that were being examined [especially moose] tend to avoid areas of high road density and urban development. Perhaps if we examined a different species in terms of its connectivity patterns, anthropogenic features would have less influence on the corridor delineation process. For example if we trying to delineate habitat corridors for bird or fish species, road density would have much less influence because they are not primarily land based species.

The final corridors that we delineated were very similar to HRM‟s recent proposal in terms of their direction and location. One corridor is located in the western-central region of the peninsula, the other two are located in the south eastern region of the peninsula. We proposed two road crossings that could eventually be developed if funding becomes available. These crossings are located in areas of low density and near feasible land.

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http://www.americanforests.org/blog/safe-crossings-for-wildlife/

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